The Gestural Misinformation Effect: Skewing Eyewitness Testimony Through Gesture

DANIEL J. GURNEY, KAREN J. PINE, and RICHARD WISEMAN
University of Hertfordshire

The susceptibility of eyewitnesses to verbal suggestion has been well documented, although little attention has been paid to the role of nonverbal communication in misinformation. Three experiments are reported; in each, participants watched footage of a crime scene before being questioned about what they had observed. In Experiments 1 and 2, an on-screen interviewer accompanied identically worded questions with gestures that either conveyed accurate information about the scene or conveyed false, misleading information. The misleading gestures significantly influenced recall, and participants' responses were consistent with the gestured information. In Experiment 3, a live interview was conducted, and the gestural misinformation effect was found to be robust; participants were influenced by misleading gestures performed by the interviewer during questioning. These findings provide compelling evidence for the gestural misinformation effect, whereby subtle hand gestures can implant information and distort the testimony of eyewitnesses. The practical and legal implications of these findings are discussed.

The reliability of eyewitnesses' memory has been a key issue in forensic research, and a wealth of studies have highlighted eyewitnesses' sensitivity to misleading postevent information. Most notably, studies have shown that a witness's responses can be influenced by manipulation of a question's wording (Loftus, 1975; Loftus & Zanni, 1975). Witnesses can be directed to give a particular response when presented with a biased answer set (Loftus, 1975; Tversky & Kahneman, 1974) or a descriptive verb that insinuates details of an event (Harris, 1973; Loftus & Palmer, 1974). The misinformation effect (Loftus & Hoffman, 1989) proposed that witnesses are sensitive to postevent information that can alter their perception of the original event. Based on this theory, witnesses' memories of events are constructed from information that is available to them, and the introduction of inaccurate postevent information during questioning becomes integrated with the original encoded memory. As a result, witnesses can form an inaccurate representation of what they observed, and many studies cite cases where false postevent information has skewed eyewitness testimony (see Loftus, 2005, for a review).

Misinformation is not limited to biased questioning but can also be presented through pictorial cues, such as doctored photographs and advertisements. Braun, Ellis, and Loftus (2002) found that when participants were presented with visual evidence that

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contradicted details of their holiday experience, they were found to alter their reported memory to coincide with this new information. Similarly, participants have been found to report historic events inaccurately when presented with visual evidence that contradicts the original event (Sacchi, Agnoli, & Loftus, 2007). As with verbal information, postevent visual details can become integrated into the eyewitnesses' memory and lead them to believe that this is what was originally observed. Whereas the susceptibility of eyewitness memory to these manipulations is well researched, less attention has been paid to how other, nonverbal cues can influence eyewitnesses. Far less is known about how a witness's memory can be skewed by postevent information conveyed nonverbally, particularly through hand gestures. Thus, we propose the *gestural misinformation effect* and investigate how information conveyed in gestures acts as a form of misinformation and influences an eyewitness's responses.

Gestures are ubiquitous in human communication. They can expand on information that is communicated verbally (Langton, O'Malley, & Bruce, 1996; Sacchi et al., 2007), add clarity to speech (Goldin-Meadow, 1993; Kendon, 1980), and make communication between a speaker and listener more effective (Beattie & Shovelton, 1999; Graham & Argyle, 1975). Gestures can also communicate information that is difficult to articulate in speech (Church & Goldin-Meadow, 1986), such as complex shapes or ambiguous line drawings (Goldin-Meadow, 1999; Graham & Argyle, 1975). Listeners may also depend on gestures for information, particularly when the verbal source is ambiguous (Thompson & Massaro, 1986) or inaudible (Rogers, 1978). Just as gestures can build on information in speech, they can also provide critical semantic details that are absent from speech. Kendon (1980) described a speaker talking about a large cake and making a large circular movement of the index finger, portraying its round shape. When asked about the shape of the cake, listeners remembered it as round even though this was not mentioned in speech.

Gestures play a critical role in the way information is communicated. Kelly, Barr, Church, and Lynch (1999) showed how additional semantic information about a story could be gleaned from gesture and reported by listeners afterwards. Participants watched a video of a woman saying "My brother went to the gym" in one of two conditions: "speech" (no gesture) or "speech and gesture" (the woman accompanied her speech with a gesture of shooting a basketball). Participants in the latter condition reported that her brother had gone to play basketball, even though this was not stated in speech. In addition, some participants falsely recalled the woman as saying "My brother went to play basketball." This demonstrates that gestures can convey semantic content and can also influence the comprehension and memory of pragmatic information.

Further support for this notion comes from Cassell, McNeill, and McCullough (1999). In their study, participants watched a video narration of a Sylvester and Tweety cartoon showing a narrator accompanying his speech with either supplementary (matched) hand gestures or contradictory (mismatched) hand gestures. For instance, for the phrase "Granny whacks Sylvester," the narrator either performed a (matched) slapping gesture or a (mismatched) punching gesture. The authors reported a marked difference in how the two groups retold the story. The mismatched gesture group reported more of the incorrect details conveyed than the matched gesture group (40% and 5%, respectively). Furthermore, the authors reported one participant as saying, "and granny like punches him or something." Together, these studies suggest that gestures form an integral part of communication, with information conveyed in gesture becoming integrated into the listeners' memory representation.

Sensitivity to misleading information in gestures has been demonstrated in children. In the study by Broaders and Goldin-Meadow (2010), 39 children were asked open-ended questions, accompanied by the interviewer gesturing specific information (e.g., asking "What else did he do?" while gesturing playing a whistle). They found that conveying misleading information in this way altered the children's representation of the event and led them to give inaccurate information that was consistent with the gesture. Children are known to be more susceptible to suggestions and memory encoding errors than adults (Bruck & Ceci, 1999; Poole & Lindsay, 2002), so it is an open question as to whether adults' testimony would be similarly influenced. Replicating this effect in adults would lend support to the notion that gestured information can alter memory representation and subsequently skew eyewitness testimony.

In light of the substantive support for verbal misinformation and evidence that gestures play an important role in communication, this study explores whether gestures may also act as a form of misinformation during the questioning of eyewitnesses. Three experiments examined whether participants' responses to questions about a crime scene could be manipulated by an interviewer portraying misleading information through his hand gestures. It was predicted that gestures would act as a form of misinformation and that participants would incorporate gestured information into their testimony.

