Falsely Remembered Words as Explicit Primes: Combining a False Memory Paradigm with a Priming Task

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Abstract

The study examined the interacting effects of false memory and explicit priming phenomena in order to better understand the underlying mechanisms. This was accomplished by combining experiments that examine the effects of false memory and explicit priming utilizing a single experiment building off previous work by Roediger and McDermott (1995) and Tulving, Schacter, & Stark (1982). The goal was to determine whether words that have been shown to consistently appear as false memories when reading specific word lists can function as primes in a word-completion task in the same way as actually presented words. The data suggest that the underlying processes between recognition and fill-in-the-blank memory tasks are similar, which supports the hypothesis that critical lures can work as priming stimuli in the same way as words actually seen.

Falsely Remembered Words as Explicit Primes: Combining a False Memory Paradigm with Priming Task

Two areas that have been researched extensively in experimental psychology are false memories and priming. However, it is not clear how false memories and priming may relate to one another. To address this issue, I utilized a combination of experimental methods on the false memory and priming phenomena to see how these effects may relate to and interact with one another. My hypothesis was that using the DRM word lists described by Deese (1959) and Rodiger and McDermott (1995), which have been shown to consistently create false memories for a specific "critical lure" word by presenting many words related to the "critical lure", a false memory can be created and act as an explicit prime with similar effects to an actual memory. For example, a DRM word list containing words such as *tired, bed, dream*, *etc*, will cause participants to fill in a word fragment such as SLE_ _ with *sleep* with a higher frequency than those who were not presented with that DRM word list.

This study will provide insight into the false memory phenomenon especially, in order to determine whether false memories have the same properties as actual memories when it comes to tasks other than just recall or recognition.

Literature Review

A study published in 1982 by Tulving, Schacter, and Stark demonstrates one version of explicit priming. Participants were given a list of 96 words to study and were then asked one day later and one week later to recognize as many words as they could from the list. Participants were also asked to perform a word completion task, such as C _ _ A R _ T (cabaret), that contained words from the list and words that were not on the list. It was found that, even when participants could not remember a word from the original list, they still had better performance

on the word completion task than they did for words they had never seen. This effect was shown even after one week, when the participants' performance on the recognition task had greatly decreased in accuracy.

A similar study was conducted by Nelson, Keelean, and Negrao (1989). While many of their findings do not specifically relate to the proposed study, the word fragments used in the 1989 studied were the first few letters of each word instead of various letters throughout the word (such as in the Tulving et al., 1982, experiment). This is the design that will be implemented in the proposed study because of its relative simplicity compared to creating word fragments with various letters throughout the word left blank.

A 1959 study by Deese was later revisited by Roediger and McDermott in 1995 in order to demonstrate the surprising false memory effects that occur after studying specific lists of related words. Roediger and McDermott created lists of 12 words; each list had items relating to a specific highly-associated word that was not presented. For example, a list containing *bed, rest, awake, etc.,* would be highly associated to the word *sleep.* They found that these lists created high levels of false recall and false recognition of the high associate that was not presented.

Though Roediger and McDermott produced many lists to create false memories, not all lists create the same level of recall. Stadler, Roediger, and McDermott (1999) studied 36 of these associative lists and discovered that some lists had a critical lure false recognition rate as high as 80% while other lists were as low as 10%. They further determined which lists created the highest rates of false recall and recognition and found 18 lists to be most effective (Stadler et al., 1999). For this study, I will be using 16 DRM word lists that consistently produce high levels of false memory, from 42% to 65% false recall, in an attempt to maximize observed

effects. I will also be using eight DRM word lists with recall below 40% (10% to 37%) in order to provide a range of expected recall levels for increased generalizability of results.

In a study conducted by Dewhurst and Anderson (1999), it was found that false memories for critical lure words can be created when category lists are presented with similar words grouped together as well as with similar words mixed across lists. Although the average rate of false recognition is lower for the mixed lists, this study utilizes this design in order to mask the intention of the study by making the differing categories less pronounced.

Method

I combined studies involving the priming and memory effects, specifically the Tulving et al. (1982) study involving priming for word completion, and the Roediger and McDermott (1995) study that demonstrated the possibility of creating false memories using specific word lists.

Participants

Sixty-four participants from Introductory Psychology at Bemidji State University were recruited for this study. The participants were offered extra credit for participation.

