

Loftus & Palmer 1974 Reconstructive Memory Study Replication

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Abstract

This study replicated Loftus and Palmer's (1974) classic experiment on reconstructive memory and misinformation effect, examining whether the verb used in a question, "smashed" vs "hit", affects speed estimates and false memory for broken glass. Sixty high school students from Hangzhou Basis International School, aged 16-18, with 35 being males and 25 being females, watched a short YouTube video of a car accident and were randomly assigned to answer a question about the car's speed in the accident containing either "smashed" or "hit." Immediately afterward, they gave their estimation for the car's speed in km/h. One week later, they were asked whether they had seen broken glass, which is not present in the actual video. Results showed that participants in the "smashed" condition gave statistically significantly higher speed estimates, with a mean of 87.93 km/h, than those in the "hit" condition, with a mean of 54.16 km/h, as $t = 3.82$ and $p < 0.05$ in the t-test. Additionally, participants who were asked with "smashed" were significantly more likely to falsely report seeing broken glass, 69.0% in "smashed" group, compared to those asked with "hit", 32.3% in "hit" group, as $\chi^2(1) = 8.08$ and $p < 0.05$ in the chi-square test. These findings support hypotheses and the fact that memory can be reconstructed. It demonstrates that subtle wording changes can distort eyewitness memory for both numerical estimates and details. The experiment applies to real-world settings, reminding people that neutral, non-leading questioning in legal settings, especially in eyewitness testimony is essential.

Keywords

Reconstructive memory; Misinformation effect; Eyewitness testimony; False memory; Wording effect

1. Introduction

1.1. Definition and Background

Eyewitness testimony, the account an individual gives to law enforcement is vital in the legal system. In the modern world, many legal cases are judged based on these testimonies. Is eyewitness testimony truly reliable? Psychological research indicates

that memory is not a passive recording process, but an active and imaginary reconstruction process (Loftus, 1975)[2]. In 1932, Bartlett proposed the Reconstructive Memory and Schema Theory. He demonstrated that the memory process integrates new information with people's original schemas, defined as existing mental frameworks, thereby, they unconsciously distort their recollections to their own expectations (Bartlett, 1932)[1]. The reconstructive nature of memory, meaning that memory is not fixed but malleable, makes the eyewitness testimony vulnerable to the influence of post-event information, thereby undermining accuracy.

The classic study conducted by Elizabeth F. Loftus and John C Palmer in 1974 proved this phenomenon. They conducted two experiments. In the first experiment, 45 students are asked to estimate the speed of cars after viewing seven traffic accident films. The question is "About how fast were the cars going when they ... into each other?" The data indicates that compared to verbs like "collide", "hit", "contacted", or "hit", subjects give higher estimation of speed in the question that uses the verb "smashed". The way of phrasing, like using more intense verbs, could systematically alter the memory of the participants and lead to different speed judgement. After one week, Loftus and Palmer conducted the second experiment by asking "Did you see any broken glass?". Participants who received the verb "smashed" were more likely to falsely report seeing broken glass in the video, even though there was no glass in the film. The verb "smashed" activates the schema of a serious accident, causing participants to reconstruct their memories and include details consistent with the schema, such as a higher speed and broken glass (Loftus & Palmer, 1974)[3].

Further evidence for reconstructive memory comes from Loftus's (1999)[4] "lost in the mall" study. In the experiment, participants were given a fake narrative about themselves getting lost in a mall as a child. Results suggested that approximately 25% of participants "remembered" the false event happening in the past (Loftus, 1999)[4]. Some even added additional fake details to the anecdote. This powerfully demonstrates that information present after an event can create entirely new false memories, not just changing memory.

Even subtle changes in wording can introduce completely new and fake information into memory, leading to reconstruction of episodic memory, which is the memory of a particular event. The information merges seamlessly with the original event, and when participants retrieve their memories after the event, they are convinced that the false information was also part of the initial experience. These studies all together establish that memory is highly malleable and vulnerable to suggestion, showing that eyewitness testimony is not entirely reliable.