EXPERIMENT 1

Participants first watched footage of a crime scene, followed by a questioning phase on video, where an actor portraying a police interviewer asked participants questions about the crime. Presenting the questioning phase on video enabled us to ensure that the verbal questions were identical for all groups; careful video editing allowed manipulation of the interviewer's gestures while keeping the verbal questions constant. During questioning, participants saw the interviewer accompany the questions with a gesture that conveyed either accurate information about the scene (an accurate gesture) or inaccurate information (a misleading gesture). To establish what responses would be elicited in the absence of visual information, a control group was included, comprising participants who only heard the audio of the interviewer's questions but did not see the questioner.

Therefore, all groups heard identical verbal questions, and any differences in their testimonies could be attributed to nonverbal factors. It was predicted that their responses would concur with the information conveyed to them by the interviewer's gesture.

METHOD

Design

A between-subject design was used, with three conditions: accurate gesture, misleading gesture, and control (no gesture). The dependent variable was the response participants gave to the critical question.

Participants

Sixty-six undergraduate psychology students (13 male, 53 female) from the University of Hertfordshire, ranging in age from 18 to 48 years (M = 21.24, SD = 4.51), were assigned randomly to one of the three groups (n = 22 for each). Participants were awarded course credit for taking part.

Materials

The stimuli presented to participants included a closed circuit–style video of a confrontation between two people in a dark alley. The video had no sound and lasted approximately 45 s.

For the questioning phase of the experiment, a video was constructed in which an actor played the role of a police interviewer. The video was filmed at the University of Hertfordshire's Observation Laboratory and showed the interviewer sitting at a desk with a folder to resemble a police interview scenario. During filming, one camera was positioned in front of the interviewer, and a second was positioned over his shoulder to capture his hand gestures. In order that all participants heard the same verbal questions, the asking of the questions was recorded only once, and the accompanying gestures were recorded separately afterwards.

The first critical question was, "You may have noticed some jewelry worn by the victim. Please write down what jewelry you think he was wearing," spoken directly to camera. For the two corresponding over-shoulder videos, the interviewer either gestured to a finger on his opposing hand (to depict a ring) or grasped his wrist (to depict a watch). These two over-shoulder shots of the gesture were each edited into the video sequence in full screen (during the word *jewelry*) to produce two versions of the video for the two experimental conditions. The video in each condition thus comprised the same footage of the interviewer talking directly to camera, but with the camera angle changing briefly to show either an accurate gesture of a ring or a misleading gesture of a watch. (In the crime scene the man wore a ring but no watch.) Therefore, both groups heard exactly the same question, but each group saw it accompanied by a different gesture.

In addition to the critical question, three distractor questions ("How tall was the man?" "How old was the man?" "What color jacket was he was wearing?") and an introductory video (showing the interviewer writing at a desk) were filmed. All videos were directed in the same manner, with occasional camera angle changes to avoid making participants suspicious of the camera angle changes in the critical question videos. A series of black screen videos were presented to participants in the control group as they listened to the audio questions.

Procedure

All participants watched the same crime scene video followed by the questioning phase. The presentation of the videos for the questioning phase varied by condition: Those in the "accurate" condition saw the interviewer performing the accurate (ring) gesture for the critical question, and those in the "misleading" condition saw the misleading (watch) gesture. Participants in the control group saw no video (only a black screen) and heard only the audio from the interviewer's questions.

An introductory video of the "police" interviewer was shown, accompanied by a voiceover instructing participants to watch the crime scene carefully so they could answer questions about it afterwards. The questioning phase followed with two distractor questions, the critical question, and then another distractor question, each separated by a 12-s segment of black screen to enable participants to write down their answer to the question. Controls saw a black screen throughout this phase of the experiment.

RESULTS

Participants wrote down their responses to the interviewer's critical question about the man's jewelry. "Ring" and "watch" were the target responses for each of the "ring" and "watch" categories, although other items of jewelry worn on the wrist (such as a bracelet) were also counted as valid responses to the watch gesture. Other items of jewelry, including earring, chain, or necklace were logged as "other" responses. If participants failed to give an answer in the accurate ($n = 2$), misleading ($n = 4$), and control ($n = 6$) groups, their data were excluded from the analysis.

More correct ("ring") responses were given by participants who saw the accurate (ring) gesture (95%, $n = 19$) than by those in the misleading (watch) (67%, $n = 12$) gesture and control (no gesture) (63%, $n = 10$) groups. Subsequently, more incorrect responses of "watch" were given by those who saw the misleading watch gesture (30%, $n = 6$) than by those in the accurate (5%, $n = 1$) or control (19%, $n = 3$) groups. The association between condition (gesture: accurate, misleading, and control) and response (ring, watch, other) was examined in a chi-square test and was found to be significant, $\chi^2(4, n = 54) = 12.10, p = .016$. The incorrect responses revealed that no participants in the accurate (ring) condition answered "watch," but "watch" made up all ($n = 6$) of the incorrect responses in the misleading (watch) group and 50% ($n = 3$) of the incorrect responses from controls. The responses of the control group appeared to be more varied as the remainder of their answers were made up of more miscellaneous ("other") responses ("earring" and "necklace"). Thus, the gesture shown to participants appeared to affect the responses they gave.

DISCUSSION

The results of Experiment 1 suggest that participants' responses were largely consistent with the information conveyed to them in gestures. Participants' memory of some of the detail in the scene appeared to have been aided by the accurate gesture and distorted by the false information from the misleading gesture. These results are consistent with previous research that found that verbal questioning can distort a participant's existing memory of events (Loftus & Hoffman, 1989; Loftus & Palmer, 1974). Noteworthy is how some participants who gave the incorrect response of "watch" (or "bracelet") in the misleading condition elaborated their report with additional details of the item, such as it being gold or silver, despite it being absent from the scene. (In comparison, no participants in the control who gave the same incorrect answer elaborated on their responses.) These results provide preliminary support for the gestural misinformation effect and suggest that nonverbal, as well as verbal, information can influence what an eyewitness remembers.

Although this experiment revealed that gestures could lead participants to both a correct and incorrect response, the questioning made it clear that jewelry was present in the scene. Rather than suggesting the presence of jewelry, it is possible that the gesture may only have altered perceptions of what jewelry this was. It remains to be seen whether gestures can suggest the presence of objects that were absent from the crime scene. This question is explored in Experiment 2, which involves suggesting to participants, via gesture, the presence of an object that was absent from the scene they witnessed.

