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Abstract

This study examines whether unconscious processing of misleading post-event information can influence explicit and implicit eyewitness memory. Using the existing misinformation paradigm, false post-event information was presented to participants either under full or divided attention. Eyewitness memory was tested with both explicit (free recall and cued recall tests) and implicit memory tests (truth rating test). Participants who were misinformed under full attention recalled significantly more misinformation than their counterparts who were misinformed under divided attention and the control group. However, results from the truth rating test showed that both explicit and implicit forms of misinformation had no impact on implicit eyewitness memory. Since this study is the first to examine the effect of post-event information on implicit eyewitness memory, there is much room for improvement in the selection and design of the implicit memory test that is suitable for eyewitness setting. Other limitations and potential directions for future research are also discussed.

Can Implicit Post-Event Information Influence Eyewitness Memory Explicitly?

Eyewitnesses are an important source of evidence which helps identify suspects and prosecute offences (Buckhout, 1975; Engelhardt, 1999; Flowe, Mehta & Ebbesen, 2011; Wells & Olson, 2003). In the report, *The Criminal Investigation Process* (1975), one of the most important determinants of whether a case was solved is the presence of an eyewitness. However, a recent analysis on DNA exoneration cases, between 1992 and 2009, revealed that more than 70% of false convictions was a result of eyewitness misidentification (Kassin, Bogart & Kerner, 2012). For example, 88% of exonerations in rape cases and half of the exonerations in murder cases involved victims' misidentification of the perpetrators (Gross, Jacoby, Matheson, Montgomery & Patil, 2005). These findings thus cast doubt upon the credibility and probative value of eyewitness evidence.

Many studies have examined the possible mechanisms leading to erroneous recollections on the part of eyewitnesses (e.g., Cutler, Penrod & Martens, 1987; Loftus, Miller & Burns, 1978, Yuille & Cutshall, 1986). Some of the factors which might compromise eyewitness testimony include new information supplied after an event (i.e., *post-event information*) (Loftus, 1974; Loftus, 1975), a long retention interval (Yuille & Cutshall, 1986), and high weapon visibility during the event (Cutler et al., 1987). Of these factors, post-event information (PEI) has received substantial attention over the past 40 years' (Loftus, 2005). The research examining the impact of PEI has shown that eyewitnesses are not only

susceptible to memory loss over time, but also memory distortion due to misleading PEI (Yuille & Cutshall, 1986). The incorporation of PEI in eyewitness memory is referred to as the *misinformation effect* (Loftus & Hoffman, 1989). However, when examining the misinformation effect, the research to date has examined instances in which the participants are explicitly attending to the PEI. It is unclear, though, whether implicitly presented PEI may similarly lead to the misinformation effect. Indeed, witnesses may be bombarded with different types of information from various sources, e.g., when they talk to other co-witnesses, overhear others' discussions, and receive new information from the media or interrogators (Loftus, 1991). It is unlikely that witnesses could attend to all sources of PEI, which, in turn, leads to the possibility that they may incorporate some PEI unconsciously. The present study therefore seeks to extend the literature on the misinformation effect by examining whether implicitly presented PEI may shape the extent to which eyewitnesses explicitly and implicitly recall a crime scene.

In what follows I will discuss 1) the robust research examining PEI and eyewitness memory, 2) the mechanisms argued to lead to the misinformation effect, and 3) how implicitly presented PEI may be related to the misinformation effect.

Misinformation Effect

Research examining the misinformation effect typically followed a three-stage procedure: 1) participants first view an event, 2) they are then exposed to misleading

information about the event, and finally 3) the participants take a memory test about the witnessed event (see, e.g., Loftus, 1991). In Loftus' first study, which employed this three-stage procedure, participants were presented with a series of slides depicting an auto-pedestrian accident (Loftus et al., 1978). One of the slides was altered so that half of the participants saw the car stopped at a stop sign while the other half saw the car stopped at a yield sign (Loftus et al., 1978). In the second stage of the experiment, all participants filled out a questionnaire asking them about the details of the accident. For half of the participants, one of the items in this questionnaire asked them whether they saw another vehicle passing the car while it was stopped at the stop sign. For the remaining participants, they were asked the same question with the words "stop sign" replaced by "yield sign". The remaining items in that questionnaire were identical for all participants. In the final stage, all participants took a forced-choice recognition test about the accident they viewed earlier. In this test, 15 pairs of slides were presented; one of each pair was old and the other one was new (Loftus et al., 1978). Participants were instructed to select the slide that they had seen during the accident. One of the pairs was the critical pair: it included a slide showing the car stopped at the stop sign, and a similar slide which showed the car stopped at a yield sign (Loftus et al., 1978). The results showed that participants who were exposed to misinformation during the second stage were more likely to identify the slide with the wrong traffic sign (Loftus et al., 1978). This study demonstrated that when people are exposed to misleading information (e.g.

suggestive questions) after they witnessed an event, their memory for the witnessed event might be distorted by information they come in contact with after the original event.

Research has also shown how misinformation effect can be introduced through narratives containing false information, or through the discussions people have with co-witnesses (which is known as the *social contagion* effect) (e.g., Gabbert, Memon & Allan, 2003; Meade & Roediger, 2002, Zaragoza & Lane, 1994). In explaining why such instances of misinformation effect occur, researchers have argued that they are the result of failure of source monitoring.