Materials and Procedure

Participants completed the study in small groups in order to facilitate more participants within time constraints. All participants were asked to sign an informed consent form (Appendix A). I primed the participants by presenting one of two PowerPoint slideshows that contain lists of words comprised of 12 DRM word lists combined into one. Combined lists were constructed by taking the first word from all 24 DRM word lists, then the second words, third words, and so on (Rafferty & Overbeek, 2005). Participants were instructed to focus on the words because later their memory would be tested. Participants then completed a filler math task (Appendix B),

consisting of simple but time consuming algebra problems, before being presented with either a recognition task or a fill in the blank (word-completion) task. The filler math task was used in order to reduce the possibility of improved memory for words at the end of the list because of recency effects and to avoid ceiling effects. The filler task also prevented simple mental repetition of words seen during the PowerPoint presentation, which could also skew results.

The recognition and word completion tasks included words that the participants saw in the previous list (36), the critical lure words (12), and words the participants never saw from the other PowerPoint word list (36 presented on that list as well as the 12 associated critical lures). There were 96 words total in each list (see Appendices C and D, Appendix C has critical lure words in boldface). The recognition and fill-in-the-blank tasks included the same words, with some letters in the fill-in-the-blank words replaced with spaces. For words between three and four letters in length, the first two letters were given and the rest were blanks, for words between five and seven letters, the first three letters were given, and for words over eight letters the first four letters were given. Both the recognition and fill-in-the-blank tasks also had two form versions to control for word order and prevent confounding effects. The time allowed to complete the math filler task was 3 minutes, and for the recognition and fill-in-the-blank tasks 10 minutes was allowed.

It was predicted that the critical lures would have a completion rate significantly higher than the rate for words not previously seen. It was also predicted that the differences in recognition of old words and critical lures would be proportionately equal to the differences in word completion for old words and critical lures.

Results and Discussion

To analyze the results, recognition tasks were scored so that a recognition response ("yes") was scored as a 1, whether it was correct or incorrect, and a non-recognition response ("no") was scored as a 0. For fill-in-the-blank tasks, a response that matched a presented word was scored as a 1, whether it was a word they saw or a word that they did not see (from the other list), and a response that did not match a presented word was scored as a 0. The dependent variable was created by calculating the means for words seen, words not seen, critical lures seen, and critical lures not seen for each individual. This dependent variable, then, represents the proportion recognized (in the recognition task) or completed (for the fill-in-the-blank task) for each of the combinations of the independent variables (word type and words seen or unseen).

To examine possible confounding effects of Powerpoint and form versions, 2 (task) X 2 (word type) X 2 (words seen or unseen) X 2 (Powerpoint/form) mixed design factorial analyses of variance (ANOVAs) were used to examine the interactions of Powerpoint and form versions with the other three variables of interest. The ANOVA including form version revealed no significant interactions between form version and any of the three variables of interest, $p > .05$. From this, it was concluded that form version did not have an effect on results and it was left out of further analyses. The ANOVA including Powerpoint did reveal significant interactions with Powerpoint version, however. There was a significant four-way interaction between Powerpoint, word type, words seen or unseen, and task, $F(1, 59) = 4.15$, $p < .05$; partial η^2 (.07) indicated a weak interaction effect. This interaction implies that Powerpoint version had an effect on participant responses, which was not intended.

Because of the unintended effect of Powerpoint version, 3-way ANOVAs were conducted on word type, task, and words seen or unseen separately for Powerpoint A and

Powerpoint B. For Powerpoint A, the 3-way ANOVA revealed no significant interaction between the three variables of interest, $F(1, 30) = 1.28$, $p > .25$; partial η^2 (.04) indicated a very weak interaction effect. Also, for Powerpoint B, the 3-way ANOVA revealed no significant interaction, $F(1, 29) = 3.20$, $p > .05$; partial η^2 (.10) indicated a weak interaction effect. The fact that neither Powerpoint version produced a significant 3-way interaction means that task did not interact with the combination of the other two variables. In other words, the interaction between word type and words seen or unseen did not depend on the task. This implies that the underlying mechanisms responsible for memory of the words and memory of the critical lures are similar for both tasks.

In both analyses of Powerpoints, the Words Seen or Unseen X Task interaction was significant. For Powerpoint A, $F(1, 30) = 99.32$, $p < .0005$; partial η^2 (.77) indicated a very strong interaction effect. This interaction is also displayed in Figure 1.