The present study aims to replicate the experiment conducted by Loftus and Palmer (1974), which is about how the verbs used in the speed estimation affect participants' estimations of the car speed and their memories of "broken glass", to

investigate whether the way a question is phrased will have an impact on the memory of individuals. This study is based on the misinformation effect, which is defined as a psychological phenomenon where an individual's memory of an event is distorted by misleading post-event information.

1.2. Hypothesis

Based on reconstructive memory theory and the findings of Loftus and Palmer (1974), the following hypotheses were tested. The first hypothesis predicted that participants who receive the question "how fast were the cars going when they smashed into each other?" will provide higher speed estimates than those participants who are asked "how fast were the cars going when they hit into each other?" The second hypothesis predicted that participants who receive the question "how fast were the cars going when they smashed into each other?" are more likely to report seeing broken glass in the accident than those who are asked "how fast were the cars going when they hit into each other?" The corresponding null hypotheses stated that there would be no significant difference in speed estimates between the two conditions, and no association between verb condition and reported memory of broken glass.

2. Research Methods

2.1. Design and Participants

Sixty Chinese students from Hangzhou Basis International School participated in this experiment. The sample, with ages ranging from 16 to 18 years old, includes 35 males and 25 females. The participants were randomly assigned to two different questions after watching two identical YouTube video clips of simulated traffic accidents. 31 participants (21 males and 10 females) were asked "how fast were the cars going when they hit into each other?", while 29 participants (14 males and 15 females) were asked "how fast were the cars going when they smashed into each other?"

Ethical guidelines were strictly followed in the experiment. All the participants signed informed consent, in which they were informed that they would take part in a study about memory, before the experiment. Anonymity and confidentiality were maintained as their names were not recorded. Participants were allowed to withdraw from the experiment at any time as it is voluntary. The study didn't create harm on participants. After the completion of the study, a debriefing was conducted if requested with a video providing detailed explanation of the study, including the concept of misinformation effect and memory reconstruction.

2.2. Materials and Procedures

The materials used in the experiment include two videos showing identical traffic accidents with two different questions, data recording sheets, and informed consent

form (See appendix). Each participant was tested individually and completely unaware of the purpose of the study. After signing the informed consent form, six experimenters randomly assigned them to the "smashed" group and "hit" group. They would watch a short video about traffic accidents and then answer a question. In Experiment 1, each experimenter asked 5 participants from the "smashed" group the question- "how fast were the cars going when they smashed into each other?" and 5 participants from the "hit" group the question- "how fast were the cars going when they hit into each other?". The estimated speeds of the participants were recorded in data recording sheets. In Experiment 2, the question, "Did you see broken glass in the video?", was asked to the participants after one whole week. Their "yes/no" responses to the "broken glass" question were recorded. After the experiment, the participants were given an explanation video if they were interested in seeing the true purpose of the study (See appendix).

In this study, which includes two experiments, the independent variable was operationally defined as the verb used in the critical question --"how fast were the cars going when they HIT/SMASHED into each other?", namely "hit" or "smashed". The dependent variable in Experiment 1 was operationally defined as the speed estimate in kilometers per hour that participants gave. The dependent variable in Experiment 2 was operationally defined as the binary "yes/no" response to the question "Did you see broken glass in the video?" Potential confounding variables included participants' prior experience with car accidents, the experimenter's verbal tone, the participant's mood that day, language barriers, and the time of day when participants were tested. These confounding variables were controlled by random assignment, standardized question, Chinese definition of "hit" or "smashed" if needed, and the same experiment time after recess for all groups.

