Finally, several isolated oddities are worth mentioning. One male and one female subject described *T* as wearing spectacles, although he does not do so and never has. Both of them mentioned the spectacles in their spontaneous reports, and the female subject was willing to swear to their existence. In addition, one subject mentioned a nonexistent cap, and another a brown overcoat.

These points are enough to show how remarkably inaccurate and uncritical the memory of a person's appearance can be. Sometimes the errors of testimony cumulate into a complete confabulation. The description given by subject *K.* (see Table 9–1) is one example of this. For another, consider this description give by *X.*: "round black hat; dark or black shoes; reversed collar." In fact the hat was brown, the shoes red, and the collar completely concealed by the closed jacket.

Descriptions of individuals play an extremely important part in the testimony of witnesses. With respect to such testimony, the outcome of the present experiment leads to a clear conclusion. *Retrospective accounts of people's appearance, especially about hair color, beardedness, and color of clothing, should be given no credit whatsoever unless special attention was directed to these features during observation itself.*

# 10 Reconstruction of Automobile Destruction

*Elizabeth F. Loftus and John C. Palmer*

*Elizabeth Loftus is well known for her extensive work on witness memory. The study reprinted here demonstrates the prejudicial effect of leading questions, or—to put it another way—illustrates the human tendency to combine information from all available sources in reconstructing the past. The elegance of Loftus and Palmer's experiment contrasts sharply with the primitive methods available to Stern seventy years earlier (Selection 9); the difference reflects the methodological progress of psychology since 1904.*

How accurately do we remember the details of a complex event, like a traffic accident, that has happened in our presence? More specifically, how well do we do when asked to estimate some numerical quantity such as how long the accident took, how fast the cars were traveling, or how much time elapsed between the sounding of a horn and the moment of collision?

It is well documented that most people are markedly inaccurate in reporting such numerical details as time, speed, and distance (Bird,

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1927; Whipple, 1909). For example, most people have difficulty estimating the duration of an event, with some research indicating that the tendency is to overestimate the duration of events which are complex (Block, 1974; Marshall, 1969; Ornstein, 1969). The judgment of speed is especially difficult, and practically every automobile accident results in huge variations from one witness to another as to how fast a vehicle was actually traveling (Gardner, 1933). In one test administered to Air Force personnel who knew in advance that they would be questioned about the speed of a moving automobile, estimates ranged from 10 to 50 mph. The car they watched was actually going only 12 mph (Marshall, 1969, p. 23).

Given the inaccuracies in estimates of speed, it seems likely that there are variables which are potentially powerful in terms of influencing these estimates. The present research was conducted to investigate one such variable, namely, the phrasing of the question used to elicit the speed judgment. Some questions are clearly more suggestive than others. This fact of life has resulted in the legal concept of a leading question and in legal rules indicating when leading questions are allowed (*Supreme Court Reporter*, 1973). A leading question is simply one that, either by its form or content, suggests to the witness what answer is desired or leads him to the desired answer.

In the present study, subjects were shown films of traffic accidents and then they answered questions about the accident. The subjects were interrogated about the speed of the vehicles in one of several ways. For example, some subjects were asked, "About how fast were the cars going when they hit each other?" while others were asked, "About how fast were the cars going when they smashed into each other?" As Fillmore (1971) and Bransford and McCarrell (1974) have noted, *hit* and *smashed* may involve specification of differential rates of movement. Furthermore, the two verbs may also involve differential specification of the likely consequences of the events to which they are referring. The impact of the accident is apparently gentler for *hit* than for *smashed*.

## EXPERIMENT I

### Method

Forty-five students participated in groups of various sizes. Seven films were shown, each depicting a traffic accident. These films were segments from longer driver's education films borrowed from the Evergreen Safety Council and the Seattle Police Department. The length of the film segments ranged from 5 to 30 seconds. Following each film,



the subjects received a questionnaire asking them first to "give an account of the accident you have just seen," and then to answer a series of specific questions about the accident. The critical question was the one that interrogated the subject about the speed of the vehicles involved in the collision. Nine subjects were asked, "About how fast were the cars going when they hit each other?" Equal numbers of the remaining subjects were interrogated with the verbs *smashed*, *collided*, *bumped*, and *contacted* in place of *hit*. The entire experiment lasted about an hour and a half. A different ordering of the films was presented to each group of subjects.