EXPERIMENT 2

Research into the misinformation effect provides evidence that leading questions not only can distort memories (Loftus & Hoffman, 1989; Loftus & Palm-

er, 1974) but also can prompt the creation of entirely new memories (Garry, Manning, Loftus, & Sherman, 1996; Loftus & Pickrell, 1995), even if they would have been impossible to observe (Braun, et al., 2002). Experiment 1 indicated that gestures could distort a memory, although it is not possible to conclude at this stage that gestures can also *implant* memories. Experiment 2 addressed this question by exploring whether gestures could suggest the presence of objects that did not appear in the video participants witnessed. Two groups were exposed to misleading gestures during questioning, with each gesture suggesting the presence of a different absent feature. For this experiment, a new stimulus video of an office theft was used, and three critical questions were developed concerning the man's physical characteristics. These questions concerned the man's facial features and whether he was wearing any jewelry. A question about jewelry was also used. However, because the man wore no jewelry in this scene, both the ring and watch gestures were misleading. Therefore, this experiment explored whether multiple misleading gestures could implant a memory of an object into the participant's representation of the scene. Further methodological changes included the introduction of multiple-choice answer sets to ensure a cleaner dataset. A short distractor task was also introduced between the stimulus and recall videos to help reduce memory trace of the video.

METHOD

Design

A between-subject design was used, with participants randomly allocated to three conditions: gesture group 1, gesture group 2, and control/no gestures. The dependent variable was the responses participants gave to each of the critical questions.

Participants

The 72 participants (20 men, 52 women) ranged in age from 18 to 81 years ($M = 30.31$, $SD = 17.93$); there were 24 participants in each condition. Participants were predominantly psychology undergraduates who were awarded participation credit for taking part.

Materials

A 30-s stimulus video was created. It depicted a thief entering an office, placing a stolen item in his jacket pocket, and then exiting the room. The clip had no sound.

As in Experiment 1, a series of interviewer videos were prepared for the questioning part of the experiment. As before, participants were asked, "Was the man wearing any [jewelry]?" with a full-screen over-shoulder camera cutaway edited in the sequence of the interviewer gesturing either a ring (gesture group 1) or watch (gesture group 2) gesture on the word "jewelry." Because the man was not wearing any jewelry, both gestures in this experiment were misleading.

Videos for another two critical questions were prepared. In these videos, the interviewer performed the critical gesture while asking the question directly to camera without any over-shoulder cutaways. Therefore, two versions of these critical questions were recorded separately to correspond to each gesture condition. The "additional clothing" critical question asked, "Did you notice [anything else] he was wearing?" with misleading gestures "gloves" (grasping opposing hand) and "hat" (touching head) occurring on the words "anything else" for gesture groups 1 and 2, respectively. The "facial features" critical question asked, "You got a glimpse of his [face] in the video. Do you remember any distinguishing features?" with the interviewer performing either a "beard" (stroking chin) or "glasses" (touching nose bridge) gesture on the word "face" for gesture groups 1 and 2, respectively. Three distractor questions were included ("How tall was the man?" "How old was the man?" "What did he take as he left?"), which also featured naturalistic gestures. The audio in the blank (black screen) video for the control group was selected from one of these videos at random for each critical question.

Answer booklets with multiple-choice answers were provided. The responses in all answer sets included the answer portrayed through the gesture in both conditions, as well as another two distractor answers and an "other" (none) response.

Procedure

Participants watched the crime scene stimulus video and completed a short distractor task (lasting approximately 5 min) before progressing to the recall phase of the experiment. The gestures participants saw depended on condition. Those in gesture group 1 saw the ring, gloves, and beard gestures, and those in gesture group 2 saw the watch, hat, and glasses gestures for the critical "jewelry," "additional clothing," and "facial features" questions, respectively. Participants in the control group saw a black screen video and heard only the audio from the questions.

The questions were presented in a designated order (two distractor questions, critical question, distractor, critical, distractor, critical). Each question was separated by a 12-s segment of black screen to enable participants time to select an answer from a list of multiple choices for all questions. Participants were instructed to choose one response from those in the answer booklet and to select "other" if they believed the response was not listed.

RESULTS

Participants answered the three critical questions asked by the questioner (concerning the man's jewelry, additional clothing, and facial features) by choosing one item from a given answer set. Thus, all responses were categorical. Any positive response was considered to be incorrect (the man was wearing no jewelry and no additional clothing and had none of the distinguishing facial features listed).

Although there were no correct responses, the majority of responses given by the control group consisted of the "other" (or none) response (53%). In contrast, the majority of responses for the two misleading gesture groups were made up of other incorrect responses (68% and 54% in the two gesture groups, respectively), including both target and miscellaneous responses. A summary of the target responses is provided in Figure 1.

The ring and watch gestures generated more of each response in their respective gesture conditions (60%, $n = 6$ and 100%, $n = 10$, respectively). Similarly, the gloves and hat gestures prompted more of those answers in each condition (75%, $n = 6$ and 56%, $n = 5$). For the "facial features" question, the beard gesture did result in a greater number of "beard" responses (93%, $n = 14$), although it remained a frequent answer across both the "glasses" (90%, $n = 9$) and control (71%, $n = 5$) conditions. The glasses gesture did not appear to exert an influence (10%, $n = 1$).

The effect of the gestures was first analyzed by comparing the frequency of the responses consistent with the misleading gesture with the frequency with which the same response occurred in the absence of the gesture (control condition). Overall, of the participants who saw a misleading gesture, 29% gave the response conveyed by it. Comparatively, 15% of participants gave the response when they did not see the gesture. These data were submitted to a 2 × 2