3. Results

3.1. Experiment 1 statistics analysis

3.1.1. Descriptive Statistics

In Experiment 1, there were 60 participants in total that gave a speed estimate. The "hit" condition included 31 participants, with estimates ranging from 10 km/h to 120 km/h, mean equaling to 54.16 km/h and a standard deviation of 26.36 km/h. The "smashed" condition included 29 participants, with estimates ranging from 25 km/h to 200 km/h, mean equaling to 87.93 km/h and a standard deviation of 40.28 km/h (See Table 1). A mean comparison bar graph was produced below, showing that the participants who were asked with "smashed" produced a significantly higher average speed estimate than those who were asked with "hit" (See Figure 1). A histogram showing the frequency of speed estimations for each group illustrated that the "smashed" group's normal curve is more spread-out and shifted to the higher end compared to the "hit" group's normal distribution curve (See Figure 2). Finally, a Beeswarm plot of all individual responses was created, highlighting a

significant mean difference and some extreme outliers in the “smashed” group (See Figure 3).

Table 1. Speed Estimate

	Verb	Frequency	Mean	Standard Deviation	Minimum	Maximum
Speed	Hit	31	54.16	26.36	10	120
km/h	Smashed	29	87.93	40.28	25	200

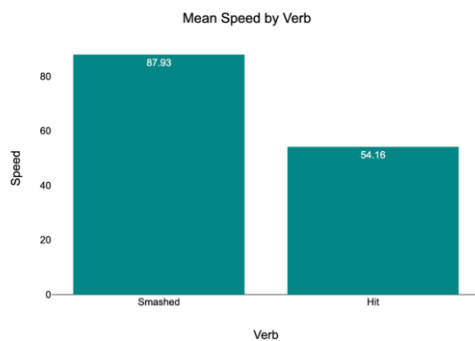


Figure 1. Mean Speed by Verb

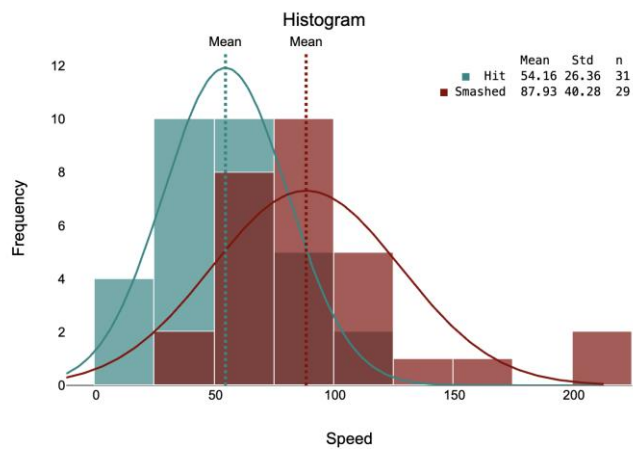


Figure 2. Histogram

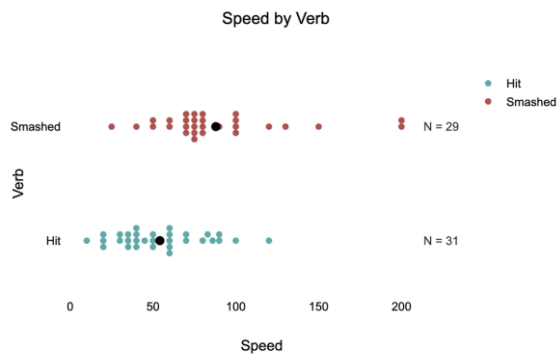


Figure 3. Speed by Verb

3.1.2. Inferential Statistics (t-test)

An independent-samples t-test (Welch's correction for unequal variances) compared speed estimates between the "smashed" and "hit" conditions. It reveals that participants in the "smashed" condition gave significantly higher estimations of speed than those in the "hit" condition. The mean difference was 33.77 km/h, the t-value is 3.82, and the p-value is 0.00039, which is less than 0.05 (See Table 2). Therefore, the difference in speed estimation is not due to chance.

