Eyewitnesses Are Misled By Human But Not Robot Interviewers

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Abstract— **This paper presents research results from a study to determine whether eyewitness memory was impacted by a human interviewer versus a robot interviewer when presented misleading post-event information. The study was conducted with 101 participants who viewed a slideshow depicting the events of a crime. All of the participants interacted with the humanoid robot, NAO, by playing a trivia game. Participants were then interviewed by either a human or a robot interviewer that presented either control or misleading information about the events depicted in the slideshow. This was followed by another filler interval task of trivia with the robot. Following the interview and robot interactions, participants completed a paper-pencil post-event memory test to determine their recall of the events of the slideshow. The results indicated that eyewitnesses were misled by a human interviewer ($t(46) = 2.79$, $p < 0.01$, $d = 0.83$) but not by a robot interviewer ($t(46) = 0.34$, $p > 0.05$). The results of this research could have strong implications for the gathering of sensitive information from an eyewitness about the events of a crime.**

Index Terms—**Human-Robot Interaction, Interviews, False Memory, Memory, Social Demands.**

I. Introduction

Eyewitness testimony is often the most compelling evidence used by jurors in a trial, and has been shown to hold more sway over judges and juries than physical evidence (see [1] for a review). However, research on eyewitness memory suggests that such confidence in eyewitness testimony is misplaced (e.g., [2], see [3] for a review). In addition to research on eyewitness memory, exculpation due to post-conviction DNA evidence also provides evidence that eyewitness memory is not reliable [4]. Inaccurate eyewitness memory can occur, for instance, when misleading post-witnessed-event information is embedded in a narrative (e.g., [2]) or in questions about the event (e.g., [5-7]). The critical finding is that memory for a witnessed event is impaired when misleading, as compared to neutral or veridical, information is presented after the event. Although this result can be attributed to memory failures, other factors have been shown to contribute to inaccurate eyewitness memory [8]. For instance, social demands—or compliance with the perceived goals of the researcher—leads people to provide eyewitness reports that are counter to their memory for the event. This effect occurs with adults, but the role of the interviewer has been shown to be particularly important in obtaining veridical eyewitness memory from child witnesses. For instance, children who were interviewed by a police officer provided fewer accurate and more inaccurate memories than those interviewed by a neutral interviewer [9]. The purpose of the present study was to determine whether eyewitness memory was impacted more or less when a human interviewer versus a robot interviewer presented misleading post-event information.

II. Related Work

A. The Misinformation Effect

The impact of misleading post-event information on eyewitness memory is typically examined in the laboratory using the misinformation paradigm. For this paradigm, participants witness an event, such as a slide show portraying a maintenance man entering an office to repair a chair [8]. During his visit, the maintenance man also steals some money and a calculator. Later, people either read about (e.g., [2]) or answered questions about the witnessed event [5]. In a control condition, the questions asked about neutral information, such as "Just then, a tall man carrying a tool box entered the office. What do you think the man's profession was?" In the misled condition, misleading information about critical items was embedded in several questions. For instance, although the maintenance man hid the stolen calculator under a screwdriver in his toolbox, the misleading questions states: "The man headed toward the door. He stopped at his toolbox, lifted a hammer, and laid the calculator underneath it. Did he appear to be hiding it?" After another delay, people answer questions about the witnessed event, such as "The maintenance man lifted a tool out of his toolbox and placed the calculator beneath it. What tool was it?" Memory for the screwdriver is compared between the control and misled conditions; the typical finding that memory was worse in the misled condition is known as the *misinformation effect*. The misinformation effect is a robust finding (see [10] for a review), although some manipulations have been shown to ameliorate it, such as providing a post-event warning [2] or focusing attention on the source of the information [5]. The purpose of the present experiment was to determine whether the humanity of the interviewer was one such manipulation.

B. Robots and Avatars versus Humans

Research has shown that if an object moves, humans will attribute anthropomorphic characteristics to that object [11, 12]. In the case of robots, the more human-like behaviors the robot exhibits the more likely humans are to interact with it and treat it like another human [12-15]. Research conducted by Chidambaram *et al.* [14] indicated that robots were more likely to persuade humans to comply with a robot's suggestions if non-verbal cues (e.g., gaze, gestures, orientation, etc.) were incorporated into the robot's behaviors versus using verbal cues alone. In the study conducted by Chidambaram *et al.*, the results indicated that the use of bodily cues alone were more persuasive and led to higher compliance in the participants of the study than the use of vocal cues alone [14].

Another factor that impacts human – robot interaction is the length and/or frequency of interactions with robots. As humans interact with robots for longer periods of time or through repeated encounters, they tend to develop stronger bonds or connection with that robot. They are more likely to share information with the robot and they will have a greater tendency to attribute anthropomorphic characteristics to the robot [12, 16, 17]. However, in a study conducted by Bethel *et al.* [18] with children ages 4 – 5 years old, the children interacted immediately with the robot using the same social conventions (e.g., greeting, turn-taking, etc.) observed in human – human interactions, even though they had no prior experience interacting with robots. In the study, the children were interviewed by either a human or a robot regarding information they were given regarding a secret that they were requested to keep and the results indicated that the children were as likely to share this secret information with a robot as they were a human.