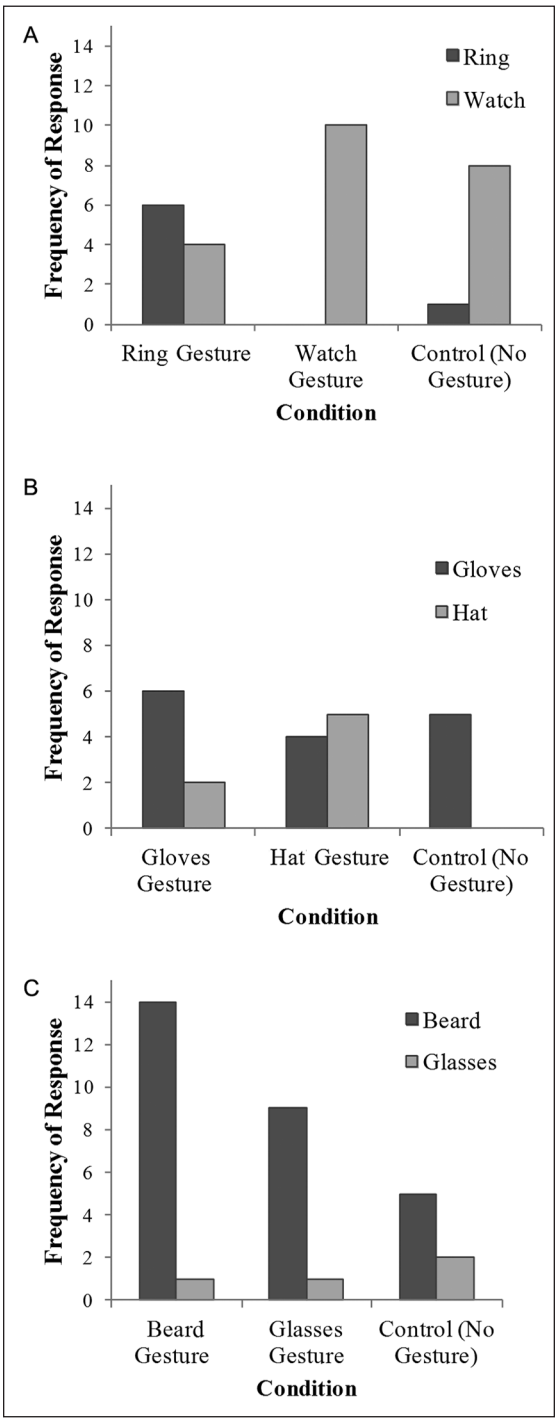

FIGURE 1. Frequency of responses for the (a) "jewelry," (b) "additional clothing," and (c) "facial features" questions by condition

chi-square analysis testing an association between gesture (saw gesture or not) and response (gave target response or not) and retrieved a significant effect, $\chi^2(1, n = 282) = 7.90, p = .005$. Thus, participants' responses were associated with the gesture performed to them.

To further this analysis, a Mann–Whitney *U* test was performed. As participants in the experimental groups saw three misleading gestures, the data were scored according to how many target responses they gave (ranging from 0 to 3). The test revealed that those in gesture group 1 gave significantly more target responses than controls, $U = 165.5, n_1 = 24, n_2 = 24, p = .006$. Similarly, those in gesture group 2 gave more target responses than controls, although this did not reach significance, $U = 229.0, n_1 = 24, n_2 = 24, p = .170$.

DISCUSSION

The results of Experiment 2 provide further evidence that hand gestures may act as a form of misinformation and skew eyewitness' responses. Across the three critical questions, participants' responses concurred with the information that was conveyed to them through gesture. Although some responses remained popular across all conditions ("gloves" and "watch") and may reflect guesses, more of those responses arose in their respective conditions. Although the glasses gesture had comparatively little effect (and in fact prompted more "beard" responses), this result could be explained by the gesture's ambiguity. For this gesture the interviewer simply touched the bridge of his nose, a movement that may have conveyed little information.

Building on the findings from Experiment 1, these results further suggest that gestures may influence participants to give a particular response. In this experiment, the ring gesture conveyed misleading information and generated a higher number of "ring" responses. Noteworthy also is how three of the participants who gave the "ring" response also reported the man wearing gloves after seeing the gloves gesture, incompatible answers that would have been impossible to observe.

Although these findings provide further insight into gestural misinformation, some considerations about the methods should be made. Participants in Experiments 1 and 2 were questioned over video and were not able to interact with the interviewer. This ensured that the questioning was rigorously controlled, but it could be argued that ecological validity was compromised. Previous research indicates a decrease in communicative value when a speaker's gestures are presented through video rather than live (Holler, Shovelton, & Beattie, 2009), and visual attention to speakers' gestures differs between video and live conversations (Gullberg & Holmqvist, 2002, 2006). As the form of gesture presentation varies, so may the effects of gestural misinformation. To assess how effective misleading gestures can be in a real interview situation, the method was changed to accommodate these discussion points.

EXPERIMENT 3

Experiments 1 and 2 found that gestures could distort and create participants' memories when presented through video. These results support the existence of gestural misinformation. In light of these observations, it is important to investigate whether the effects of gestural misinformation are replicated in a live, face-to-face interview. Testing gestural misinformation in a live interview is an important progression; the cognitive interview technique widely used today is conducted live and designed to ease social interaction between the witness and interviewer (Fisher & Geiselman, 1992). In addition, gestures performed by speakers live are more likely to draw attention from the listener (Gullberg & Holmqvist, 2002, 2006) and be processed for information intuitively (Gullberg & Kita, 2009). Thus, exploring gestural misinformation in a more naturalistic, live interview would provide more insight into whether gestures can skew eyewitness testimony under questioning.

In Experiment 3, participants were questioned about the stimulus video by a live interviewer who again performed misleading gestures while asking his questions. Participants were able to interact with the interviewer and responded freely to his questions after providing a statement on what they had witnessed. This method ensured that participants were more engaged with the interviewer and gesture presentation was more natural. Thus, this experiment provided an environment more representative of a police interview.

As in Experiment 2, the interviewer performed one of either two sets of misleading gestures (or no gestures, for the control condition). Further methodological improvements were made in this experiment. First, gestures that confounded with another (i.e., ring and gloves) were arranged so they did not appear in the same condition, and one gesture (glasses) was modified so it conveyed information less ambiguously. In addition, another critical question (concerning which pocket the man put an item in) was introduced.

METHOD

Design

As in Experiment 2, a between-subject design assigned participants randomly to three groups; the first were presented with one set of misleading gestures (gesture group 1), the second with another set of misleading gestures (gesture group 2), and a third, control group saw no gestures. The dependent variable was the responses participants gave to each of the critical questions in the interview. All dependent variables were measured as categorical responses.

Participants

A sample of 90 participants (16 male, 74 female) were recruited opportunistically for the experiment, ranging in age from 18 to 32 years (M = 19.75, SD = 2.37). The majority of participants were undergraduate or postgraduate psychology students from the University of Hertfordshire, who were awarded participation credit for taking part.

