

## Summary

# An Examination of the False Memory Rates of Turkish Words with the Deese-Roediger-McDermott (DRM) Paradigm

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Human memory is generally accurate, but, at times and under certain conditions, we remember events inaccurately. These errors in how an event is remembered are called “false memory” (Roediger & McDermott, 1995). False memory phenomenon has been widely researched through various methods in psychology. Among them, one of the most popular methods that utilize an experimental design is the Deese-Roediger-McDermott (DRM) paradigm. In this paradigm (Roediger & McDermott, 1995), participants study a list of words that are semantically associated with a word, called the critical lure, which is not presented during the study phase (Gallo, 2010). Typically, participants falsely recall and recognize critical lures in a subsequent memory test comparable to the accurate recall rates of the studied words presented in the middle of the list. Thus, in the DRM paradigm, false memory is revealed by remembering the non-presented critical lures. Critical lures are falsely remembered more often than unrelated words and this pattern is believed to reflect the influence of semantic organization of memory in accurate and inaccurate remembering (McEvoy, Nelson, & Komatsu, 1999). Accordingly, words are connected to each other via associative links and studying a word activates its close associates enabling fast access to information in the semantic network and these associative connections can be indexed by the free association method (Nelson, McEvoy, & Schreiber, 2004).

This paradigm has been applied in different languages such as Spanish (Anastasi, Leon & Rhodes, 2005), Italian (Iacullo & Marucci, 2016) and Polish (Ulatowska ve Olszewska, 2013). However, although a previous study attempted to utilize DRM paradigm with Turkish words (Goz, 2005), the selection of experimental stimuli (i.e., words) was based on word frequency and not on associative connections, and thus an exact replication comparable to the standard DRM method remains to be conducted with using Turkish words. The purpose of the current research was to fill in this gap in the Turkish

literature on the examination of false memory rates in the DRM paradigm. In addition, other experimental manipulations were conducted to examine the robustness of the false memory effect. The effects of word order and context change as well as the false memory rates of different critical lures were investigated in Study 1. Study 2 assessed the role of the generation effect (i.e., being actively involved in the encoding of words) in the production of false memories in the DRM paradigm. Furthermore, Study 2 examined the response times in an attempt to contribute to the literature differentiating false and accurate memories based on the speed of response.

### Study 1

Study 1 aimed to investigate false memory rates of Turkish words with an exact replication of the standard DRM paradigm (Roediger & McDermott, 1995). Also, the effects of word order and context change were examined. Context change (change vs. no change) was manipulated between-subjects by changing the location of the memory test than the study phase. Word order was manipulated between-subjects by arranging the lists of associates of the critical lures based on associative strength. In the strong-to-weak (SW) condition, the strongest associates of the lures appeared first and descending order based on associate strength determined the order of the words. The opposite ordering was used in the weak-to-strong (WS) condition and, in the middle (M) condition, the strongest associates appeared in the middle of the list while the weak associates were positioned in the beginning and end of the lists. Ten words were chosen as critical lures from Roediger and McDermott’s (1995) study. Study lists were composed of the words that are semantically associated with the critical lures and were chosen based on the associative strength as indexed by the Turkish free association norms (Tekcan & Goz, 2005). Each study list included 12 words.

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Seventy undergraduates voluntarily participated in this study. Participants studied 10 lists of words and received an immediate recall test. After all lists were studied and recalled, participants were administered a final recognition test that included 3 studied words from each list. The recognition test included 30 studied words and 30 unstudied words (10 critical lures and 20 unrelated words). The results of the free recall test confirmed the typical findings of the DRM literature by showing that critical lures produced high levels of false memory. Moreover, word order did not influence false memory rates, but the hit rate was slightly higher when strong associates were presented in the middle than at the end of the study list. Results of the recognition test indicated that critical lures produced false alarm rates more than unrelated words. Word order and context change did not have any effect on false recognition rates. These results underscore the robustness of the false memories generated in the DRM paradigm (Gallo, 2010). Overall, Study 1 replicated the typical findings in the literature and contributes to the cross-cultural validity of the DRM paradigm in studying false memory.

### Study 2

The purpose of Study 2 was to examine the role of generation effect in both memory accuracy and production of false memories. Moreover, participants' response times were measured in an attempt to further examine the differences in accurate and inaccurate memories. For this purpose, critical lures used in Study 1 were selected as experimental stimuli. Specifically, 4 critical lures from Study 1 and 1 new critical lure were utilized in Study 2. Study lists included 10 words that were associatively related to the critical lures. Forty-two undergraduates participated in the study and were randomly assigned to two groups, generation and control. Participants in the generation condition studied the word fragments and had to generate the correct word that goes with the presented fragment whereas participants in the control condition studied the intact words. All participants studied all word lists under these conditions, and, different than Study 1, they were not administered a recall test after each word list. After all words were studied, participants were administered a 35-item recognition test using the OpenSesame program. The recognition test included 10 studied words, 5 critical lures, 10 weakly related lures, and 10 unrelated words. In accordance with Roediger and McDermott's (1995) findings, critical lures produced the highest false alarm rates as compared to weakly related and unstudied words. The results further indicated that being actively involved in the production of words during study (i.e., generation of words) increased cor-

