

Eyewitness Memory for Firearms: Narrative Accounts and Specific Questioning in the Elucidation of Accurate Information

Matthew J. Sharps¹ · Kaichen McRae² · Mitchell Partovi¹ · Justin Power¹ · Alanna Newton¹

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Abstract Much eyewitness research has addressed memory for persons and scenes, but limited work has addressed memory for firearms, frequently an important point in investigations and in court. The present research addressed this topic using the format of a traditional police interview, in which seventy subjects provided unrestricted free recall of a weapon seen in a crime situation, followed by responses to specific questions. Three firearms were used in a between-subjects format: a typical modern semi-automatic pistol, a less-typical Old West revolver, and an atypical single-shot muzzle-loading pistol. In the free recall stage, respondents provided about four times as many correct as incorrect details. However, in the specific-question stage, there were only 1.2 times as many new correct responses as new incorrect details, consistent with current cognitive theory. No difference between the weapons was observed in the production of correct responses, but the revolver and single-shot pistol resulted in more incorrect responses than did the modern semi-automatic, regardless of the saliency of weapon features. These results demonstrate the importance of the original, initial free recall phase in developing accurate identification of a given weapon, and of the type of weapon involved, and have important implications for police interviewing for accurate weapon identification.

Keywords Eyewitness memory · Memory for firearms · Eyewitness accuracy · Cognitive interview

✉ Matthew J. Sharps
matthew_sharps@csufresno.edu

¹ California State University, Fresno, Fresno, CA, USA

² Alliant International University, Fresno, Fresno, CA, USA

Eyewitness memory for weapons, frequently a crucial factor in investigative and court proceedings (Sharps et al. 2003; Sharps 2010; Herrera et al. 2014) has been little addressed in the literature. Even though witnesses frequently focus substantial attention on a given weapon in a given situation (“weapon focus,” e.g., Maas and Kohnken 1989; Pickell et al. 2006; Steblay 1992), memory for weapons has in general been shown to be relatively poor (Sharps et al. 2003), as has the visual interpretation of weapons in crime scenes (Sharps and Hess 2008; Herrera et al. 2014). These issues are frequently of seminal importance in criminal investigations and trials (Sharps et al. 2003; Sharps 2010).

Previous research (e.g. McRae et al. 2014; Sharps et al. 2003) has addressed, on a preliminary basis, some of the cognitive dynamics of eyewitness memory for firearms, outside the specialized and well-documented realm of weapon focus. Research on other aspects of memory for firearms may shed substantial theoretical light on eyewitness processing of inanimate objects generally, but the issue of firearms memory is clearly also of importance in its own right. Issues of firearms memory arise in criminal investigation and proceedings in many cases. Firearms separated from a given perpetrator may be identified as having been in the hands of that perpetrator by a given witness; the specific perpetrator who held a given firearm can be of enormous importance in the trial and investigation of crimes committed by groups; and a disguised perpetrator may come to be identified by a given witness from the successful identification of his or her weapons. There are many examples of the importance of this issue, but it is clear that this relatively neglected topic has substantial relevance in the real world of criminal investigation and jurisprudence (Sharps 2010).

But what is the best way for police or other investigators to elicit weapon information from eyewitnesses? Research on the Cognitive Interview, mainly concerned with person

identification and events, indicates that open, free-recall based questions, followed by more specific, directed questions, may produce optimal results for accuracy, without inflation of inaccurate responses (e.g., Memon and Bull 1991; Memon et al. 2010; Sharman and Powell 2013). It may therefore be true that these procedures are also optimal for weapon memory as well. A test of this idea was a primary emphasis of the present research; respondents were tested, as will be seen below, for the effectiveness of memory under open, free-recall, narrative conditions, followed by more specific, directed questions. It should be noted that other aspects of the Cognitive Interview (e.g., rapport-building) were not examined in this initial study; the goal here was to separate out specific cognitive components of weapon processing from other dynamics which might cloud the basic issues. It should be noted that future research should address the several dynamics of the cognitive interview, separately and in aggregate, for weapon memory as well as for other aspects of eyewitness cognition. For the present, initial effort, however, it was important to isolate the dynamics of cognition from other aspects of the cognitive interview, including affective dynamics. The focus of the present study, therefore, was the cognitive processing of weapon information; more general testing of the Cognitive Interview per se was outside the scope of the present study.