Source Monitoring

According to the source monitoring model, when an individual is witnessing an event, the event memory and the source of that event memory (i.e., the time and place where the memory is derived) are stored (Johnson, Hashtroudi & Lindsay, 1993). Sometimes, however, people will misremember the source of the memory, in other words, they misjudge the origin of an event memory (Lindsay & Johnson, 1989). In the eyewitness setting, the source monitoring model suggests that misinformation effect occurs when the misinformed witnesses erroneously identify memories for PEI as memories acquired from the witnessed event (Johnson et al., 1993). For example, in Loftus et al.'s (1978) original study, the memory for the accident and the source memory for the accident were encoded when participants were viewing the slides at the beginning (Time 1). After that, participants filled out a questionnaire

which asked about the accident they just witnessed (Time 2). When they were filling out this questionnaire, the memory for misinformation presented in the questionnaire and the source memory for the questionnaire were stored. The following recognition memory test was a test of participants' source memory for the witnessed accident because participants had to judge which slide they had encountered at Time 1. Participants who were exposed to misleading information at Time 2 were found to be more likely to choose the slide with the wrong sign in the recognition memory test because they mistook the source of that information as emanating from Time 1 instead of Time 2 and, thus, exhibit the misinformation effect.

Johnson et al. (1993) noted that source monitoring relies fundamentally on the quality of the information stored about the events. Factors such as stress and divided attention disrupt people's normal perceptual and encoding processes, which may lead to the storage of incomplete information (Johnson et al., 1993). If the information acquired about an event is impoverished, identification of the source of that memory becomes more difficult and prone to errors (Mitchell & Johnson, 2000). As source confusion is a major contributor to the misinformation effect (Lindsay & Johnson, 1989; Zaragoza & Lane, 1994; Lindsay, Allen, Chan & Dahl, 2004), the quality of the PEI encoded could be an important factor which determines the strength of the misinformation effect. Specifically, if witnesses acquire misleading PEI unconsciously, they might be more likely to confuse the source of PEI with the source of the witnessed event because of a lack of source-specifying information of the

PEI (Mitchell & Johnson, 2000). While this possibility has yet to be examined within the eyewitness literature, there is evidence suggesting that people can be influenced by prior information that they learned unconsciously (e.g., Jacoby & Kelley, 1987; Jacoby, Woloshyn & Kelley, 1989). This is known as *implicit learning*.

Implicit Learning

A classic study conducted by Jacoby et al. (1989) demonstrated that unconsciously-learned information could affect people's subsequent perceptual performance. The authors instructed participants to study a list of famous and non-famous names; half of the participants studied them under full attention while the other half under divided attention. A recognition memory test of these names was then administered to the participants; unsurprisingly, participants who studied the names under divided attention performed worse than their counterparts in the full attention condition (Jacoby et al., 1989). A fame judgement test was also administered. In this test, a list which comprised names that had been presented and new non-famous names was given to the participants and they were asked to judge how famous each name was. It was found that participants in the divided attention condition demonstrated a tendency to judge the non-famous names that they encountered before as famous (Jacoby et al., 1989). Since these participants learned the non-famous names under divided attention, the source-specifying information of these names was not stored completely. This resulted in a mere feeling of familiarity of the names (Jacoby et al., 1989;

Johnson et al., 1993; Mitchell & Johnson, 2000). This phenomenon, *the false fame effect*, demonstrates how divided attention may impair people's ability to accurately monitor the source of memory (Jacoby et al., 1989).

Another study conducted by Perfect and Askew (1994) investigated whether advertisements presented without participants' attention would influence their attitudes towards those adverts. In their experiment, the authors asked half of the participants to examine the layout of a magazine while the other half to read the adverts in the magazine. As a result, the first group of participants were exposed to the magazine's adverts unconsciously while the second group viewed the adverts deliberately. A test was then administered to all participants. This test comprised the presented adverts and new adverts; participants were asked to rate how appealing and eye-catching each of these adverts was (Perfect & Askew, 1994). In addition, participants were instructed to indicate which of the adverts they recognized as having been presented previously. The results showed that participants who viewed the adverts unconsciously remembered less presented adverts than those who deliberately read the adverts. However, both groups of participants demonstrated a positive bias in attitudes towards the adverts that they had been exposed to (Perfect & Askew, 1994).

Additionally, unconsciously learned information could influence people's perceived credibility of such information even though they may not overtly recall learning it (Begg, Anas & Farinacci, 1992). Begg et al. (1992) conducted a series of experiments to examine

whether implicit learning could influence people's judgment about the credibility of information. In one of their experiments, Begg et al. (1992) presented statements to participants who were either under full or divided attention. Participants were also informed which statements were true and which were false. After that, participants were given a list that included old and new statements, and were instructed to rate the truthfulness of each statement. They then completed a recognition test of the statements. It was found that participants from the divided attention condition recognized fewer statements than their counterparts in the full attention condition; however, they were more likely to rate the old statements as true than the new statements (Begg et al., 1992).