Table 2. Welch's correction for unequal variances

Statistic	Value
Mean difference	33.77
t (Welch's)	3.82
p-value (two-tailed)	0.000391018 (<0.05)

3.2. Experiment 2 statistics analysis

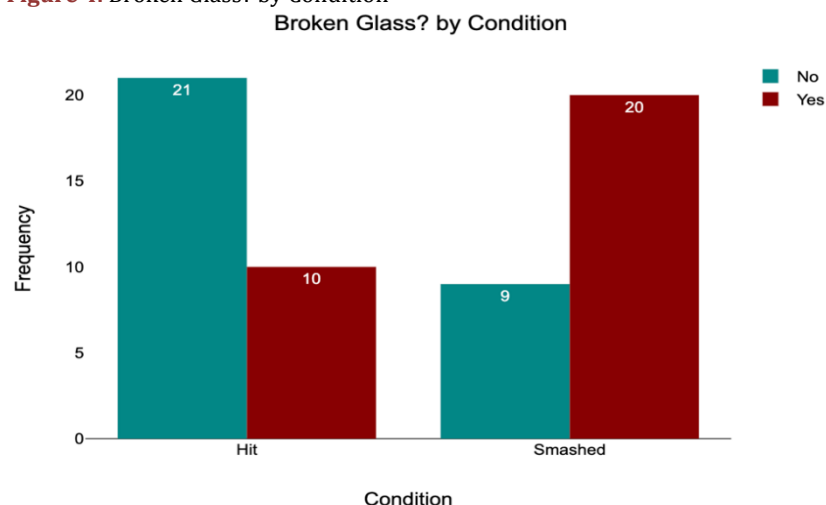
3.2.1. Descriptive Statistics

In Experiment 2, participants were asked one week later whether they saw broken glass in the video. The real answer is no. There are 30 "yes" and 30 "no" responses in total. Among the 31 participants in the "hit" condition, 10 (32.3%) participants reported "yes", while 21 (67.7%) participants reported "no". Out of the 29 participants in the "smashed" condition, 20 (69%) participants reported "yes", while 9 (31%) participants reported "no" (See Table 3). The frequency table clearly illustrates the difference (See Figure 4).

Table 3. Broken Glass

Broken Glass?	Condition		Total
	Hit	Smashed	
Yes	10 (32.3%)	20 (69%)	30
No	21 (67.7%)	9 (31%)	30
Total	31	29	60

Figure 4. Broken Glass? by Condition



3.2.2. Inferential Statistics (chi-square)

A chi-square test of independence was conducted in experiment 2 to show the relationship between verb condition and participants' false memory of broken glass. Analysis shows that there is a statistically significant association, as chi-square value for one degree of freedom is 8.08, p-value equals 0.0045, which is less than 0.05 (See Table 4). This means that participants who are asked with "smashed" were significantly more likely to report seeing broken glass (20 out of 29, 69.0%) than those who are asked with "hit" (10 out of 31, 32.3%). In fact, there is no broken glass in the actual video displayed.

Table 4. A chi-square test

Statistic	Result
χ^2	8.08
Degree of freedom	1
p-value	0.0045 (<0.05)

4. Discussion

The present study successfully replicated Loftus and Palmer's (1974) classic experiment on reconstructive memory. The first hypothesis that participants who were asked with the verb "smashed" would give higher speed estimates of the cars than those who were asked with "hit," was supported. The mean difference of 33.77 km/h was statistically significant, as the t-value is 3.82, and the p-value is less than 0.05. The finding supports the original Loftus and Palmer experiment as a subtle change in questioning wording affects the eyewitness memory (Loftus & Palmer, 1974).

The second hypothesis that participants in the "smashed" condition would be more likely to report seeing broken glass one week after watching the video was also supported. 32.3% of participants in "hit" condition falsely reported witnessing broken glass, while 69.0% of participants in "smashed" condition falsely reported witnessing broken glass. The chi-square test of independence showed that there is a statistically significant association between verb condition and false memory of broken glass, as $\chi^2(1)$ equals to 8.08 and p-value is 0.0045, which is less than 0.05. This result matches the original Loftus and Palmer (1974) experiment 2. It demonstrated that the post-event information, which can be as simple as verb usage can also create false details, showing misinformation effect and the reconstructive nature of memory (Loftus & Palmer, 1974).