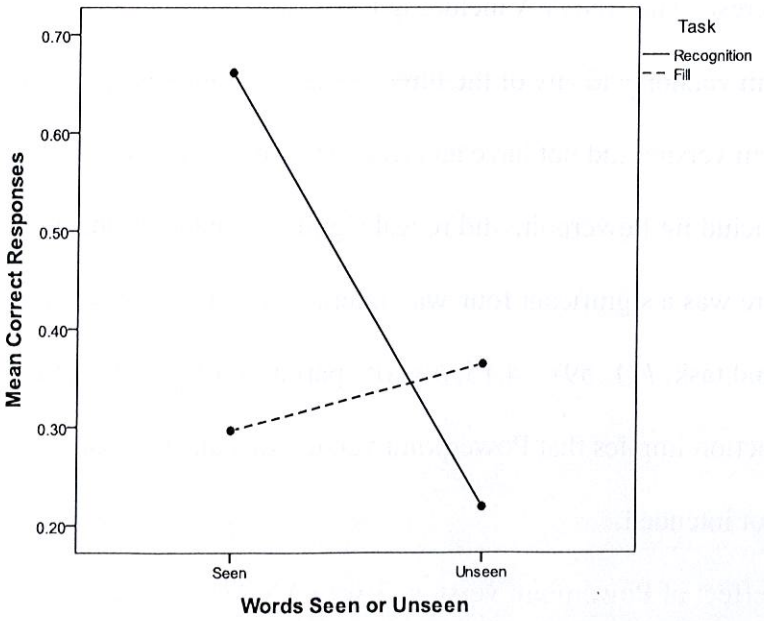

Figure 1. Mean correct responses as a function of words seen or unseen and task for Powerpoint A.

These results are not in agreement with what are well established facts about memory (Baddeley, Eysenck, & Anderson, 2008), especially for the fill-in-the-blank task, because the correct completion rate for unseen critical lures was higher than the correct completion rate for seen critical lures in the fill-in task. In fact, the rate of completion for the fill-in task was higher than the rate of recognition for the recognition task for unseen critical lures. From what is known to be true about memory (Baddeley et al., 2008), the completion rate for critical lures that are unrelated to words seen should not exceed the completion rate for critical lures that are related to words seen and completion rates for fill-in-the-blank tasks should not exceed correct responses for recognition tasks.

For Powerpoint B, the Words Seen or Unseen X Task interaction was also significant, $F(1, 29) = 32.42$, $p < .0005$; partial η^2 (.53) indicated a very strong interaction effect. This interaction is also displayed in *Figure 2*.

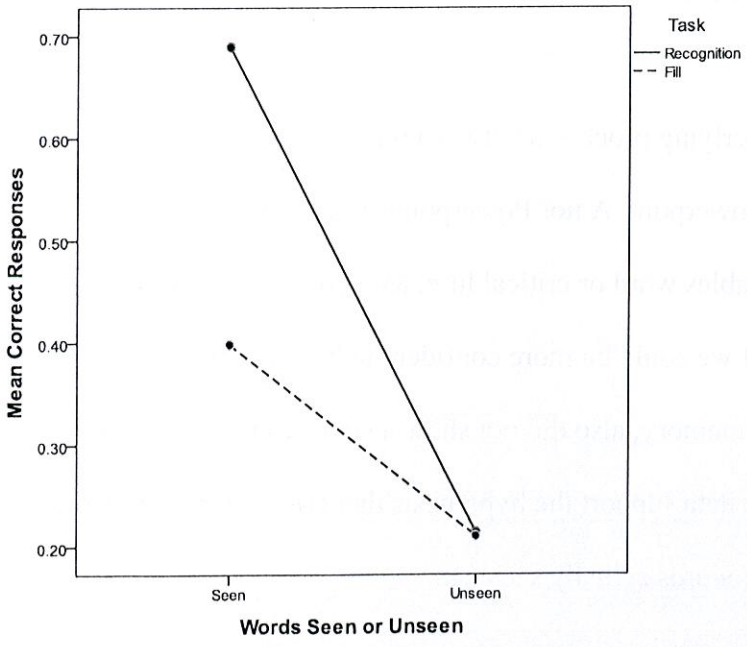

Figure 2. Mean correct responses as a function of words seen or unseen and task for Powerpoint B.

In contrast to Powerpoint A, these results were in agreement with what is known to be true about memory (Baddeley et al, 2008). For Powerpoint B, recognition rates were always higher than completion rates. Also, rates for words and critical lures that were seen were always higher than the rates for words that were unseen. These results are both to be expected.

The nature of the interaction between words seen or unseen and task leads me to question the results obtained from Powerpoint A, but to have some confidence in the results obtained from Powerpoint B. Because of these results, my further analysis focuses on the results of Powerpoint B and not on the results from Powerpoint A.