Thus, based on this line of literature, it is possible that unconscious learning of erroneous PEI may bias the recall of an eyewitness. In real-life eyewitness situation, witnesses come across PEI from different sources and they may learn some of the misinformation unintentionally. Although the implicitly-acquired PEI might not be recollected consciously, it might affect witnesses' subsequent perception of the credibility of the misinformation. For instance, they might become biased towards other co-witnesses' testimony or a certain individual from the lineup that match the misinformation they learned unconsciously. The change in the witnesses' perception of the misinformation may in turn be internalized and become part of their eyewitness memory over time. The current study therefore investigated whether exposure to misleading PEI under divided attention may lead

eyewitnesses to perceive the misinformation to be more truthful.

Study Overview

In order to examine whether misinformation, presented under divided attention, shapes the extent to which participants rate the information as truthful, modifications were made to the existing misinformation paradigm in the following ways: 1) misinformed participants either received PEI under full or divided attention, and 2) an implicit memory test was administered in addition to the conventional explicit memory tests. There were three experimental conditions in this study: control, misinformed under full attention (FA) and misinformed under divided attention (DA). Participants' explicit memory was assessed with free recall and cued recall tests. This was done to ensure replication of the standard misinformation effect. To assess their implicit memory, participants completed a truth-rating test; this test has been used in the study conducted by Begg et al. (1992) as an implicit measure of memory. The truth rating test included 1) statements that were true descriptions of the witnessed event, 2) statements that repeated misinformation, 3) true statements that described the details about which misinformation was supplied, and 4) new statements that were false descriptions of the event.

The first hypothesis of this study was that participants in the FA group would mistakenly recall more PEI than the control group and the DA group did during the explicit memory tests. The second hypothesis predicted that both the DA and FA groups would rate statements

which repeated the misinformation they had been exposed to as truer than the control group did. The third hypothesis predicted that both misinformed groups would exhibit a specific pattern in their truth ratings, that is, they would rate the true statements as more credible than the repeated information, and the repeated misinformation would be rated as more credible than the false new statements.

Method

Participants and Research Design

Sixty participants (16 male) were recruited via an online experiment sign-up system at an urban college in the Northeast of the United States. Participants ranged in age from 18 to 33 years ($M = 20.46$, $SD = 3.17$). Each participant received a course credit for his/her participation. At the beginning of the study, participants were told that the study examined the effect of emotional arousal on cognitive functioning. The experimental design of this study consisted of one between-subjects factor, i.e., presentation of misinformation: no misinformation (control condition, $n = 20$), full attention (FA condition, $n = 20$), and divided attention (DA condition, $n = 20$).

Materials

Short film. The stimulus in the experiment was a 42-second video depicting an armed robbery in a café. The video showed two men entering the café with firearms and robbing the customers (see Appendix A for a detailed description of the crime event).

Audio narrative. A 57-second audio narrative was created to describe the crime video but it included five false facts about the crime. These false facts were generated by altering five critical details selected from the crime video. Four of these false facts were related to the people's appearances while the remaining one was related to the crime scene (see Appendix B for the audio narrative transcript). The audio narrative was recorded with a female voice at a constant speech rate.

Tone-counting task. The stimulus used in the tone-counting task for the control and DA groups was a series of randomly-generated tones that were either low-pitched (1000 Hz) or high-pitched (2500 Hz). Each tone lasted for 50 milliseconds and the whole series of tones matched the length of time of the audio narrative. The tones were played via headphones and participants were instructed to report the number of high-pitched tones that they heard. The tone-counting task has been employed in several divided attention studies (e.g. Frensch, Wenke & Runger, 1999; Pedersen & Rist, 2001).

Distractor tasks. In order to prevent participants from rehearsing the video details or the misinformation in the audio narrative after their presentation, two distractor tasks were included in this experiment.

After viewing the video, participants engaged in the first distractor task which prevented them from rehearsing the content of the video. This distractor task was necessary because a previous eyewitness study found that immediate recall of the crime event could inoculate

participants against misinformation (Wang, Paterson and Kemp, 2013). The Affective Style Questionnaire (Hofmann & Kashdan, 2010) was used as this distractor task because it was irrelevant to this study and it helped support the cover story about the purpose of the experiment. This questionnaire contained 20 items and participants were instructed to rate how true of them each item is on a five-point scale (1 = *not true of me at all*; 5 = *extremely true of me*). Sample items included “People usually can’t tell how I am feeling inside” and “I can tolerate being upset” (Hofmann & Kashdan, 2010). Participants’ responses to this questionnaire were not analyzed.

After the audio task (in which the misinformed participants received the misinformation), participants summarized a 4,000-word news article that was unrelated to the study and they were told that this task assessed their reading comprehension. The purpose of this distractor task was to prevent the misinformed participants from recalling the content of the audio narrative. Participants spent 15 minutes on this distractor task.

Free recall test. Participants’ explicit memory was tested with a free recall test. The test contained the following instruction: “In the space provided please report all the details that you can remember about the event and the people involved; including as much detail as you can about the sequence of events and the offenders. Please do not leave any details out, but do not guess about details that you cannot remember. Feel free to use full sentences or bullet points, but make sure that your report is as accurate as possible” (see, e.g., Gabbert, Hope &

Fisher, 2009).

