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Summary
Does Semantic Association Play a Role in Post-Event Misinformation Effect?

İlyas Göz
Acıbadem University

Serra Tekin
University of Gothenburg

Ayşe Ayçiçeği Dinn
İstanbul University

There is a substantial amount of research investigating the post-event misinformation (PEM) effect from various perspectives. In a typical PEM experiment, participants first witness an event, then receive misinformation about the original incident and later they are tested for their memory of the original information. For example, Loftus, Miller and Burns (1978) showed participants a series of slides of a traffic accident. In the critical slide, there was a '*Stop sign*' on the side of the road. After viewing the slides, the witnesses were presented misinformation indicating that there was a '*Yield sign*' on the side. Findings revealed that the witnesses who received PEM ('*Yield sign*') performed poorly in correctly recalling the original item ('*Stop sign*') compared to the witnesses who did not receive any misinformation.

This procedure is not different in the recent studies (e.g., Stark, Okado, & Loftus, 2010) and they reported similar findings. Such findings encouraged researchers to further explore the underlying processes of the PEM effect. Researchers put forward various explanations to account for the effect. Some argued that the original information is impaired by the misinformation (e.g., Loftus et al., 1978) whereas some argued against the impairment theory and asserted that misinformation has no effect on the original information; it is available but there is an accessibility problem because of recognition test. These studies used different recognition tests and found out no any effect of PEM on original information (e.g., McCloskey & Zaragoza, 1985; Tversky & Tuchin, 1989).

After some debates on this incompatible findings for some years, the psychologists tackled the factors playing a part in the effect of PEM on the original information. The impact of age (e.g., Lehman, McKinley, Thompson, Leonard, Liebman, & Rothrock, 2010), low and high confidence levels in the memory (e.g., Bergen, Horselenberg, Merckelbach, Jelicic, & Beckers, 2010), the source of the PEM (e.g., Bodner, Musch, & Azad, 2009) and the memory tests as well as the question types (e.g., Er, Alpar, & Uçar, 2005) are a few examples of the factors that drew interest in the PEM literature. However, we have not found the role of the semantic association between the original information and the misinformation among these factors.

On the other hand, according to the Fuzzy Trace Theory (FTT) the semantic relation between the original experience and PEM is important because false memories originate from the semantic encoding (gist) of the original experience (e.g., Brainerd & Reyna, 2004). More specifically, the likelihood of a false memory response is higher when the PEM has a strong semantical association with original information than it has a weak association. (e.g., Seamon, Luo, Schlegel, Grene, & Goldenberg, 2000; Smith, Ward, Tindell, Sifonis, & Wilkenfeld, 2000). Based on the principles of FTT, Brainerd and Reyna (2012) predicted that younger children would be less affected by the PEM compared to older children. This inference relies on the developmental differences with respect to the ability of semantic coding. In other words, children become more skilful in extracting and processing semantic aspects of stimulus as they grow up. That is why young children are less affected by PEM compare to the older ones.

The current study aims at testing the effect of semantic association between the original experience and PEM on false memories in adults. Such a testing would provide an external validity for the concept of developmental reversals. Within this framework we predict that; (a) there will be more false recognition when the original information and the misinformation pertain to the same category compared to when they pertain to different categories; and (b) there will be more false recognition when they are strong associates compared to when they are weak associates.

In our experimental design three types of misinformation were used: (a) an item that has a strong semantic association to the original information (i.e., the strong associate), (b) an item that has a weak semantic associa-

Address for Correspondence: İlyas Göz, Acıbadem Üniversitesi Psikoloji Bölümü, Ataşehir / İstanbul, Türkiye
E-mail: ilyas.goz@acibadem.edu.tr

tion to the original information (i.e., the weak associate) and, (c) an item from a different category which does not any semantic relation to the original information (i.e., a non-associate item). In the recognition test, the witnesses were asked to recall the original item among the four choices given: the three misinformation types and the original item.