Even though the present study aligned with Loftus and Palmer's original study, several limitations must be acknowledged. First, the sample consisted of high school students aged 16-18 from one single school. Their lack of driving experience can also interfere their estimation of car speed. This sample demography limits external validity, as the findings cannot be fully generalized to all age groups, all cultures, and all real-world eyewitnesses. Moreover, showing a short YouTube clip was only a simulation. Rather than truly witnessing a real-world car crash, watching a video

stimulus reduced the level of emotional engagement, so it might affect memory reconstruction. Finally, demand characteristics and Hawthorne effect played a role as well. After answering the first question regarding speed, some participants might have guessed the study's purpose and adjusted their response one week after for the broken glass question. The presence of experimenters would potentially alter their speed estimation.

5. Conclusion and Future Outlook

In conclusion, this study successfully replicated Loftus and Palmer's (1974) findings. The use of the verb "smashed" in questioning led to statistically significant higher speed estimates and a higher likelihood of reporting false broken glass memory compared to the verb "hit." These results showcase the reconstructive memory theory and misinformation effect, ultimately highlighting the vulnerability of eyewitness testimony to minute changes in wording. Therefore, legal practices need to be careful so to prevent misjudgement and consequences.

Despite these limitations, the study has important real-world implications. Eyewitness testimony is often treated as definitive evidence in legal settings. The present study suggested that even a single word change, "hit" to "smashed" can significantly change witness's memory of both speed and broken glass. This finding is crucial as lawyers and police must be trained to use the most neutral question during witness investigation. The present study also supports the broader psychology principle that memory is not a perfect camera recording but a reconstructive process that can be changed based on post-event information.

Future research should address the above limitations by using large, more diversified, and more representative samples. Experimenters should ideally employ people from all ages, all cultures, and all social backgrounds. Furthermore, researchers could test other verbs such as "collided" or "bumped" to further verify the gradient of intensity suggested by Loftus and Palmer (Loftus & Palmer, 1974). Finally, experimenter should use a more realistic and longer clip of real accident footage to enhance ecological validity.

Appendix

A. Part 1 Raw Data

Participant No.	Gender	Condition ("hit" / "smashed")	Estimated Speed (km/h)
1	Female	Smashed	80
2	Male	Hit	83
3	Female	Smashed	70
4	Male	Hit	60
5	Female	Smashed	100
6	Female	Smashed	70
7	Male	Hit	90
8	Female	Hit	120
9	Female	Smashed	130
10	Male	Hit	80
11	Male	Hit	60
12	Male	Smashed	70
13	Male	Smashed	80

14	Male	Hit	70
15	Male	Smashed	75
16	Male	Hit	60
17	Male	Smashed	100
18	Male	Hit	45
19	Male	Hit	40
20	Male	Smashed	200
21	Female	Hit	50
22	Male	Hit	40
23	Female	Hit	35
24	Male	Hit	60
25	Male	Hit	20
26	Female	Smashed	75
27	Male	Smashed	90
28	Male	Smashed	150
29	Female	Smashed	75
30	Female	Smashed	120
31	Male	Hit	30
32	Male	Hit	30
33	Male	Hit	40
34	Male	Hit	50
35	Male	Hit	70
36	Male	Smashed	50
37	Male	Smashed	60
38	Male	Smashed	80
39	Male	Smashed	100
40	Male	Smashed	100
41	Male	Smashed	80
42	Male	Hit	40
43	Male	Hit	20
44	Male	Hit	35
45	Male	Smashed	75
46	Female	Smashed	75
47	Female	Hit	50
48	Female	Hit	20
49	Female	Smashed	60
50	Male	Hit	35
51	Female	Hit	10
52	Female	Smashed	200
53	Female	Hit	100
54	Female	Smashed	25
55	Female	Hit	90
56	Female	Smashed	70
57	Female	Hit	60
58	Female	Smashed	50
59	Female	Hit	86
60	Female	Smashed	40

B. Videos Shown

Hit Video: <https://www.youtube.com/watch?v=2pvChGovFbc>

Smash Video: <https://www.youtube.com/watch?v=IHEDIYbwRyw>

C. Part 2 Raw Data

Participant No.	Condition	Broken Glass?
1	Hit	No
2	Smashed	Yes
3	Hit	No
4	Smashed	Yes
5	Hit	Yes
6	Hit	No
7	Smashed	Yes