It should also be noted that the present research may apply strongly to traditional police interviewing outside the specific realm of the Cognitive Interview, as more traditional interviewing tends also to proceed from a general, free-recall, narrative phase to more specific questions on the part of the investigating officers (e.g., Memon and Bull 1991).

The present research therefore addressed this question, using an initial, narrative phase of weapon identification and information, followed by a series of more specific, directed, feature-intensive questions (see Sharps and Nunes 2002; Sharps 2003, 2010) designed to elicit the specific features of the given weapon from the given witness.

As discussed above, weapons are typically poorly remembered (e.g., Sharps et al. 2003). This is logical. For most people, weapons are relatively unfamiliar, and are therefore generally processed in “gestalt” rather than “feature-intensive” terms (Sharps et al. 2003; Sharps 2010; Sharps and Nunes 2002). Guns are generally processed as overall gestalt configurations rather than as detailed, item-specific representations. In other words, people in general tend to see, interpret and remember a “gun,” a gestalt representation relatively free of useful details, rather than a specific *type* of gun, with the specific features that might lead to a positive identification of the specific weapon used in a given crime. This is obviously problematic for investigative and courtroom exigencies, which generally require precisely the types of weapon details that most witnesses are unlikely to encode.

The importance of the gestalt/feature-intensive consideration has been demonstrated in previous research (see

especially Sharps et al. 2003; see also Sharps 2010; Sharps and Nunes 2002). In the Sharps et al. (2003) study, fewer than half of respondents correctly recognized and identified a common weapon (a short-barreled revolver) only ten minutes after having seen it under ideal viewing conditions. More familiar weapons (handguns such as short-barreled revolvers and semi-automatic pistols) were better identified than less-familiar ones (e.g., older military pistols). However, a weapon shown to be relatively unfamiliar to these respondents (an Uzi automatic assault pistol) was recognized at a relatively high level, better remembered than the more common or familiar weapons.

The explanation of this finding lay in the sheer number of features presented by the larger and more complex Uzi, which lent themselves to a relatively high level of feature-intensive processing. The Uzi is composed of more visible, isolable parts than are smaller and simpler handguns; this relative abundance of perceived features, inherent in respondent perception of the Uzi automatic weapon, resulted in better recognition. It should be noted that, in this case, a relatively high level of feature-intensive processing did not require significant knowledge of firearms. For example, the folding stock of the Uzi could simply be remembered as a large metal triangle at the back of the weapon; the extended magazine, a large, clearly visible rectangular structure at the base of the weapon, could be remembered simply as a dark metal bar. These features, even if not properly identified in expert, feature-intensive terms, tended to improve respondents’ ability to distinguish the Uzi from weapons which did not have these or comparable features.

Thus, the ability to recognize a weapon in “feature-intensive” terms, based on greater numbers and greater saliency of more identifiable features, resulted in stronger eyewitness identification (Sharps et al. 2003). A weapon which presents a number of identifiable features is more likely to be remembered accurately than one which is relatively sparse in feature-intensive detail.

This importance of feature-intensive processing in weapon recognition would therefore seem to recommend specific, feature-intensive questioning on the part of law enforcement. In the questioning of a given witness, whether by Cognitive Interview or by more traditional police methods, it would therefore seem that the later phase of specific, feature-oriented questions would be more important than the more general, gestalt, free-recall narrative format typical of the initial phase of questioning. However, a critical question remains. In the case of weapons, relatively unfamiliar to most people, is it possible that specific questions are more likely to lead a given witness astray, in that a given witness may be subjected to a higher level of reconfigurative memory, thus yielding more *inaccurate* details, by feature-intensive questions?

This is by no means an insignificant question. Bartlett (1932) showed that memory, far from being static, ultimately *reconfigures*; memory changes in the directions of gist, brevity, and personal belief (see also Ahlberg and Sharps 2002; Bergman and Roediger 1999). This has specific implications for weapon memory. A given witness is more likely to give a “gist” report (e.g., to report a “gun,” rather than, for example, a .38 Taurus revolver with a two-inch barrel), with a relative paucity of details (barrel length, color, magazine type) resulting from the *brevity* of memory, and with an influence of *personal belief* about the weapon (perhaps deriving from relative typicality and therefore familiarity of a given weapon for a given witness, as well as from suggestions of specific weapon features, details, and structures which may be inherent in the relatively feature-intensive questioning typical of current police procedure and actually *required* by the Cognitive Interview).