Materials

The same stimulus video (showing a theft in an office) as in Experiment 2 was used here. A funnel debrief questionnaire was also prepared for this experiment and asked, "Did you feel influenced by the interviewer in any way?" and "Which of his hand gestures do you remember seeing?"

Procedure

Participants watched the stimulus video and completed a short distractor task before going to the interview room, containing a table with two chairs facing each other, placed approximately 1 m apart. When seated, the participants completed a short distractor task and wrote a statement of what they saw in the video before the interview commenced.

The interviewer followed a transcript to ask the questions. During the interview for the experimental conditions, he performed the critical gestures while summarizing the events of the video. For instance, for the facial features question, the interviewer explained, "At one point in the video the man turned around and you got a glimpse of his face," with the critical beard or glasses gesture occurring on the phrase "his face." The interviewer then asked, "Were there any distinguishing features you think he may have had?"

As before, distractor questions were prepared ("How old was the man?" "What color was his jacket?" "Which drawer did the take the item from?") and were sandwiched between the critical gesture and question. The interview continued to follow this pattern of "critical gesture, distractor question, critical question" for the "jewelry" and "additional clothing" questions. A further critical question was, "Which jacket pocket do you think he put the item in?" following a critical gesture of either "left inside pocket" (gesture group 1) or "right outside pocket" (gesture group 2).

The interviewer performed the same gestures as in Experiment 2, although the glasses gesture was changed to a gesture of two imaginary circles around his eyes. The interviewer performed other, noncritical gestures when discussing the events of the video so to not draw attention exclusively to the critical gestures. The interviewer also avoided deictic expressions (e.g., "like this") and did not fixate any of his gestures. Care was taken to avoid deviating from the transcript if participants interrupted or answered prematurely.

In the control group, the interviewer asked the same standardized questions but did not perform any accompanying gestures. This method allowed for a more naturalistic control group, in contrast to the black screen videos used in Experiments 1 and 2.

The interviewer avoided asking leading questions. For instance, participants were asked, "Did you notice any additional clothing?" as opposed to "What additional clothing was he wearing?" If a participant claimed not to know, the interviewer asked whether he or she was sure before moving into the next question. After questioning, the interviewer clarified the answers with the participant during a summary of the interview to ensure that the participant was happy with the responses given.

RESULTS

Participants answered the interviewer's questions freely by giving their responses verbally, which were

then written down by the interviewer. In this experiment, four critical questions were asked (concerning the man's jewelry, what other clothing he was wearing, and what facial features he had). The fourth critical question asked which jacket pocket he put an item in. Responses that were congruent with the interviewer's gesture were counted as target responses. As before, "bracelet" was also accepted as a target response for "watch" (for the jewelry question), and "facial hair" or "stubble" was accepted as a target response for "beard" (for the facial features question). Figure 2 summarizes the responses given by gesture groups.

More of the responses given in the control group correctly identified no target responses (86%), compared with those in the two misleading gesture conditions (72% and 77%, respectively). The ring, watch, gloves, and beard gestures prompted more of each response in their respective conditions (56%, $n = 5$; 100%, $n = 10$; 67%, $n = 2$; 100%, $n = 10$), and the glasses and hat gestures did not yield the majority of responses in their respective conditions (50%, $n = 2$; 29%, $n = 2$). To analyze the effect of the gestures, the frequency of target responses and the frequency with which the same response occurred without a gesture (control group) were compared for the three critical questions together. Participants who saw a misleading gesture were more likely to give the target response (17%) than those who did not see the gesture (7%). A significant association was found between response and gesture condition, $\chi^2(1, n = 77) = 4.19$, $p = .041$. Thus, participants who saw the interviewer accompanying the question with a hand gesture were more likely to give the response conveyed by this gesture.

A further Mann–Whitney U test considered the number of target responses participants gave between those who saw misleading gestures and controls. Participants could have given either 0, 1, 2, or 3 target responses to the previous three critical questions. The test revealed that those in gesture group 1 gave significantly more of the target responses than controls, $U = 307$, $n_1 = 30$, $n_2 = 30$, $p = .007$, as did and those in gesture group 2, $U = 340$, $n_1 = 30$, $n_2 = 30$, $p = .038$.

Another question was asked about which jacket pocket the intruder put an item in. For this question there was a positive answer (the intruder did put the item in a pocket, though which pocket was unclear) Participants chose either his left or right

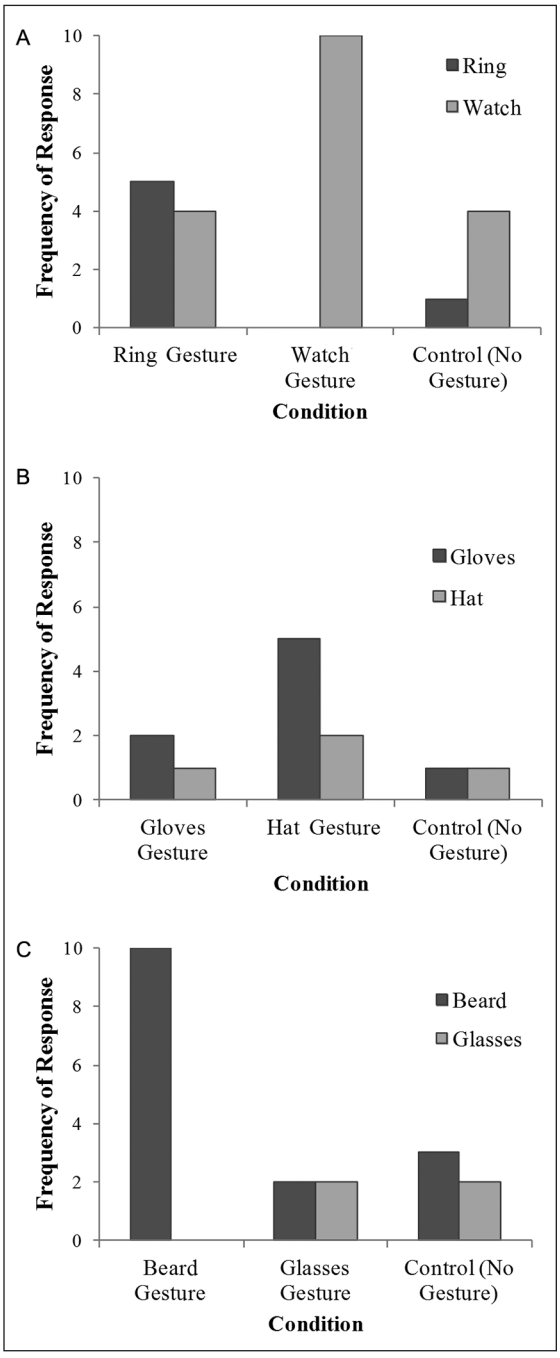

FIGURE 2. Frequency of responses for the (a) "jewelry," (b) "additional clothing," and (c) "facial features" questions by condition