Cued recall test. After the free recall test, participants received a cued recall test which comprised five open-ended questions. These five questions concerned the five pieces of misinformation that were supplied in the audio narrative. For instance, one of the victims in the video was wearing a black coat. However, the audio narrative stated that the coat was green. The cued recall test item corresponding for this detail asked the participants what was the color of the coat that victim was wearing (see Appendix C).

Truth rating test. This study used the truth rating test to assess participants' implicit memory of the misinformation (Begg et al., 1992). This test contained four types of statements: 1) true descriptions about the original event, 2) repeated misinformation, 3) true statements that described the details about which misinformation was supplied, and 4) new false descriptions about the event (see Appendix D for the test items). All participants received the same set of test items and they were instructed to rate the probable truth of each statement on a six-point scale (1 = *certainly false*; 6 = *certainly true*). Unlike the seven-point response scale employed in the study of Begg et al. (1992), the current study used a six-point scale which excluded the neutral point so as to force participants to evaluate the probable truth of each statement (Brown & Nix, 1996).

Manipulation check. Participants in the DA condition completed an extra question asking them whether they remembered hearing anything from the unattended ear during the

audio task. This question served as a manipulation check to ensure that the tone-counting task was an effective distraction.

Procedure

The procedure of this experiment followed the three-stage misinformation paradigm employed as in previous eyewitness memory literature. Participants were tested individually to prevent any unwanted co-witness discussion after viewing the short film. Upon arrival to the laboratory, participants were given a consent form to sign. After consenting to participate, they were randomly allocated to one of the experimental conditions (i.e. control, FA or DA condition). They were then instructed to sit in front of a laptop computer.

In the first phase of the experiment, all participants were informed that they were going to watch a short film depicting a robbery and they were instructed to pay careful attention. The participants were then asked to put on headphones which connected to the laptop computer. The experimenter then started the video; the video was played only once for each participant. When the short film ended, the experimenter asked the participant to complete the Affective Style Questionnaire.

After participants completed this questionnaire, the experimenter explained the next phase of the experiment. Participants in the control group were asked to complete a tone-counting task; specifically, a series of high- and low-pitched tones were played and the participants had to count the number of high-pitched tones. To ensure that participants knew

the difference between the tones, the experimenter administered two practice trials (each contained five tones) and had the participants state the number of high tones after each trial. For the FA condition, the experimenter informed the participants that they were going to listen to an audio narrative recapping the event they saw in the short film; however, the participants did not know that the narrative contained misinformation. For the DA group, the experimenter told the participants that the upcoming phase was a dichotic listening task which would assess their attentional control. Participants in this group were instructed to attend to one ear. In that ear, the participants were presented with a series of tones. To motivate them to attend to the tones, scratch paper was provided for them to mark down the high tones they heard. At the same time, the audio narrative was presented to the unattended ear. Before the dichotic listening task began, the experimenter administered the same practice trials used for the control group. After the task was clearly explained to the participants, they commenced listening to the audio narrative and the tones.

After this audio stimulus phase, all participants performed a distractor task that required them to read an unrelated news article and write a basic summary about it. Upon completion of the distractor task, all participants proceeded to take the memory tests in the order of free recall, cued recall and truth rating tests. The memory test with the least information about the short film was administered first. After completing all the memory tests, participants in the DA condition completed the manipulation check.

At the end of the experiment, each participant completed a demographics form and fully debriefed. Before the participants left, they were instructed to not discuss the experimental details with other students.

Coding

Two researchers derived 44 details of the crime scene from the 42-second video clip. These details were used as the reference to score participants' responses to the free-recall test (See Appendix E). Two independent coders reviewed and scored all the participants' written responses. A correct item was defined as a description that matched any of the 44 derived details. A misinformed item was defined as a description that matched any of the five pieces of misinformation supplied as PEI during the audio narrative. An intrusion error was defined as false description that came from participants themselves instead of the audio narrative. To assess inter-coder reliability, Pearson correlations were computed with the percentage of total correct items and the percentage of total misleading items recalled as the dependent variables. The results indicated a high degree of agreement among the two raters ($r = .842$ for percentage of total correct items recalled and $r = .939$ for percentage of total misleading items recalled).

Results

First, the results from the manipulation check will be provided. Second, the effect of PEI on explicit eyewitness memory will be examined by comparing the free recall and cued recall

performances between the three experimental conditions. Finally, implicit eyewitness memory was examined by analyzing the truth ratings for each type of statements in the three groups.

Manipulation Check

Participants in the DA group were asked to write down anything they could recollect hearing with the unattended ear during the earlier tone-counting task. Six participants (30%) did not remember anything; 8 participants (40%) replied that they heard a voice describing the event they viewed earlier; 4 participants (20%) recollected some specific words or phrases that they heard; 2 participants (10%) answered that they heard a general description about the event and could also recollect some specific words. None of the participants recalled any misinformation supplied in the audio narrative.

Free Recall

A one-way analysis of variance (ANOVA) was conducted to examine the impact of attention on the accuracy of eyewitness memory. Experimental condition (control group vs. FA group vs. DA group) was set as the independent variable while percentages of total correct items and total misinformation recalled were the dependent variables.