Personal belief can very well influence eyewitness memory. Loftus showed that the formatting of questions about a car collision could significantly alter the memory of witnesses with regard to the car’s speed. She also showed that asking witnesses about the presence of a barn in a given film of a rural journey could generate the existence of such a barn in their memories, even though no such barn was present in the given film (see Loftus 1979). In research on eyewitness memory for realistic crime scenes in the authors’ laboratory, we showed that the second most common *type* of errors, after errors concerning the clothing and physique of a given perpetrator, lay *entirely in the imagination of the given witness*, operating after the fact of witnessing the given scene (Sharps et al. 2009).

It is therefore clear that *post-event information*, information provided to a witness in questioning conducted *after the occurrence* of a given crime, can result in important alterations of that witness’s testimony. In the case of the present research, this means that specific, feature-intensive questions might elicit specific memories; but they could also trigger *false* memories, which could enter a given witness’s account based on the dynamics elucidated by Bartlett (1932) and examined in the realm of eyewitness memory by Loftus and others.

Based on all of these factors, it appears that the nature of feature-intensive questioning, in terms of its presentation of potentially new details to a given witness, may alter a witness’s internal cognitive representation of weapons, on which eyewitness testimony concerning those weapons is based.

Thus, we see the prospect that the typical questioning pattern (free narrative followed by constrained specifics), typically used in current police procedure and required by the Cognitive Interview, may *increase* error, rather than decrease it, in the specific, feature-intensive question phase. This consideration led to the following specific hypotheses:

1. Relatively specific questions, in the manner of later phases of the Cognitive Interview and of more traditional police interviewing, may result in a level of inaccurate or confabulated responses beyond that which would be obtained by a more general, narrative, free-recall based weapon description.
2. More typical weapons should prove less susceptible to these types of errors than more atypical types, based on the influence of typicality, and hence familiarity, on personal belief.

The present research formed specific tests of these hypotheses.

Method

Subjects Seventy college-aged respondents (55 males, mean age = 18.98, SD = 1.08, and 15 females, mean age = 19.27, SD = 1.10) participated in this research for course credit. Gender proportions reflected the proportions of those from the classes volunteering for this research. All demonstrated visual acuity of 20/40 or better by modified Snellen test (e.g., Sharps et al. 2007). This specific course population has a relatively high attrition rate, reflecting the relatively broad spectrum of individuals, in terms of intellectual and academic achievement, initially admitted to the university classes. The sample for this experiment, then, may be argued to be relatively reflective of the intellectual, linguistic, social, and cross-cultural characteristics of the population sampled, which derived from the highly multicultural region of central California in the United States. The obvious exceptions were that these college-aged individuals tended to be in good health, and generally possessed relatively good eyesight.

Materials Subjects were asked to respond to a high-quality digital photograph of a field-valid crime scene, developed with the advice and supervision of expert police officers highly experienced in the sorts of situations encountered by witnesses and officers on the street (see Sharps et al. 2007, 2009). This photograph depicted a potentially violent crime situation, including a male “perpetrator” aiming a handgun at a male “victim.” The setting was a gravel driveway next to a typical suburban house. The scene was viewed in strong sunlight. This scene is one of a number used in this laboratory in the systematic studies of eyewitness memory referenced above (see Sharps et al. 2007, 2009; also see Sharps 2010, for review). These studies were initially intended to bridge a long-standing gap in the literature between studies of high experimental precision but limited ecological validity, and those of high ecological validity but limited experimental control (Sharps et al. 2007, 2009; Sharps 2010). Convergent evidence from these experiments suggests that materials such as

the scene used here strike a relatively good balance between the frequently opposed necessities for strong experimental control and reasonable field validity (see Sharps 2010, for full discussion of these issues).

The handgun in question was one of three, in a between-subjects format. These were a short-action .45 caliber Colt blue-steel semi-automatic pistol, typical of modern crime scenes, but relatively lacking in feature-intensive detail; a .44 caliber blue-steel single-action Ruger Super Blackhawk revolver with a 7 ½ inch barrel, a “cowboy gun” less typical but possessing more feature-intensive detail; and a .50 caliber Cabela’s blue-steel flintlock muzzle-loading pistol, very atypical of modern crime scenes but possessing a wealth of detail (e.g., flintlock, brass buttplate, trigger guard, brass foreplate, and attached wood-and-brass ramrod and foresight).