8	Smashed	Yes
9	Smashed	Yes
10	Hit	No
11	Hit	No
12	Hit	No
13	Smashed	No
14	Hit	No
15	Hit	No
16	Smashed	No
17	Hit	Yes
18	Smashed	Yes
19	Smashed	Yes
20	Smashed	Yes
21	Smashed	Yes
22	Smashed	Yes
23	Hit	Yes
24	Hit	Yes
25	Hit	Yes
26	Smashed	Yes
27	Smashed	Yes
28	Hit	No
29	Hit	No
30	Hit	No
31	Hit	No
32	Hit	No
33	Hit	Yes
34	Hit	Yes
35	Hit	No
36	Smashed	Yes
37	Smashed	Yes
38	Smashed	Yes
39	Smashed	No
40	Smashed	Yes
41	Hit	Yes
42	Hit	No
43	Smashed	Yes
44	Smashed	Yes
45	Smashed	No
46	Hit	No
47	Hit	No
48	Smashed	Yes
49	Hit	No
50	Hit	No
51	Hit	No
52	Smashed	No
53	Hit	No
54	Smashed	No
55	Hit	Yes
56	Smashed	No
57	Hit	Yes
58	Smashed	No
59	Hit	Yes
60	Smashed	No

D. Informed Consent Form

Study Title: Replication of Loftus & Palmer (1974): The Effect of Leading Questions on Eyewitness Memory

Experimenter(s): Bryten, Charles, Eric, Franklin, Jerry, Rose

In order to participate in this research study, it is necessary that you give your

informed consent. By signing this statement, you are indicating that you understand the nature of the research study and your role in that research and that you agree to participate in the research. Please consider the following points before signing:

- I understand that I am participating in psychological research.
- I understand that the purpose(s) of this research is to investigate how the wording of questions can influence a person's memory of an event, the expected duration of my participation will be approximately 2 minutes, I will engage in these tasks, watching a short video clip of a traffic accident and then answering a questionnaire about what I saw, and the experimenter(s) will employ the following experimental procedures, participants will be randomly assigned to one of several question conditions and will be asked a different question depending on the group.
- I understand that my identity will not be linked with my data, and that all information I provide will remain confidential.
- I understand that this study is associated with these risks: There are no known physical, psychological, social, or economic risks beyond those encountered in daily life. Some participants may experience mild boredom or slight frustration when answering questions. The video depicts a simulated car accident, which could cause momentary distress to individuals who have experienced a real traffic collision; if you feel uncomfortable, you may stop participating at any time.
- I understand that I may reasonably expect to receive the following benefits from participating in this study: There is no direct personal benefit from participating. However, this study will contribute to a better understanding of how memory can be influenced by subtle changes in questioning, which may have implications for legal and educational settings.
- I understand I will have to pay the following cost, none, or receive the following compensation: No monetary compensation will be provided. If you are a student in a psychology course, you may receive course credit or extra credit as determined by your instructor.
- I understand that my participation in this research project is voluntary, that my refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled, and that I may discontinue participation at any time without penalty or loss of benefits to which I am otherwise entitled.
- I understand that I will be provided with an explanation of the research in which I participated and be given the name and contact information of an individual to contact if I have questions about the research. In addition, I understand that I may contact relevant administration personnel, if I have questions concerning my rights as a participant in psychological research or to report a research-related injury.
- I understand that certain facts about the study might be withheld from me, and

the researchers might not, initially, tell me the true or full purpose of the study. However, the complete facts and true purpose of the study will be disclosed to me at the completion of the study session.

By signing this form, I am stating that I am 16 years of age or older, that I understand the above information, and that I consent to participate in this study being conducted at BASIS International School Hangzhou.

Signature:

Today's Date:

Print your Full Name:

(Consent form signed by all participants, physical copies are present.)

Debriefing Video If Needed

<http://www.youtube.com/watch?v=8hwEUaOeuFQ&feature=fvw>

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