Method

Participants

The sample consisted of 202 (33 men, 169 women) undergraduates at Istanbul University and Haliç University (Turkey). Their ages varied between 17 and 25 (M = 19.8, SD = 1.3). Participation was voluntary and participants were randomly assigned to the experimental or the control group.

Materials

The materials consisted of two videos of a cell phone theft, a narrative describing the events in the videos, a recognition test and a demographic information form.

The Selection of the Critical Items in the Video. In the video there were three critical items each of which belongs to a different category (flower, beverage, and dress). The critical items in the scenario were as follows: flowers (the flowers on the table), soft drinks (what the victim was drinking) and clothes (what the thief was wearing). Two main criteria were taken into consideration in the process of specifying those items. The theft was recorded in a café; thus the first criterion was the plausibility of the presence of the items in a café. Secondly, the misinformation (strong and weak associates) had to be consistent with word association norm lists in the literature. The strong and the weak associates within each category were decided based on a survey which was administered to 193 undergraduate students (126 women, 67 men).

In the survey, the participants were asked to list the first three types of flowers, soft drinks and clothes that came to their mind. The most frequent two items were used as the 'strong associates' while the least frequent item was used as the 'weak associate'. Those items fulfilled the second criterion described above. Additionally for each category, one non-associate item was specified by the researchers. The presentation of strong and weak associations was counterbalanced in the videos and narratives. To be more specific, one of the two strong associates was the original item in the video for one participant while other strong associate was presented as a misinformation in the narrative. This order of the same two strong associates was reversed for the subsequent participant.

The Video. The two videos were silent and each lasted approximately four minutes. They were identical except for the three critical items. The videos started with a man (victim) reading a newspaper in a café while another man (thief) is having a drink at another table. On the victim's table there are a beverage and a vase and some flowers in it. The thief stole the mobile phone of the victim under the cover of asking for an address. The videos ended with the victim realising the theft and leaving the café to go after the thief.

In Video 1 the critical items were *roses – coca cola – sweater* and in Video 2 they were *daisies – orange juice – shirt*. In both of the conditions the weak associates were *poppies – milk – coat* and the non-associates were *banana – cigarette – glasses*. Half of participants were presented Video 1 while the other half were presented Video 2 in order to counterbalance the material.

Narrative. Participants were given a narrative of what happened in the video. It consisted of approximately 200 words and contained three pieces of misinformation (either strong, weak or non-associate). The control group did not receive misinformation.

Recognition Test. The test consisted of 14 multiple-choice questions with four alternatives. The alternatives were the original item, the strong associate, the weak associate, and the non-associate item. For instance, one of the critical questions 'What was the victim drinking?' had the following choices: *coke, orange juice, milk* and *cigarette*. Three of the questions targeted the critical items whereas eleven of them were fillers.

Procedure

The participants viewed a video of a theft and then completed a filler task (a paper and pencil test) for 15 minutes. Following the filler task, they were asked to read a narrative which described the events in the video. Half of the participants received one of the three kind of misinformations in the narrative (experimental group) whereas the other half did not (control group). Subsequent to a second 15 minutes filler task participants were administered the recognition test to assess their memory of the original event.

Results and Discussion

The results demonstrated a post-event misinformation effect as expected. The percentages of false memory responses were 34.9 in the experimental group, whereas it was only 10.94 in the control group (z = - 7.00, p < .001).

The false memory responses decreased in the experimental group as the association between the original and the misinformation weakened. When the numbers of false memory responses to different types of misinfor-

mation are compared, the only significant difference was found between the strong associate and the non-associate item. That is, witnesses were more prone to accept strong associates over non-associate items (strong – weak: $z = 1.58$, $p > .05$; strong – non associate: $z = 2.79$, $p < .01$; weak – non associate: $z = 1.08$, $p > .10$).