Modern semi-automatics such as the Colt short-slide are, in the Central California region in which the study was conducted, frequently used in crimes, frequently available in gun and sporting-goods stores, and frequently found, and displayed in media, as a result of law-enforcement gun-sweeps. “Cowboy” weapons such as the Blackhawk are less so; and replica muzzle-loaders such as the flintlock follow as a *very* distant third. Thus, on these three indices, the three weapon types vary in typicality on an ordinal scale, with the .45 (Colt) first, the .44 (“Cowboy”) second, and the .50 (flintlock) third. In the present study, twenty-four usable protocols were provided by subjects presented with the .45, twenty-two from the .44, and twenty-four from the .50. The three weapons involved varied systematically on two dimensions; typicality for a modern crime scene, and level of feature-intensive detail for eyewitness processing. It should be noted that these two variables were intertwined; no attempt was made to separate them in the present study. Future research may attempt to do so, but the fact that these twin factors occur together arises not from methodology, but from the reality of firearms technology as we see it, today, in real-world situations; an antique flintlock, if used in a crime, is both more feature-intensive and more atypical than any modern weapon. Therefore, the present study proceeded with reference to this practical fact of firearms technology, in an effort to be directly relevant to actual criminal situations as they occur in the real world.

Procedure

Subject “witnesses” were seated ten to twenty feet from a standard white movie screen, which they faced and on which the scene was projected. The scene was shown to respondents for 5 seconds, without prompting or prior preparation. Law enforcement experts are generally in agreement that a firearm assault situation such as that depicted may result in a violent conclusion in literally less than a second (e.g., Moore 2006; see also Grossman 1996). Therefore, the 5-second retention

interval used in the present experiment meant that respondents had ample observation and processing time by typical field standards.

A ten-minute retention interval was imposed, during which respondents were queried about their names and other demographic information. These queries, and the information elicited, were similar to that which would be elicited by American police dispatchers in the interval between initial report of a crime and the arrival of police on the scene (e.g., Moore 2006).

Following this interval, in the narrative, “free recall” segment of this study, respondents were asked to describe the event they had seen, in as much detail as possible. The wording of this request for information was based on the assistance of senior, experienced police field training officers, in order to produce a realistic example of typical police questioning, which, as noted above, tends to be open-ended at least at the beginning of the initial interview, as suggested by Cognitive Interview procedures. Respondents were allowed ten minutes to recall all information they could. Then, respondents were asked to recall any additional details they could, again in a manner similar to that employed by investigating officers dealing with an actual crime. This request was repeated twice more, for a total of one initial recall question and three subsequent requests for any additional information that could be added.

Following this procedure, in the “specific questions” segment, respondents were subjected to ten specific questions, again in the manner of the Cognitive Interview, regarding the weapon they had seen. These questions addressed the wood-and-metal composition of the weapon, its color, its shape, its length, its barrel length and caliber, any unusual features, engravings, symbols, and the nature of its sights. These questions were intended, on a feature-intensive basis, to obtain the fullest possible picture of the given weapon.

Results were tabulated by three raters for accuracy. Full agreement was reached by all raters both for the weapon information and identification components of the “free-recall” component of this study, and for the “specific rating” components of this study, which were of course all directed toward weapon memory. Correct features were effectively face-valid (either a trigger-guard is there or it isn’t; hence the full agreement among the raters). Raters were unaware of the hypotheses driving this study at the time of rating.

Results

Question Format

There was no significant difference in eyewitness accuracy, in terms of *correct* response, for the three weapon types overall between narrative free recall and more specific, feature

intensive conditions ($p < .05$). However, as suggested by work on the Cognitive Interview (e.g., Memon and Bull 1991; Memon et al. 2010; Sharman and Powell 2013), the more specific questions produced nonsignificantly ($p < .05$) superior performance (mean correct responses 3.87, $SD = 1.84$) to the narrative free recall condition (mean correct responses 2.33, $SD = 1.69$).

The narrative free-recall format produced a mean of 2.33 correct detail responses per weapon ($SD = 1.69$), as reported above, with an *inaccurate* response rate of 0.7 ($SD = 0.84$) responses. The difference, a mean ratio of 3.32 correct to incorrect responses, was significant, $t(1,69) = 6.86$, $p < .001$.