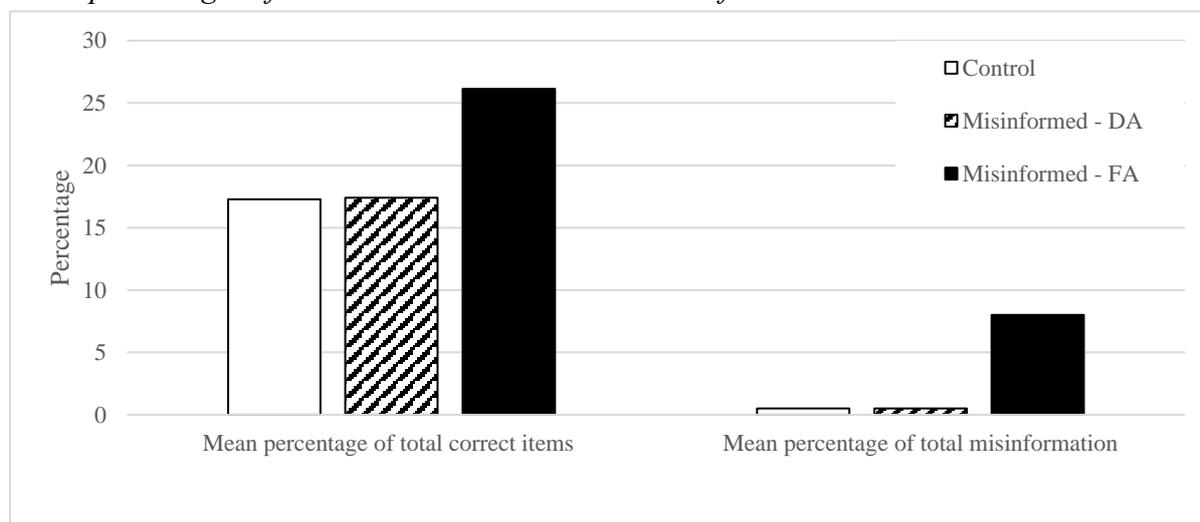
The results revealed a main effect for condition $F(2, 57) = 10.58, p < .001, \eta^2 = .27$. Post hoc comparisons using Bonferroni corrected t -tests indicated that FA group ($M = 26.14\%$, $SD = 6.48\%$) recalled significantly more correct information than the control group ($M =$

17.27%, $SD = 8.14\%$) and the DA group ($M = 17.39\%$, $SD = 6.19\%$). There was no significant difference between the control and DA group.

A Brown-Forsythe test was conducted to compare the percentages of total misinformation recalled between the three conditions because the assumption of homogeneity of variance was violated for this variable. A main effect for condition was found, $F(2, 20.42) = 4.03$, $p = .034$, $\eta^2 = .12$. FA group ($M = 8.00\%$, $SD = 16.42$) recalled more misinformation than the control group ($M = .50\%$, $SD = 2.24$) and the DA group ($M = .50\%$, $SD = 2.24$). The average percentages of total correct items and total misleading items recalled by the three groups are shown in Figure 1.

Figure 1

Mean percentages of total correct items and total misinformation recalled



Cued Recall

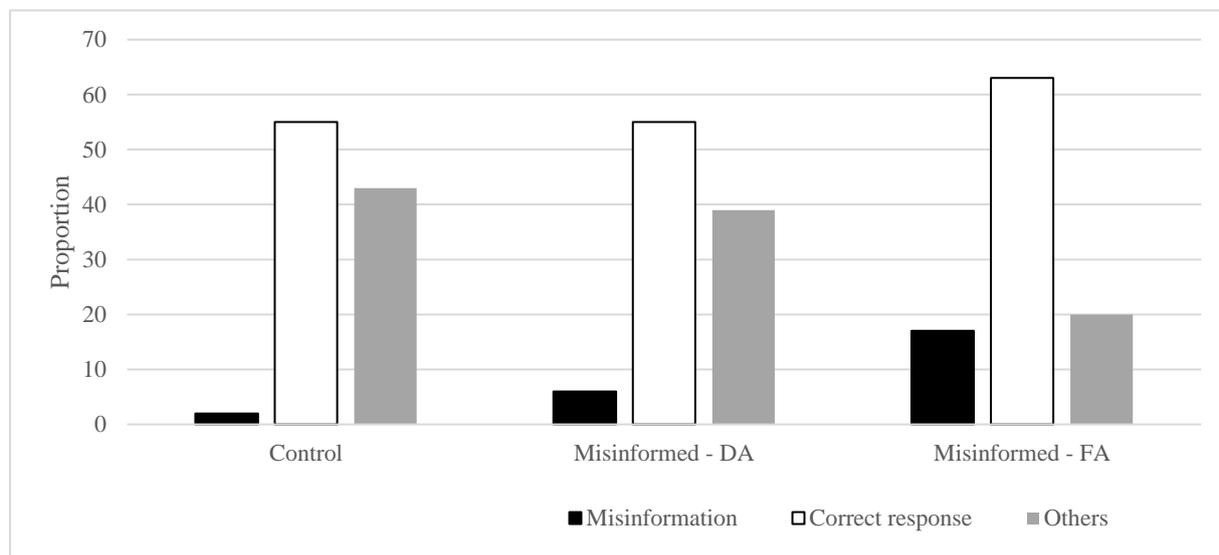
Cued recall responses were coded into one of the following three categories: 1) correct response, 2) misinformation, or 3) other recall errors. Proportion of misinformation recalled to the total number of items in cued recall test was computed for each participant. A one-way

ANOVA was conducted to examine the impact of attention on the proportion of recalled misinformation. A significant difference was found in the proportion of misinformation recalled between the three groups, $F(2, 34.50) = 8.37, p = .001, \eta^2 = .23$. Tamhane's T2 post hoc test revealed that participants in the FA group ($M = 17.00\%, SD = 17.50\%$) recalled significantly more misinformation than the control group ($M = 2.00\%, SD = 6.16\%$).