pocket, and then his inside or outside pocket. Some participants did not provide a full answer in gesture group 1 ($n = 5$), gesture group 2 ($n = 3$), or the control group ($n = 4$), and some participants ($n = 3$, all in gesture group 2) gave the pocket side but not the pocket type. Participants who saw the interviewer performing a "left inside" gesture were more likely to claim the item was put in his left inside pocket (48%, $n = 12$) than those in the other gesture (15%, $n = 4$) or control (23%, $n = 6$) groups. In contrast, those who saw him perform the "right outside" gesture were more likely to give the "right outside" response (59%, $n = 16$) than those in the alternate (24%, $n = 6$) but not control group (61%, $n = 16$). Thus, because the responses of the control group were closely matched to those who saw the "right outside" gesture, the "left inside" gesture directed participants away from their natural tendency. The data were submitted to a 3 × 4 chi-square testing an association between condition (left inside, right outside, no gesture) and response ("left inside," "left outside," "right inside," "right outside") and retrieved a significant effect, $\chi^2(6, n = 78) = 13.47$, $p = .036$. To investigate this further, another 3 × 2 chi-square collapsed the data by the "right" and "left" responses and the "inside" and "outside" responses independently. An effect was present for just the "right" and "left" responses, $\chi^2(2, n = 81) = 6.17$, $p = .046$, and the "inside" and "outside" responses, $\chi^2(2, n = 78) = 12.27$, $p = .002$.

DISCUSSION

Whereas Experiments 1 and 2 established that gestures can affect participants' responses through video, this experiment revealed that gestures can also affect responses when participants are questioned in a face-to-face interview. Because participants were free to interact with the interviewer and gave free responses to his questions, this experiment provides a more ecologically valid representation of a police interview and provides more compelling evidence that gestures can affect eyewitness testimony.

Across Experiments 2 and 3, participants who saw a misleading gesture were significantly more likely to give a target response than those who did not. The glasses and hat gestures were the only gestures not to contribute to this effect. An explanation for this could be that these gestures appeared too ambiguous to communicate their respective information. The lower proportions of positive responses from participants in general may also have prevented these differences from being observed. Although research indicates that gestures may be more communicative live than through video (Holler et al., 2009), the proportion of participants who gave a target response live was lower (17%) than through video in Experiment 2 (29%). An alternative explanation for this is the methodological differences between the experiments, namely, the use of a forced-choice questionnaire in Experiment 2, and further experiments could address this issue.

GENERAL DISCUSSION

Previous research has shown that the manipulation of verbal information can skew the memory of eyewitnesses and affect the responses they give (Harris, 1973; Loftus, 1975; Loftus & Palmer, 1974). This study demonstrates that witnesses can also be misled by information that is conveyed through hand gestures. This study builds on research that gestures can suggest additional semantic information to listeners (Cassell et al., 1999; Kelly et al., 1999) and that such information can affect eyewitness testimony not only in children (Broaders & Goldin-Meadow, 2010) but also in adults. In Experiment 1, when the interviewer's question was accompanied by a consistent accurate gesture, participants were more likely to produce an accurate report. When his question was accompanied by a gesture that was inconsistent with the facts, they were more likely to report inaccurate information. Experiment 2 confirmed that two separate misleading gestures were able to manipulate responses independently under the same conditions. Because the information participants reported in these experiments could not have been based on their observations and was largely consistent with the interviewer's gestures (while his speech remained identical across all conditions), there appears to be strong evidence that the interviewer's gestures influenced the participants' responses. In Experiment 3, these results were replicated in a more ecologically valid interview scenario. In addition, this experiment revealed that although participants reported feeling influenced and could identify misleading gestures when they were performed to them, they were still

susceptible to information conveyed through gesture. In light of these findings, this study provides evidence for a gestural misinformation effect and indicates that misleading postevent information can mislead eyewitnesses not only through speech, as previous research has shown, but also through gesture.

This study furthers understanding of the communicative potential of gesture by demonstrating that semantic information from gestures not only can be integrated with speech but also is salient enough to produce a robust misinformation effect. However, this study has more far-reaching implications and shows that although hand gestures can have many positive effects (e.g., increasing the efficiency of communication), there may also be negative effects. This study highlights that participants can recall false information presented only through gesture and that such an effect could have an impact in the questioning of eyewitnesses. The *cognitive interview* has proved an effective way of reducing inaccurate eyewitness testimony by removing biased questioning (Fisher & Geiselman, 1992; Memon, Zaragoza, Clifford, & Kidd, 2010; Wells, Memon, & Penrod, 2006), although gestural misinformation remains as a possible form of influence. Audio recording interviews enables one to determine when a witness has been misled by the wording of a question. However, to ensure that nonverbal persuasion is detected, it would be important for initial interviews with witnesses to be video recorded, ensuring that the interviewer is fully visible on the recording as well as the witness. Without this recording, any misleading gestures are likely to go unnoticed.

Gesture influence may also be more covert and occur incidentally. Gestures typically differ from speech in representation and often serve a different role in communication (McNeill, 1996). Whereas speech conveys information in a "segmented, combinatorial" format, gestures convey information in a "global, mimetic" style (Goldin-Meadow, McNeill, & Singleton, 1996). Gestures also complement speech fluently, whereas speech is far less fluent and full of errors and hesitations (Cassell, 2000). A key feature of gestures is their ability to communicate visual details that are not articulated in speech (Cassell et al., 1999; Goldin-Meadow, 1999; Graham & Argyle, 1975; Kendon, 1980). Thus, gestures may suggest the imagery of a scene and cause witnesses to confuse the semantic details conveyed to them through gesture with those actually witnessed. Although gestures are not readily noticed by participants and occur as "background elements" in conversation (Henderson & Hollingworth, 1999), they are a powerful tool in communication.