For Powerpoint B, I examined the interaction between task and word type. This interaction was not significant, $F(1, 29) = 0.35$, $p > .55$; partial η^2 (.01) indicated a very weak interaction effect. This further suggests that the underlying memory processes are similar for both the recognition and the fill-in-the-blank tasks. The interaction between word type and words seen or unseen was also not significant, $F(1, 29) = 2.56$, $p > .10$; partial η^2 (.08) indicated a weak interaction effect. This supports the idea that critical lures are very similar to presented words.

The data suggest that the underlying processes between recognition and fill-in-the-blank memory tasks are similar. Neither Powerpoint A nor Powerpoint B had significant interaction effects between the task and the variables word or critical lure, and word seen or unseen. Powerpoint B, which had results that we could be more confident in because of their consistency with what is known to be true about memory, also did not show a significant interaction between word or critical lure and task. These data support the hypothesis that critical lures can work as priming stimuli in the same way that words actually seen can.

This study should be replicated with new Powerpoint lists to study this phenomenon without the concern for confounding Powerpoint effects. While it is unclear what was the difference between Powerpoint A and Powerpoint B, I believe that it is simply an unintended effect from the random list construction and another random arrangement of the lists would not produce these dichotomous results.

It is possible that the non-significant results may be due to low power from small sample sizes; however, the small partial η^2 values found in the analyses lead me to believe that the non-significance did not result from low power. The small partial η^2 values found in the analyses imply that only a very small percentage of the variance in responses is accounted for by these effects.

References

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Appendix A: Informed Consent Form

Bemidji State University - Department of Psychology
Informed Consent Form

Thank you for volunteering to participate in this study. The purpose of this study is to investigate memory processes. Your participation is voluntary, and you may withdraw at any time without penalty. Although you will not be granted extra credit points unless you complete this study, you have an opportunity to earn extra credit points by participating in another experiment or other means listed in your course syllabus.

The information you give us is confidential. Your name or any identifying information will not be on any information you provide. Because this is a research study, we will not provide you with individual information about your performance. We will, however, discuss the research with you after it is completed by sending you an e-mail. Your participation in this study will consist of viewing a list of words, performing simple math calculations, and completing a memory task. The words will be presented for about 2 sec each and the entire list will take about 6 min. The entire experiment should take less than half an hour.

We do not anticipate that you will experience any discomfort as a result of being a participant in this study. However, if you have any such concerns, please feel free to discuss them with the experimenter or any of the people listed below. If you have concerns about the any of the psychological measures used in this study or your own reactions to the study, Dr. Guggenheimer or Mr. Hanus in the Counseling Center (Birch Hall) at 755-2024 are available for your information and assistance.

I have read this letter and voluntarily agree to participate in this research; I take responsibility for reading the debriefing that will be sent to me via e-mail.

Signature: _____ **Date:** _____

e-mail address (print clearly): _____

(tear here)

- -

(keep this part)

Psychology Research

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Dr. Guggenheimer or Mr. Hanus (Counseling Center - Birch Hall, 755-2024)

146 x 688	514 x 702	405 x 817	812 x 733	992 x 437

$37\overline{)2183}$	$56\overline{)6496}$	$73\overline{)6278}$	$44\overline{)9636}$	$19\overline{)8493}$

393 x 363	234 x 798	951 x 898	220 x 978	369 x 481

$28\overline{)8792}$	$52\overline{)7956}$	$13\overline{)5681}$	$34\overline{)8024}$	$47\overline{)8648}$

935 x 159	107 x 839	548 x 986	977 x 855	278 x 309

$27\overline{)3375}$	$12\overline{)9492}$	$13\overline{)5681}$	$42\overline{)8694}$	$72\overline{)9432}$

Appendix C: Recognition Task

music	Y	N	leader	Y	N
Ford	Y	N	ashes	Y	N
needle	Y	N	thrown	Y	N
vehicle	Y	N	tide	Y	N
nap	Y	N	hesitant	Y	N
tired	Y	N	barge	Y	N
bus	Y	N	fast	Y	N
snore	Y	N	**smoke**	Y	N
knitting	Y	N	**king**	Y	N
sharp	Y	N	speed	Y	N
sound	Y	N	Mississippi	Y	N
melody	Y	N	sandwich	Y	N
sleep	Y	N	**cold**	Y	N
band	Y	N	jelly	Y	N
car	Y	N	**doctor**	Y	N
thread	Y	N	aroma	Y	N
river	Y	N	rose	Y	N
cigar	Y	N	rye	Y	N
slow	Y	N	fragrance	Y	N
pollution	Y	N	winter	Y	N
prince	Y	N	hot	Y	N