However, the proportion of misinformation recalled in the DA group ($M = 6.00\%, SD = 9.40$) was not significantly different from the FA group and the control group. The average proportion of each type of response in the three experimental conditions are shown in Figure 2.

Figure 2

Mean proportions (%) of different types of responses in the cued recall test



Truth Rating

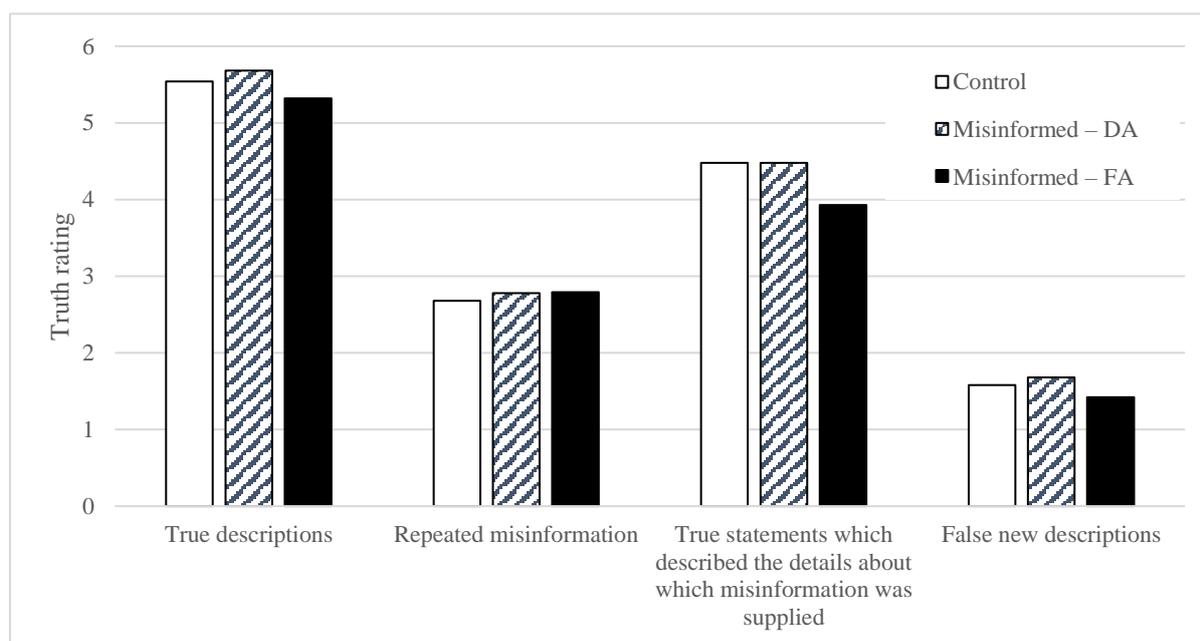
A 3 (experimental conditions) \times 4 (types of statements) mixed-design ANOVA with repeated measures was conducted to analyze results from the truth rating test. The dependent

variable was the average truth rating for each type of statements in each experimental condition.

There was a significant main effect for types of statements on average truth ratings, $F(3, 168) = 232.47, p < .001$, partial $\eta^2 = .81$. True descriptions were rated as the most credible, followed by true statements that described the details about which misinformation was supplied, then the repeated misinformation, and the false new descriptions were rated as the least credible. There were no other main or interaction effects.

Figure 3

Truth ratings of the four types of statements



Discussion

The goal of this study was to examine whether PEI presented under divided attention would lead eyewitnesses to perceive the misinformation as more truthful. Since misinformation effect is due to the failure of source monitoring, it was inferred that obtaining

PEI under divided attention would lead to erroneous eyewitness memory because source-specifying information was lacking (Mitchell & Johnson, 2000). However, the effect of implicit learning of misinformation might not necessarily manifest in explicit memory test (e.g., Jacoby & Dallas, 1981). To examine whether implicit form of PEI would influence explicit and implicit eyewitness memory, a third experimental condition, i.e., misinformed under divided attention, was added to the existing misinformation paradigm. The truth rating test was also added to assess participants' implicit eyewitness memory.