### Results

Table 10-1 presents the mean speed estimates for the various verbs. Following the procedures outlined by Clark (1973), an analysis of variance was performed with verbs as a fixed effect, and subjects and films as random effects, yielding a significant quasi-F ratio, $F'(5,55) = 4.65$, $p < .005$.

Some information about the accuracy of subjects' estimates can be obtained from our data. Four of the seven films were staged crashes; the original purpose of these films was to illustrate what can happen to human beings when cars collide at various speeds. One collision took place at 20 mph, one at 30, and two at 40. The mean estimates of speed for these four films were: 37.7, 36.2, 39.7, and 36.1 mph, respectively. In agreement with previous work, people are not very good at judging how fast a vehicle was actually traveling.

### Discussion

The results of this experiment indicate that the form of a question (in this case, changes in a single word) can markedly and systematically

TABLE 10-1
Speed estimates for the verbs used in Experiment I

| Verb | Mean speed estimate |
|---|---|
| Smashed | 40.8 |
| Collided | 39.3 |
| Bumped | 38.1 |
| Hit | 34.0 |
| Contacted | 31.8 |

affect a witness's answer to that question. The actual speed of the vehicles controlled little variance in subject reporting, while the phrasing of the question controlled considerable variance.

Two interpretations of this finding are possible. First, it is possible that the differential speed estimates result merely from response-bias factors. A subject is uncertain whether to say 30 mph or 40 mph, for example, and the verb *smashed* biases his response towards the higher estimate. A second interpretation is that the question form causes a change in the subject's memory representation of the accident. The verb *smashed* may change a subject's memory such that he "sees" the accident as being more severe than it actually was. If this is the case, we might expect subjects to "remember" other details that did not actually occur, but are commensurate with an accident occurring at higher speeds. The second experiment was designed to provide additional insights into the origin of the differential speed estimates.

## EXPERIMENT II

### Method

One-hundred-fifty students participated in this experiment, in groups of various sizes. A film depicting a multiple car accident was shown, followed by a questionnaire. The film lasted less than 1 minute; the accident in the film lasted 4 seconds. At the end of the film, the subjects received a questionnaire asking them first to describe the accident in their own words, and then to answer a series of questions about the accident. The critical question was the one that interrogated the subject about the speed of the vehicles. Fifty subjects were asked, "About how fast were the cars going when they smashed into each other?" Fifty subjects were asked, "About how fast were the cars going when they hit each other?" Fifty subjects were not interrogated about vehicular speed.

One week later, the subjects returned and without viewing the film again they answered a series of questions about the accident. The critical question here was, "Did you see any broken glass?" which the subjects answered by checking "yes" or "no." This question was embedded in a list totalling ten questions, and it appeared in a random position in the list. There was no broken glass in the accident, but, since broken glass is commensurate with accidents occurring at high speed, we expected that the subjects who had been asked the *smashed* question might more often say "yes" to this critical question.



### Results

The mean estimate of speed for subjects interrogated with *smashed* was 10.46 mph; with *hit* the estimate was 8.00 mph. These means are significantly different, $t\,(98) = 2.00$, $p < .05$.

Table 10-2 presents the distribution of "yes" and "no" responses for the *smashed*, *hit*, and control subjects. An independence chi-square test on these responses was significant beyond the .025 level, $\chi^2(2) = 7.76$. The important result in Table 10-2 is that the probability of saying "yes," *P(Y)*, to the question about broken glass is .32 when the verb *smashed* is used, and .14 with *hit*. Thus, *smashed* leads both to more "yes" responses and to higher speed estimates. It appears to be the case that the effect of the verb is mediated at least in part by the speed estimate. The question now arises: Is *smashed* doing anything else besides increasing the estimate of speed? To answer this, the function relating *P(Y)* to speed estimate was calculated separately for *smashed* and *hit*. If the speed estimate is the only way in which effect of verb is mediated, then for a given speed estimate, *P(Y)* should be independent of verb. Table 10-3 shows that this is not the case, *P(Y)* is lower for *hit* than for *smashed*; the difference between the two verbs ranges from .03 for estimates of 1–5 mph to .18 for estimates of 6–10 mph. The

TABLE 10-2
Distribution of "yes" and "no" responses to the question "Did you see any broken glass?"

| | Verb condition | | |
|---|---|---|---|
| Response | Smashed | Hit | Control |
| Yes | 16 | 7 | 6 |
| No | 34 | 43 | 44 |

TABLE 10-3
Probability of saying "yes" to "Did you see any broken glass?" conditionalized on speed estimates

| | Speed estimate (mph) | | | |
|---|---|---|---|---|
| Verb condition | 1–5 | 6–10 | 11–15 | 16–20 |
| Smashed | .09 | .27 | .41 | .62 |
| Hit | .06 | .09 | .25 | .50 |

average difference between the two curves is about .12. Whereas the unconditional difference of .18 between the *smashed* and *hit* conditions is attenuated, it is by no means eliminated when estimate of speed is controlled for. It thus appears that the verb *smashed* has other effects besides that of simply increasing the estimate of speed. One possibility will be discussed in the next section.