A z-test was conducted to compare the responses to misinformation in three conditions. The results revealed that the misinformation was recalled as the original information more frequently both in the strong associate and the weak associate conditions (.87 and .79 respectively) than in the non-associate condition (.38), ($z = 7.01$, $p < .01$ and $z = 5.74$, $p < .01$, two tailed, respectively). The frequency of accepting the misinformation in the strong condition (.87) statistically did not differ from the weak condition (.79), ($p > .10$).

A significant difference was found in the frequency of responses (strong, weak and non-associate) when the PEM was the strong associate; χ^2 (2, $N = 46$) = 60.04, $p < .001$. Consistently, there was also a significant difference in the frequency of responses when the PEM was the weak associate; χ^2 (2, $N = 34$) = 11.77, $p < .01$. That is, in both conditions the most frequently chosen response was the PEM itself while the second frequent choice was the item pertinent to the same category. On the other hand, when the non-associate was given in the narrative as the post-misinformation, the non-associate itself was not mistakenly chosen the most frequently as target (original information); there was no false alarm difference between the strong item and non-associate; χ^2 (2, $N = 26$) = 1.385, $p > .10$. Although no significance was found, the strong item quantitatively was chosen as the original information more than the non-associate item.

The results display that when the original item and the PEM pertain to the same category (regardless of the strength of their relationship), the chances of obtaining the misinformation effect is higher than when they are not semantically related.

Contrary to expectation, there was no significant difference between the strong associate condition and the weak associate condition with respect to the number of false memory responses. However, it is important to note that the pattern is consistent with our prediction that PEM is not falsely accepted as the original information unless there is a semantic relation between the original event and PEM. That is why in both strong and weak conditions PEM were mistakenly accepted as the original item. Previous findings (e.g., Nelson, McKinney, Gee, & Janczura, 1998; Smith et al., 2000) showing a difference between false responses to strong and weak associates are consistent with the current pattern.

The results are also consistent with the studies demonstrating suggestibility in child eyewitnesses. These studies found that older children are more suggestible to misinformation compared to younger children (e.g., Anastasi, Lewis, & Quinlan, 2008; Carneiro, Albuquerque, Fernandez, & Esteves, 2007; Metzger, Warren, Price, Reed, Shelton, & Williams, 2008). In a study by Howe (2006) the acceptance of a strong associate gradually increased in percentages in 5, 7 and 11 year olds, that is the PEM effect increased with age. The same findings were found when visual materials are used instead of word lists (e.g., Connolly & Price, 2006; Ross et al., 2006). According to the theory, the strength of physical coding (verbatim) leads to accurate recognition while the strength of semantic coding (gist) generates false memories. In a study by Brainerd, Forrest, Karibian, and Reyna (2006) participants with learning disabilities were found to be less suggestible to false remembering than the control group; and, people with learning disability are known weak at extracting and processing the semantic aspect of material.

The present findings indicate similar patterns as in the developmental studies testing the strength of the semantic relationship between original memory and PEM. In that line of research, the objective is to test different age groups with respect to their semantic coding abilities while the current study aimed to test adults and different pieces of information with various semantic associations.

Our findings are also related to the studies conducted about 30 years ago (e.g., Loftus, Miller, & Burns, 1978; Tversky & Tuchin, 1989; McCloskey & Zaragoza, 1985). They sought an answer to the following research questions: 'What happens to the original memory when the PEM is mistakenly accepted as original information? 'Does PEM impair the original memory?' or 'Does PEM obstruct the recollection of the original memory by making it difficult to access?' (Loftus, 2005, p. 363). Our findings have an answer to this question by suggesting that the original information is neither removed nor become inaccessible by PEM; the semantic relation between PEM and original information misleads the participant to accept the PEM as original information.

In summary, the current findings point out that research should attach more importance to the associative strength between the original information and the misinformation as the strength inherently plays a role in recognition accuracy. Future research should attempt to increase the ecological validity by presenting visual materials in the recognition test instead of the verbal ones.