This has important implications, because gestural information that misleads witnesses may be less overt than speech and may be more difficult to identify. An interviewer may not necessarily intend to influence a witness but may inadvertently suggest information via hand gestures. Gestures often are spontaneous and unplanned (Krauss, 1998; McNeill, 1996) and may be produced for intrapersonal benefits, such as lexical retrieval, without communicative intent (Rauscher, Krauss, & Chen, 1996). However, listeners can still extract meaning from them (Krauss, Chen, & Gottesman, 2000). For example, the semantic specificity hypothesis shows that gestures for praxic objects (those that use the hands to function) are more ubiquitous that those for nonpraxic objects (Pine, Gurney, & Fletcher, 2010). Therefore, whereas speech can be controlled, the production of gestures is often automatic, and therefore a speaker has less awareness of them and of the information they may convey.

This observation raises questions into the process through which gestural influence occurs. One possibility is that participants responded intuitively to the interviewer's suggestions and accepted these suggestions due to demand characteristics. Witnesses have been shown to accept suggestions from interviewers intuitively, particularly those perceived to have greater knowledge and expertise (Skagerberg & Wright, 2009; Smith & Ellsworth, 1987). However, information conveyed through gesture may not be processed as overtly as information conveyed through speech, and an alternative explanation is that participants gleaned information from gestures outside of their awareness. Gestures are rarely fixated on by the listener during a conversation (Gullberg & Holmqvist, 1999, 2006), although information can still be extracted from them. Gullberg and Kita (2009) studied the relationship between gesture fixations and information uptake across a series of studies but found no evidence of an association between the two, suggesting that gestures communicate information to addressees covertly. Although studies that garner explicit measures of retrospective gesture recognition

are sparse, it is noteworthy that some have drawn attention to the inability of participants to identify gestures as the source of information. For instance, participants in Kelly et al.'s (1999) study who heard the speaker say, "My brother went to the gym," accompanied by a gesture of shooting a basketball, later misremembered her as saying, "My brother went to play basketball." Therefore, a gesture can communicate critical information to listeners without the listener being aware of the source of that information, and participants can be misled by gestures outside their awareness.

Certain properties of gestures may also increase the likeliness of them skewing eyewitnesses' responses. False memory creation is facilitated by imagery ability (Dobson & Markham, 1993; Drivdahl & Zaragoza, 2001), and imagined events can become confused with real memories (Goff & Roediger, 1998; Thomas, Bulevich, & Loftus, 2003; Wright, Loftus, & Hall, 2001). If gestures provide listeners with visual, semantic information that is not articulated in speech (Cassell et al., 1999; Goldin-Meadow, 1999; Kelly et al., 1999; Kendon, 1980), this extra perceptual detail offered by gestures may facilitate the creation of false memories. In line with the theory that memories are "reconstructed" rather than "replayed" (Loftus & Hoffman, 1989), the additional postevent information provided from gestures can also become integrated with details from the original memory and form a new representation of the witnessed event.

There are still considerations to be taken into account with this research. Participants in this study were told to "watch the video carefully," yet most witnessed events occur spontaneously without warning and usually without a determined effort being made to encode the facts. Accuracy of eyewitness memory also decreases with time (Kassin, Ellsworth, & Smith, 1989; Penrod, Loftus, & Winkler, 1982), so a time delay may make participants more susceptible to having their fading memory representation skewed by a misleading gesture and produce an even greater effect.

In summary, this study demonstrates the potential effects of misleading hand gestures in skewing the memory and responses of eyewitnesses. It adds to the substantial and robust evidence showing that witnesses can be misled by verbal questioning. Future empirical research into eyewitness testimony should take account of the gestural misinformation effect and the power of nonverbal influence, particularly its implications for criminal and forensic proceedings.

NOTE

Address correspondence about this article to Daniel J. Gurney, School of Psychology, University of Hertfordshire, College Lane, Hatfield, Hertfordshire, UK, AL10 9AB (e-mail: D.Gurney2@Herts.ac.uk).

REFERENCES

Beattie, G., & Shovelton, H. (1999). Do iconic hand gestures really contribute anything to the semantic information conveyed by speech? An experimental investigation. *Semiotica, 123,* 1–30.

Braun, K. A., Ellis, R., & Loftus, E. F. (2002). Make my memory: How advertising can change our memories of the past. *Psychology & Marketing, 19,* 1–23.

Broaders, S. C., & Goldin-Meadow, S. (2010). Truth is at hand: How gesture adds information during investigative interviews. *Psychological Science, 21,* 623–628.

Bruck, M., & Ceci, S. J. (1999). The suggestibility of children's memory. *Annual Review of Psychology, 50,* 419–439.

Cassell, J. (2000). Elements of face-to-face conversation for embodied conversational agents. In J. Cassell, J. Sullivan, S. Prevost, & E. Churchill (Eds.), *Embodied conversational agents* (pp. 1–27). Cambridge, MA: MIT Press.

Cassell, J., McNeill, D., & McCullough, K. E. (1999). Speech–gesture mismatches: Evidence for one underlying representation of linguistic and nonlinguistic information. *Pragmatics & Cognition, 7,* 1–34.

Church, R. B., & Goldin-Meadow, S. (1986). The mismatch between gesture and speech as an index of transitional knowledge. *Cognition, 23,* 43–71.

Dobson, M., & Markham, R. (1993). Imagery ability and source monitoring: Implications for eyewitness memory. *British Journal of Psychology, 32,* 111–118.

Drivdahl, S., & Zaragoza, M. (2001). The role of perceptual elaboration and individual differences in the creation of false memories for suggested events. *Applied Cognitive Psychology, 15,* 265–281.

Fisher, R., & Geiselman, R. (1992). *Memory-enhancing techniques for investigative interviewing: The cognitive interview*. Springfield, IL: Charles C. Thomas.

Garry, M., Manning, C. G., Loftus, E. F., & Sherman, S. J. (1996). Imagination inflation: Imagining a childhood event inflates confidence that it occurred. *Psychonomic Bulletin & Review, 3,* 208–214.

Goff, L., & Roediger, H. (1998). Imagination inflation for action events: Repeated imaginings lead to illusory recollections. *Memory & Cognition, 26,* 20.

Goldin-Meadow, S. (1993). *When does gesture become language? A study of gesture used as a primary communication system by deaf children of hearing parents*. Cambridge, England: Cambridge University Press.

Goldin-Meadow, S. (1999). The role of gesture in communication and thinking. *Trends in Cognitive Sciences, 3,* 419–429.