However, the specific, “feature-intensive” format produced a mean of 3.87 ($SD = 1.84$) correct responses per weapon, as compared to an *inaccurate* response rate of 3.13 details ($SD = 1.33$). This smaller difference was in fact significant, $t(1,69) = 2.38$, $p = .020$, but note the mean ratio of 1.23 correct to incorrect responses for feature-intensive specific questions, by comparison to the 3.32 ratio for the narrative free-recall format reported above. (The analysis plan to this point employed t-tests, rather than a factorial anova, because the variables analyzed were non-orthogonal. Experiment-wise error rate was a relatively low 18.55%.)

Within the experimental parameters of the present experiment, it is clear that narrative free recall produced a substantially more accurate picture of the given weapon than did specific, feature-intensive questions; the levels of correct and incorrect responses in the feature-intensive condition were practically at parity, demonstrating, within the realm of weapon memory, the types of reconfigurative processes discussed by Bartlett and Loftus (see references above).

Weapon Type

Weapon type was also shown to be important for eyewitness memory. No significant differences were observed in accurate response between the free-recall and specific, feature-intensive conditions ($p < .05$). However, weapon type was significant on incorrect responses for both the initial free-recall phase, $F(2,67) = 16.00$, $p < .001$, and for the specific, feature-intensive question phase, $F(2,67) = 16.18$, $p < .001$. Post-hoc Tukey *B* analysis demonstrated no significant difference in eyewitness performance, either in accurate responses or errors, between the atypical flintlock and the relatively atypical single-action .44, but both yielded inferior performance to the typical modern .45 semi-automatic ($p < .05$). Thus, with reference to weapon type, no difference was observed between accurate or inaccurate responses in the free-recall and specific-question phases of the interview; however, the more familiar weapon (the modern, semi-automatic .45) was better remembered under both types of questioning, producing fewer inaccurate, intrusive responses, in both phases than were the less-typical or atypical pistols, the single-action

revolver and the flintlock pistol, which were in turn statistically indistinguishable from each other in respect of inaccurate eyewitness response ($p < .05$).

Discussion

This research yielded results which, though perhaps counter-intuitive, conform well to current theoretical considerations and previous research (e.g., Bartlett 1932; Loftus 1979; Sharps et al. 2009; Sharps 2010). The initial, narrative, free-recall phase of questioning in the present study resulted in a relatively high ratio of correct to incorrect responses regarding an observed weapon; however, the more specific, feature-intensive phase of questioning raised the level of incorrect responses *nearly to the level of correct responses*, as suggested by the reconfigurative nature of memory demonstrated by Bartlett (1932) and confirmed for the eyewitness realm by Loftus (e.g., 1979).

In less formal terms, the initial narrative “What did you see?” phase of the Cognitive Interview or of a traditional police interview might be considered to provide a “blank canvas” on which the dynamics of the nervous system have little power to work; respondents under this type of questioning have little or no “post-event” information provided to them by the interviewer, and they therefore give a reasonable unaltered account of their representation of the given weapon.

However, when the interviewer begins to ask more specific questions about specific features of the given weapon, relatively unfamiliar to most people, witness imagination, and the nature of the given, specific question itself, begin to work on the witness’s internal representation of the given weapon; the relevant post-event information, provided by the given question, results in a significant creation of confabulated details.

With reference to weapon type, the two types of question (narrative free-recall versus specific feature-intensive) did not specifically alter this pattern of results for overall correct responses. However, for both types of questioning, the more typical, familiar modern weapon resulted in better results, with regard to the production of intrusive, incorrect responses, than did either the completely atypical, unfamiliar flintlock or the relatively atypical “cowboy gun.” The modern, typical weapon (the .45 semi-automatic) produced fewer incorrect details than did either of the more atypical firearms.

This is of great potential importance for real-world courtroom and investigative proceedings. The first author has seen, as a result of police “gun sweeps” in Central California (the region of this study), occasional muzzle-loaders and a few single-action revolvers which have been used in crimes, but neither of these come anywhere near the prevalence of more typical, modern weapons such as the .45 short-slide employed in this study. The present results indicate that eyewitness accounts of the deployment of these weapons in actual crimes

should receive special attention from law enforcement officers, attorneys, judges and jurors; the atypicality of specific weapons may result in eyewitness anomalies of great practical importance in criminal cases, as observed in the present results. The present results show that average people, witnesses, are more likely to generate incorrect details of such atypical weapons, from reconfigured memory, than they are of more typical weapons.