The results of the free recall test indicated that participants who were misinformed under full attention recalled significantly more false information than those who were not misinformed or those who were misinformed under divided attention. This finding is in line with previous eyewitness literature (e.g., Loftus et al., 1978; Lindsay & Johnson, 1989; Zaragoza & Lane, 1994). It also supports our first hypothesis that only participants who acquired PEI with full attention would exhibit the traditional misinformation effect. However, participants in the full attention group also recollected significantly more correct information than the other two groups. It is possible that participants in this condition experienced a practice effect by listening to the audio narrative, which recapped the crime event that they viewed earlier. Although the audio narrative contained five false details, the rest of its content might have reinforced participants' memory for the witnessed event. As a result, the audio narrative induced both the misinformation effect and practice effect

In the cued recall test, the proportion of misinformation recalled was compared across the three experimental conditions. As predicted, participants who received PEI under full attention recalled the highest proportion of misinformation in the cued recall test. Participants in the divided attention condition did not differ significantly from the other two conditions in the proportion of misinformation recalled. It is because participants who were misinformed under divided attention recalled less PEI than their counterparts in the full attention condition yet more PEI than the control group. This suggested the possibility that misleading PEI acquired unconsciously could mildly alter participants' explicit memory for the witnessed event.

Based on the results from the truth rating test, it was found that misleading PEI, regardless of whether it was supplied explicitly or implicitly, did not lead the participants to rate the misinformation as more credible than the control group. Another unexpected finding was that all three groups exhibited the same pattern of truth ratings across the four types of statements (i.e., *correct descriptions* > *true statements which described the details about which misinformation was supplied* > *repeated misinformation* > *false new descriptions*). Participants in the control condition were expected to rate the repeated misinformation and false new descriptions similarly because they were never exposed to the misinformation. A possible explanation is that, compared to the true statements and the false new statements, the details selected for creating the misinformation were too subtle and minor. For instance, some

of the misinformation concerned the colors of the people's apparels, whereas some of the true and false new statements focused on details that were relatively more noticeable, such as the robbers' actions and weapons. As a result, participants from the control condition rated the probable truth of the repeated misinformation towards the middle of the scale because they were unsure about its truthfulness. Alternatively, the control participants were more certain about the truthfulness of the true statements and the false new statements because the details these statements concerned were more noticeable in the video. Since the statements used in this implicit memory test concerned details that were possibly unequal in terms of their memorability, this may have been the reason for the unexpected pattern in truth ratings found in the control group. The misinformed under full attention and misinformed under divided attention groups also exhibited this pattern of *correct descriptions > true statements which described the details about which misinformation was supplied > repeated misinformation > false new descriptions* in their truth ratings. This could be explained by the fact that these participants were exposed to the misinformation after viewing the crime event, which led them to rate the repeated misinformation as more truthful than the false new statements. However, the potential confound found in the control condition might also be the reason for such pattern in these two misinformed groups.

Taken together, findings from this study supported the first hypothesis that participants who were misinformed under full attention would include more false information in their free

recall responses. However, the second hypothesis that both misinformed groups would rate repeated misinformation as truer than the control group did was not supported. The third hypothesis, which predicted a unique pattern of truth ratings in both misinformed groups (*true statements* > *repeated misinformation* > *false new statement*), was not supported either because this pattern was found in all three groups.

Limitation and Future Research

A major limitation of this study lies in the truth rating test. The details chosen from the video for creating misinformation and the details used to compose the true as well as the false new statements may not be equally memorable. The discrepancy between the noticeability of details that different types of statements concerned might therefore become a confounding factor which influenced how participants rate the probable truth of the statements. Future research which employs this implicit memory test should therefore assess the memorability of each detail in the witnessed event and construct the test with items of similar memorability.

In addition, the items in the truth rating test were identical for all participants. The problem with this design is that, it is unclear whether the misinformation in the statements of repeated misinformation will lead to similar result if it is used to compose true statements that described details about which misinformation was supplied, and vice versa. Counterbalancing the misinformation, that is, using each piece of misinformation to compose both types of statements and administering either one of the two sets of items to each participant, would

provide a more accurate picture of how participants perceived the probable truth of the misinformation.

Another major limitation of this study is that the audio narrative, which contained misinformation induced a practice effect in participants who were misinformed under full attention. As a result, participants in this condition recalled significantly more correct items than the other two conditions. This issue could be solved by having participants who are not misinformed (i.e., the control group) listen to the audio narrative with the misinformation replaced by correct descriptions after viewing the event.

In terms of the ecological validity of this study, the retention interval that participants experienced was too short compared to the real-life eyewitness setting. Previous eyewitness memory research (e.g., Flin, Boon, Knox & Bull, 1992) found that witnesses, on average, experience a retention interval of five months. Although it might be challenging to expand the retention interval to several months in the context of an experiment, examining participants' eyewitness memory after a significant length of time, such as two weeks, could provide insights into the impact of implicit form of PEI in long term.

The influence of implicit learning of PEI should also be examined within the context of eyewitness identification with a simultaneous lineup. Implicit learning may play a greater role under such a condition since it involves a judging process than a recollecting process. Instead of generating a description of the crime event on their own, witnesses have to engage

in a process called *relative judgement* in which they compare the people in a simultaneous lineup and select the one who looks the most like the perpetrator (Wells et al., 1998). In addition, face identification involves perceptual information processing (Read, 1995). These characteristics of eyewitness identification might therefore make it more susceptible to implicit forms of post-event information. Such research would provide a better understanding of when misinformation may shape the way eyewitnesses recall crime scenes and under which conditions they would be influenced more easily.