Goldin-Meadow, S., McNeill, D., & Singleton, J. (1996). Silence is liberating: Removing the handcuffs on grammatical expression in the manual modality. *Psychological Review, 103,* 34–55.

Graham, J. A., & Argyle, M. (1975). A cross-cultural study of the communication of extra-verbal meaning by gesture. *International Journal of Psychology, 10,* 57–67.

Gullberg, M., & Holmqvist, K. (1999). Keeping an eye on gestures: Visual perception of gestures in face-to-face communication. *Pragmatics & Cognition, 7,* 35–63.

Gullberg, M., & Holmqvist, K. (2002). Visual attention towards gestures in face-to-face interaction vs. on screen. In I. Wachsmuth & T. Sowa (Eds.), *Gesture and sign language based human–computer interaction* (pp. 206–214). Berlin, Germany: Springer.

Gullberg, M., & Holmqvist, K. (2006). What speakers do and what addressees look at: Visual attention to gestures in human interaction live and on video. *Pragmatics & Cognition, 14,* 53–82.

Gullberg, M., & Kita, S. (2009). Attention to speech-accompanying gestures: Eye movements and information uptake. *Journal of Nonverbal Behavior, 33,* 251–277.

Harris, R. J. (1973). Answering questions containing marked and unmarked adjectives and adverbs. *Journal of Experimental Psychology, 97,* 399–401.

Henderson, J., & Hollingworth, A. (1999). High-level scene perception. *Annual Review of Psychology, 50,* 243–271.

Holler, J., Shovelton, H., & Beattie, G. (2009). Do iconic hand gestures really contribute to the communication of semantic information in a face-to-face context? *Journal of Nonverbal Behavior, 33,* 73–88.

Kassin, S., Ellsworth, P., & Smith, V. (1989). The "general acceptance" of psychological research on eyewitness testimony: A survey of the experts. *American Psychologist, 44,* 1089–1098.

Kelly, S., Barr, D., Church, R., & Lynch, K. (1999). Offering a hand to pragmatic understanding: The role of speech and gesture in comprehension and memory. *Journal of Memory and Language, 40,* 577–592.

Kendon, A. (1980). Gesticulation and speech: Two aspects of the process of utterance. In M. R. Key (Ed.), *The relationship of verbal and nonverbal communication* (pp. 207–227). The Hague, The Netherlands: Mouton.

Krauss, R. M. (1998). Why do we gesture when we speak? *Current Directions in Psychological Science, 7,* 54–60.

Krauss, R. M., Chen, Y., & Gottesman, R. F. (2000). Lexical gestures and lexical access: A process model. In D. McNeil (Ed.), *Language and gesture* (pp. 261–283). Cambridge, England: Cambridge University Press.

Langton, S. R. H., O'Malley, C., & Bruce, V. (1996). Actions speak no louder than words: Symmetrical cross-modal interference effects in the processing of verbal and gestural information. *Journal of Experimental Psychology: Human Perception and Performance, 22,* 1357–1375.

Loftus, E. F. (1975). Leading questions and the eyewitness report. *Cognitive Psychology, 7,* 560–572.

Loftus, E. F. (2005). Planting misinformation in the human mind: A 30-year investigation of the malleability of memory. *Learning & Memory, 12,* 361.

Loftus, E. F., & Hoffman, H. G. (1989). Misinformation and memory: The creation of new memories. *Journal of Experimental Psychology: General, 118,* 100–104.

Loftus, E. F., & Palmer, J. C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior, 13,* 585–589.

Loftus, E. F., & Pickrell, J. E. (1995). The formation of false memories. *Psychiatric Annals, 25,* 720–725.

Loftus, E. F., & Zanni, G. (1975). Eyewitness testimony: The influence of the wording of a question. *Bulletin of the Psychonomic Society, 5,* 86–88.

McNeill, D. (1996). *Hand and mind: What gestures reveal about thought*. Chicago, IL: University of Chicago Press.

Memon, A., Zaragoza, M., Clifford, B. R., & Kidd, L. (2010). Inoculation or antidote? The effects of cognitive interview timing on false memory for forcibly fabricated events. *Law and Human Behavior, 34,* 105–117.

Penrod, S. D., Loftus, E. F., & Winkler, J. (1982). The reliability of eyewitness testimony: A psychological perspective. In N. Kerr & R. Bray (Eds.), *The psychology of the courtroom* (pp. 119–168). New York, NY: Academic Press.

Pine, K., Gurney, D., & Fletcher, B. (2010). The semantic specificity hypothesis: When gestures do not depend upon the presence of a listener. *Journal of Nonverbal Behavior, 34,* 169–178.

Poole, D. A., & Lindsay, D. S. (2002). Reducing child witnesses' false reports of misinformation from parents. *Journal of Experimental Child Psychology, 81,* 117–140.

Rauscher, F. H., Krauss, R. M., & Chen, Y. (1996). Gesture, speech, and lexical access: The role of lexical movements in speech production. *Psychological Science, 7,* 226–231.

Rogers, W. T. (1978). The contribution of kinesic illustrators toward the comprehension of verbal behavior within utterances. *Human Communication Research, 5,* 54–62.

Sacchi, D. L. M., Agnoli, F., & Loftus, E. F. (2007). Changing history: Doctored photographs affect memory for past public events. *Applied Cognitive Psychology, 21,* 1005–1022.

Skagerberg, E. M., & Wright, D. B. (2009). Susceptibility to postidentification feedback is affected by source credibility. *Applied Cognitive Psychology, 23,* 506–523.

Smith, V., & Ellsworth, P. (1987). The social psychology of eyewitness accuracy: Misleading questions and communicator expertise. *Journal of Applied Psychology, 72,* 294–300.

Thomas, A. K., Bulevich, J. B., & Loftus, E. F. (2003). Exploring the role of repetition and sensory elaboration in the imagination inflation effect. *Memory & Cognition, 31,* 630.
Thompson, L. A., & Massaro, D. W. (1986). Evaluation and integration of speech and pointing gestures during referential understanding. *Journal of Experimental Child Psychology, 42,* 144–168.
Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185,* 1124–1131.
Wells, G. L., Memon, A., & Penrod, S. D. (2006). Eyewitness Evidence. *Psychological Science in the Public Interest, 7,* 45.
Wright, D. B., Loftus, E. F., & Hall, M. (2001). Now you see it; now you don't: Inhibiting recall and recognition of scenes. *Applied Cognitive Psychology, 15,* 471–482.