However, the most important ramifications of the present research lie in the analysis of question type *across* weapons. Contrasting with assertions concerning person identification and memory for situations (e.g., Memon and Bull 1991; Memon et al. 2010; Sharman and Powell 2013), the present research indicated that eyewitness memory for *weapons* was significantly deteriorated by more specific questions beyond the level of incorrect responses generated by open-ended, free-recall interview conditions. Although more specific questions did in fact yield more correct responses than did the earlier, free-recall phase of interview, these more-specific questions resulted in far more incorrect responses as well, at a level near to parity with those details correctly recalled.

Thus, whether a given law enforcement agency makes use of the Cognitive Interview or of more traditional police interview techniques, the present research indicates that the most important phase of the interview, with regard to weapons involved in crimes, is the initial, narrative, free-recall questioning, rather than the later phase involving more specific, feature-intensive questions. The later, more specific, feature-intensive interview technique opens the possibility of more features recalled; but it also opens the probability, consistent with the work of Bartlett, Loftus, and others, of more *inaccurate* features suggested to the witness by the specific questions involved. Attention to these considerations, on the part of law enforcement and legal personnel, may result in more accurate interpretation of the testimony of eyewitnesses with reference to the weapons used in crimes.

There are, of course, specific limitations and exceptions to this research, several of which suggest important future research directions. For example, as pointed out by a reviewer of an earlier version of this article, the feature-intensive interview was the witnesses' second attempt eyewitness recall; this may, of course, have biased their memory. However, it should be pointed out that this order and type of questioning is typical of real-world law enforcement procedures; therefore this potential bias, although important and deserving of future parametric research, is typical of the real-world procedures which the present study sought to address, at least on a preliminary, exploratory basis. For the development of comprehensive psychological theory in this realm, there is no question that future research should counterbalance question type with order; but for the time being, the present research can only address typical current procedure, both traditional and Cognitive Interview, the original aim of this work.

It should also be noted that actual witnesses may be under considerable stress, both in the event and in court; this is an issue which is not addressed here, but which has great importance for future research. Also, only three weapons were used in this research. The idiosyncrasies of other weapons, potentially used in crimes, might very well alter these results. This is parametric research of the highest importance for practical results in investigation and in court; relevant data should be pursued vigorously by psychological scientists in the forensic realm.

As pointed out by an earlier reviewer, the flintlock possessed more features than the revolver, which in turn had more features than the automatic. In an ideal world, it would have been better to evaluate the ratio of correct to incorrect features per weapon, rather than the raw numbers recalled. However, experimental psychology in this realm is somewhat constrained by the realities of firearms engineering. The difficulty with this idea is that what is or is not a feature of a weapon may vary with knowledge or personal proclivities; is a foresight a foresight, or is it a foresight plus its mount to the barrel? For an ordinary person, it is the former; for a gunsmith, very much the latter. Granted that our analyses in this study were very clear, and that there was remarkable agreement between subjects (and experimenters) on the given features of the given weapon, it is still very much a matter of opinion exactly how many features a given weapon possesses. We were able, on an ordinal basis, to identify many features on the .50, fewer on the .44, and even fewer on the .45; but to create precise ratios would not really be possible within the constraints of the present design. Therefore, we dealt with the numbers of features correctly or incorrectly identified. Future research, however, might very well deal with this issue.

The present results indicate that both the initial, narrative, free-recall phase and the later, specific, feature-intensive phase of law enforcement questioning yield specific advantages and specific cautions for investigative and courtroom proceedings. Open-ended questions yielded fewer correct weapon details than errors than did more specific questions. More specific questions did in fact yield more correct responses, but on a basis, probably indistinguishable in any given case, from the level of *incorrect* responses developed by post-event information inherent in the more specific, feature-intensive questions involved. These results indicate, for eyewitness weapon memory, the importance of the initial, free recall phase in the development of accurate eyewitness accounts of the weapons used in crimes, and the importance of caution in the use of responses to later, specific, feature-intensive questioning in either the Cognitive Interview or traditional law enforcement procedures.

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