medicine	Y	N	view	Y	N
health	Y	N	**sweet**	Y	N
warm	Y	N	**shirt**	Y	N
smell	Y	N	kiwi	Y	N
bread	Y	N	shade	Y	N
physician	Y	N	pane	Y	N
chair	Y	N	ripe	Y	N
city	Y	N	jersey	Y	N
garbage	Y	N	cuffs	Y	N
pile	Y	N	cake	Y	N
waste	Y	N	nice	Y	N
ugly	Y	N	honey	Y	N
poison	Y	N	**fruit**	Y	N
web	Y	N	**window**	Y	N
couch	Y	N	blouse	Y	N
country	Y	N	steep	Y	N
metropolis	Y	N	**anger**	Y	N
state	Y	N	hard	Y	N
trash	Y	N	**foot**	Y	N
table	Y	N	cotton	Y	N
spider	Y	N	fur	Y	N
sofa	Y	N	climber	Y	N
cherry	Y	N	bike	Y	N

fight	Y	N
rage	Y	N
boot	Y	N
kick	Y	N
mean	Y	N
soft	Y	N
mountain	Y	N
toe	Y	N

Side 1

Appendix D: Fill-in Task

Complete the left column, then the right column on both sides.

mus_____	ti_____
fo_____	hesi_____
nee_____	bar_____
veh_____	fa_____
no_____	smo_____
tir_____	kin _____
bu_____	spe_____
sno _____	Miss_____
knit _____	sand_____
sha_____	co_____
sou_____	jel_____
mel_____	doc_____
sle_____	aro_____
ba_____	ro_____
ca_____	ry_____
thre_____	frag_____
riv_____	win_____
cig_____	ho_____
sl_____	medi_____
poll_____	hea_____
pri_____	wa_____
lea_____	sme_____
ash_____	bre_____
thr_____	phys_____

Side 2

Appendix D: Fill-in Task

Complete the left column, then the right column on both sides.

cha_____	jer_____
ci_____	cuf_____
gar_____	ca_____
pi_____	ni_____
was_____	hon_____
ug_____	fru_____
poi_____	win_____
we_____	blo_____
cou_____	ste_____
cou_____	ang_____
metr_____	ha_____
sta_____	fo_____
tra_____	cot_____
tab_____	fu_____
spi_____	cli_____
so_____	bi_____
che_____	fig_____
vi_____	ra_____
swe_____	bo_____
shi_____	kic _____
kiw_____	me_____
sha_____	so_____
pa_____	moun_____
ri_____	to_____

Appendix E: Debriefing

Thank you for participating in our research. We're going to tell you the basics of what we did and the questions we were trying to answer. If you would like to be notified of our results (when they're available), feel free to contact me. We can't tell you about your individual results (nor will we ever report individual results) only about the overall group data. If you have any questions, concerns, comments, or simply want more information, please contact me by replying to this e-mail or simply sending a message to:

lori.hughes@st.bemidjistate.edu

As you know, we were interested in measuring your memory for the list of words that you initially saw. The math task was simply a way to put some time between the word list and the memory task. In the memory task, you were randomly placed in either a recognition task or a fill-in-the-blank task.

If you were assigned to the recognition task, you were given a list of words and asked to circle those words that you believed you had previously seen. About half of the items were words that you had previously seen when they were presented at the beginning of the research. Most of the rest of the items were simply unrelated words that you had not seen. However, a few of the items were words that you had not seen but that were related to the words that you had seen. Based on previous research, we believed that you would mark these related (but not seen) items as words that you had seen; this is termed false recognition and can be compared with accurate recognition of words that were actually presented.

If you were assigned to the fill-in-the-blank task, you were given a list of cues to fill in with the first word that comes to your mind. About half of the items could be filled in with words that you had previously seen when they were presented at the beginning of the research. Most of the rest of the items were simply unrelated words that you had not seen. However, a few of the items were words that you had not seen but that were related to the words that you had seen. Based on previous research, we believed that you would fill in these related (but not seen) items correctly about as often as words you have previously seen and more often than words you have never seen. We believed the differences between the words previously seen, words related (but never seen), and words never seen will be comparable to the differences seen in the recognition condition.

The topic of false recognition has important applications, for example in the area of eyewitness identification. Almost everyone makes false recognitions; they are simply the result of the way humans process information. The procedure we used in this study is an accepted one. If you would like to learn more, a good place to start might be this article:

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

Your participation has helped us conduct basic research in this important area; thanks, again!