## Discussion

To reiterate, we have first of all provided an additional demonstration of something that has been known for some time, namely, that the way a question is asked can enormously influence the answer that is given. In this instance, the question, "About how fast were the cars going when they smashed into each other?" led to higher estimates of speed than the same question asked with the verb *smashed* replaced by *hit*. Furthermore, this seemingly small change had consequences for how questions are answered a week after the original event occurred.

As a framework for discussing these results, we would like to propose that two kinds of information go into one's memory for some complex occurrence. The first is information gleaned during the perception of the original event; the second is external information supplied after the fact. Over time, information from these two sources may be integrated in such a way that we are unable to tell from which source some specific detail is recalled. All we have is one "memory."

Discussing the present experiments in these terms, we propose that the subject first forms some representation of the accident he has witnessed. The experimenter then, while asking, "About how fast were the cars going when they smashed into each other?" supplies a piece of external information, namely, that the cars did indeed smash into each other. When these two pieces of information are integrated, the subject has a memory of an accident that was more severe than in fact it was. Since broken glass is commensurate with a severe accident, the subject is more likely to think that broken glass was present. There is some connection between the present work and earlier work on the influence of verbal labels on memory for visually presented form stimuli. A classic study in psychology showed that when subjects are asked to reproduce a visually presented form, their drawings tend to err in the direction of a more familiar object suggested by a verbal label initially associated with the to-be-remembered form (Carmichael, Hogan, and Walter, 1932). More recently, Daniel (1972) showed that recognition memory, as well as reproductive memory, was similarly affected by verbal labels, and he concluded that the verbal label causes a shift in the memory strength of forms which are better representatives of the label.



When the experimenter asks the subject, "About how fast were the cars going when they smashed into each other?" he is effectively labeling the accident a smash. Extrapolating the conclusions of Daniel to this situation, it is natural to conclude that the label *smash* causes a shift in the memory representation of the accident in the direction of being more similar to a representation suggested by the verbal label.

## REFERENCES


Bird, C. The influence of the press upon the accuracy of report. *Journal of Abnormal and Social Psychology*, 1927, *22*, 123–129.

Block, R. A. Memory and the experience of duration in retrospect. *Memory and Cognition*, 1974, *2*, 153–160

Bransford, J. D., and McCarrell, N. S. A sketch of a cognitive approach to comprehension: Some thoughts about understanding what it means to comprehend. In W. B. Weimer and D. S. Palermo (eds.), *Cognition and the Symbolic Processes*. Hillsdale, N.J.: Erlbaum, 1974.

Carmichael, L. Hogan, H. P., and Walter, A. A. An experimental study of the effect of language on the reproduction of visually perceived form. *Journal of Experimental Psychology*, 1932, *15*, 73–86.

Clark, H. H. The language-as-fixed-effect fallacy: A critique of language statistics in psychological research. *Journal of Verbal Learning and Verbal Behavior*, 1973, *12*, 335–359.

Daniel, T. C. Nature of the effect of verbal labels on recognition memory for form. *Journal of Experimental Psychology*, 1972, *96*, 152–157.

Fillmore, C. J. Types of lexical information. In D. D. Steinberg and L. A. Jakobovits (eds.), *Semantics: An Interdisciplinary Reader in Philosophy, Linguistics, and Psychology*. Cambridge: Cambridge University Press, 1971.

Gardner, D. S. The perception and memory of witnesses. *Cornell Law Quarterly*, 1933, *8*, 391–409.

Marshall, J. *Law and Psychology in Conflict*. New York: Anchor Books, 1969.

Ornstein, R. E. *On the Experience of Time*. Harmondsworth, Middlesex, England: Penguin Books, 1969.

Whipple, G. M. The observer as reporter: A survey of the psychology of testimony. *Psychological Bulletin*, 1909, *6*, 153–170.

*Supreme Court Reporter*, 1973, *3*. Rules of evidence for United States courts and magistrates.