rect recognition but it did not engender any difference in false memory. Although current findings are consistent with a previous study on the generation effect (Soraci et al., 2003), there is also evidence in the literature showing that generation of words during study leads to lower false recall and recognition (McCabe & Smith, 2006). Furthermore, participants in the generation condition responded faster to all words compared to the control condition. This facilitation effect is obtained uniquely for the first time in the literature and suggests that the generation process not only affects memory accuracy, but also response speed. However, there were no response time differences among the responses given to the different word types (i.e., studied words and critical lures, and weakly-related words). Thus, it appears that being actively involved in the study of words leads to overall facilitation of the response speed.

### General Discussion

The main purpose of the current research was to examine the false memory rates of Turkish words in the DRM paradigm. The uniqueness of the present research lies in the selection of experimental stimuli (i.e., words) from the Turkish free association database in contrast to similar research studies which employed the DRM paradigm with Turkish words but did not utilize the word association norms in the selection of experimental stimuli. In addition, the influence of several experimental manipulations, word order, context change, and generation effect on false and accurate remembering were assessed. False memory rates for the critical lures obtained both in recall (Study 1) and recognition (Study 1 & Study 2) tests were comparable to other studies in the DRM literature. Present study made contributions to the Turkish literature on false memory by showing that Turkish free association norms (Tekcan & Goz, 2005) can be reliably utilized in studying false memory and also to the cross-cultural generalizability of the DRM paradigm by showing that false memory rates of Turkish words are similar to that of English words. False memory produced in the DRM paradigm is believed to drive from the semantic organization of words, i.e., pre-existing semantic information (McEvoy et al., 1999) and is a result of semantic activation of the associatively related words during the study and test phases (Brainerd & Reyna, 2005); and the present findings support this position.

Study 1 replicated Roediger and McDermott's study (1995) and showed that critical lures had the highest false memory rates compared to unrelated words. This is presumably related to association activations of critical lures (Brainerd & Reyna, 2005). Furthermore, not all critical lures yielded high false memory rates and

thus there was an apparent difference in the false memory production depending on the critical word. False memory rate was not affected by any of the experimental manipulations and this can be taken as an indicator that false memory effects produced in the DRM paradigm are quite robust (Gallo, 2010). It is possible that as the associative relations among the studied words are automatically activated in a DRM experiment (McEvoy et al., 1999), such activation is likely to create resistance against the disruptive effects of context change (Smith & Vela, 2001). From the perspective of fuzzy trace theory (Reyna & Brainerd, 1995), our findings indicate that the context change manipulation was not strong enough to produce a faster decay of the verbatim traces compared to the gist representation. Such a result was obtained possibly because the retention interval was kept similar between the same and different context conditions. There is a need to further examine this explanation with manipulation of both context and retention interval in future studies. Alternatively, the context change manipulation employed in the current study might have been too weak to produce a disruptive effect on both true and false memory and thus, there is a need to replicate present findings using a stronger context manipulation.

Study 2 replicated Soraci et al.'s (2003) study and examined the generation effect in a between-subjects design. Importantly, participants' response times were measured in the recognition test. In accordance with Soraci et al.'s (2003) findings, when the participants played an active role during the study of words, they had better memory performance than the participants who just read the words as reflected by higher accuracy rates. However, the results did not show differences in false memory rates. Although the results had similarities to Soraci et al.'s (2003) study, another study found that the generative process engendered a lower false memory rate by increasing item distinctiveness (McCabe & Smith, 2006). This inconsistency might have originated from the lower number of critical lures utilized as well as the use of a between-subjects design in the present study. The roles of study design and the number of critical lures on the DRM false memory effect can be examined in future studies to better understand the role of design elements on the results of DRM experiments. Moreover, participants in the generation condition responded faster than the control condition, but the response time differences among different word types were not statistically significant. The facilitation of response times through generation instruction is a unique finding of the present study and reflects the differential processing of item information within the brain (Rosner, Elman, & Shimamura, 2012). Future studies should examine the robustness and generalizability of this facilitation effect through

generation instruction in different samples, research settings, and manipulations.

Overall, the DRM paradigm can be reliably applied with Turkish words by making use of the Turkish word association norms. Our findings contribute to the cross-cultural validity and reliability of the DRM paradigm. The study lists utilized in the present research can be used by researchers who are interested in the DRM paradigm and/or false memory. Future studies can evaluate true and false memory rates by using the materials of the current study and, also compare additional stimuli by taking our findings as base rates. We also suggest putting concentrated efforts to increase the database of critical words used in the DRM paradigm as an attempt to broaden the experimental stimuli available in false memory experiments. A limitation of the present research is noted as somewhat fewer critical lures and studied words in the recognition tests, especially in Study 2, as compared to the other studies in the literature. Also, the context change manipulation might have been weak to produce the desired effect. Nevertheless, present findings are comparable to findings obtained with English words and thus we believe that these limitations do not pose a threat to the validity of our findings.