Conclusion

The present study examined the influence of implicit, misleading post-event information by adding a new experimental condition in which participants received misinformation under divided attention. While future research is needed to examine the influence of misinformation on implicit memory, the present results suggested that it is possible for implicit forms of post-event information to influence explicit eyewitness memory. Such research will offer greater insights into when eyewitnesses may incorporate false information into their testimony and help inform the criminal justice system of when an eyewitness account of a crime has been influenced by post-event (mis)information.

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Appendix A

Detailed Description of the Video

Two armed robbers (an African American in blue hoodie and a Hispanic man in maroon hoodie) went into a café and robbed the customers. There were a total of five customers (three men and two women) in the café. The Hispanic man asked the customers to put their valuables in a white tote bag with red strips that he was holding. The two men then ran away with the African American following the Hispanic man. However, one of the customers (a girl in black coat) took out her gun and grabbed the hood of the African American. He pushed her off and managed to escape.

Appendix B

Audio Narrative of the Event and Misleading Information

The video depicted a café. There was a fire safety poster on the wall right next to the entrance. A black man who was armed with a pistol entered the café. He was wearing a blue sweatshirt and a baseball cap. He pointed his gun to people after he walked into the café. Three customers were forced to the corner next to the entrance by another robber, who was a Latino man wearing glasses and a maroon sweatshirt. He was holding a pistol on his right hand and a blue tote bag on the other hand. The Latino man pointed his gun to the customers at the corner and forced them to put their valuables into the bag. The two robbers then ran out of the café, with the black man following the Latino man. One of the customers, who was a woman wearing a green coat, took out her gun and grabbed the black man's sweatshirt. The robber turned around and pushed her away, then he left the café.

<u>Details in the video</u>	<u>Corresponding misleading information</u>
Both robbers wore the sweatshirt hoods over their heads.	The African American robber was wearing a baseball cap.
There was a poster about first aid for choking on the wall.	There was a fire safety poster on the wall.
The Latino American was holding a white tote bag.	The Latino American was holding a blue tote bag.
The customer who grabbed the African American robber's sweatshirt was a girl with black coat.	The customer who grabbed the African American robber's sweatshirt was a girl with green coat.
There were five customers in the scene.	There were three customers in the scene.

Appendix C

Questionnaire for Cued Recall

1. Was there anything on the wall next to the café entrance?
2. What were the two robbers wearing and holding at the time of the robbery?

Black man:

Latino man:

3. How many customers were in the café at the time of the robbery?
4. At the end of the video, a woman grabbed one of the robbers and tried to stop him. What was the color of her coat?

Appendix D

Questionnaire for Truth Rating

According to your memory of the crime event, please rate the probable truth of each of the following statements on a six-point scale (*certainly false*: 1, *probably false*: 2, *possibly false*: 3, *possibly true*: 4, *probably true*: 5 and *certainly true*: 6).

1. Two robbers who were armed with pistols robbed the customers in a café.	1	2	3	4	5	6
2. There were totally three customers in the café.	1	2	3	4	5	6
3. There was a child in the café at the time of the robbery.	1	2	3	4	5	6
4. The customers were told to put their valuables in the tote bag that one of the robbers was holding.	1	2	3	4	5	6
5. The Latino's gun went off during the robbery.	1	2	3	4	5	6
6. The tote bag that the Latino was holding was white.	1	2	3	4	5	6
7. The African American robber was wearing a baseball cap.	1	2	3	4	5	6
8. The woman who tried to stop the African American man at the end was wearing a black coat.	1	2	3	4	5	6
9. There was a poster about first aid for choking on the wall next to the café entrance.	1	2	3	4	5	6
10. The cashiers of the café ran after the two robbers after the robbery.	1	2	3	4	5	6

Remarks:

Items 1 and 4 are true descriptions about the video.

Items 2 and 7 are repeated misinformation from the audio narrative.

Items 6, 8 and 9 are the correct version of the misinformation provided in the audio narrative.

Items 3, 5 and 10 are false new descriptions about the video.

Appendix E

Coding for Free Recall Responses

- The wall is blue
- There are posters on the wall
- There is a “Choking” poster on the wall
- There is a “No smoking” poster on the wall
- There is a poster about “food allergies” on the wall
- A robber, who was black,
- came in through the entrance door
- The first robber was wearing a blue sweatshirt
- with a white logo on it
- The first robber had the hood on his head
- The first robber was wearing light blue jeans
- The first robber had a gun
- in his right hand
- The first robber was holding something black
- in his left hand
- The robbers were cussing
- and yelling
- A second robber came from the right side
- The second robber was Latino
- The second robber had a white tote bag with red strip
- in his left hand
- The second robber had a gun
- in his right hand
- The customers included three men
- and two women
- The second robber told the customers to put their stuff in the bag
- The second robber had a watch on his left wrist
- The second robber had glasses
- The second robber had a maroon sweatshirt
- that said “Macquarie University”
- in white
- The second robber had the hood on his head
- The two robbers ran away,
- black man followed Latino
- A woman with a hair bun
- stopped the black man
- The woman that stopped the robber had a gun
- The woman that stopped the robber had glasses
- and was wearing a black coat
- The woman yelled “Stop!”
- The woman pulled back the hoodie on the blue sweatshirt the robber was wearing
- The robber pushed the woman
- The robber (the one in blue sweatshirt) escaped