There are mixed results reported in the literature regarding how comfortable humans are with disclosing information, especially negative information about themselves to robots [19-21]. Research conducted by Turkle [19, 20] reported that the elderly participants she worked with were more likely to share personal information with a robot because the robot expressed no judgment; therefore, they felt more comfortable sharing this information with the robot than they did with humans. Conversely, Powers *et al.* [21] compared the impact of suggestions by an agent displayed on a large screen, a remotely projected robot that was displayed on a monitor or a large screen, to a collocated robot in the room with the participant. They found that participants were less likely to disclose negative personal information to a collocated robot than to either a remotely projected robot that was displayed on a computer monitor or an agent displayed on a large screen. The collocated robot was noted to have more influence in getting a person to comply with suggestions than the robot or agent displayed on the monitor or large screen. However, participants who interacted with the collocated robot also had lower conversational memory for information presented by the robot compared to information presented by the agent or remotely projected robot on a monitor or large screen. There is an indication that having a robot in the room may have distracted participants, which may have impacted their conversational memory for the information presented by the collocated robot.

A study conducted by Daugherty *et al.* [22] used a virtual police officer displayed on a screen during photographic lineups; the virtual police officer was compared to a human police officer administering a photographic lineup. As previously mentioned, eyewitness testimony, even though it is often imperfect, provides important evidence in many criminal cases. Obtaining accurate eyewitness information is essential to the validity of criminal proceedings. Although this study did not involve the use of a collocated robot, the results indicated that identification accuracy did not vary significantly based on the type of investigator (human versus virtual police officer) when conducting a photographic lineup. The study used the same scripted identification procedure with both the human and virtual officer, though a human investigator can become distracted, get fatigued, stumble over words, and exhibit reactions to the witness that a virtual officer would not exhibit. A participant in the study commented [22], "I don't feel persuaded by the virtual officer. But I might feel that way in the presence of a real person." As a result, study participants reported that the procedures presented by the virtual officer were less confusing. The results indicated that a virtual human is more likely to perform the procedures for the photographic lineup without impeding memory recall, decreasing usability, or having a negative affect when compared to a human officer performing the same role [22]. It is expected that these results would also be applicable to a robot performing this type of procedure.

C. Hypotheses

H1: We predicted that a significant misinformation effect would be obtained when the human interviewer presented the misleading post-event information, because the effect is robust. This hypothesis will be tested using an *a priori* planned comparison t-test between the control and misled conditions within the human interviewer condition.

In the case of a misinformation effect occurring with a robot interviewer, there was uncertainty as to what the hypothesis should be. The literature did not provide any clear indication of what might be expected; therefore, H2 consists of the different potential outcomes and possible justifications for each hypothesis.

H2: We predicted that if the robot interviewer was perceived by participants in the same way as a human interviewer, a significant misinformation effect would be obtained in the robot interviewer condition, as tested using the same *a priori* planned comparison t-test used in the human interviewer test. However, it could have been the case that the robot was more believable than the human interviewer, which would have resulted in better memory for the misleading information than even the control information in the robot interviewer condition. If this was the case, the misinformation effect might have been reversed. Finally, it could be that misinformation presented by the robot did not mislead participants to the same degree as misinformation presented by a human, resulting in no misinformation effect in the robot interviewer condition.

III. METHODS

A. Design and Participants

The study design presented two levels of Misinformation: control vs. misled to a group who was interviewed by a human and a group who was interviewed by a robot. Misinformation was manipulated between subjects. Participants were volunteer students who were recruited via flyers on campus and students who participated for course credit from a database maintained by the Department of Psychology at Mississippi State University. A total of 105 participants were randomly assigned to each of the four experimental conditions. Four participants were removed from both the memory test and the Interviewer Assessment because they had reported viewing the slides in a previous study. Participants ranged in age between 18 and 30 (M = 19.78, SD = 2.01). There were 58 females and 43 males for a total of 101 participants that took part in the study and had their data included in the analyses.

B. Materials

A slide sequence developed by McCloskey and Zaragoza [8] was used as the witnessed event. Six critical items were identified from series to serve as test items. Their witnessed and misled versions were as follows: Coffee *(Folgers, Maxwell House)*; Lighting Implement *(Match, Lighter)*; Reading Material *(Magazine, Newspaper)*; Soda *(Sunkist; 7-Up)*; Office Equipment *(Typewriter, Printer)*; Tool *(Screwdriver, Hammer)*.

A series of interview questions were modified from [5], and asked 15 questions about neutral information as well as the six critical items. For the control condition, the critical item was not specifically mentioned (e.g., "When he stopped at his tool box and put the calculator inside it, did he appear to be hiding it?"). For the misled condition, misinformation was embedded in the question (e.g., "He stopped at his tool box, lifted a hammer, and laid the calculator underneath it.).

A cued recall test was developed to test participants' memory for each of the critical items. The test consisted of six questions about each of the six critical items; the same test was given to participants in the control and misled conditions. For instance, the question about the tool stated: as "The maintenance man lifted a tool out of his toolbox and placed the calculator beneath it. What tool was it?"

As an interval filler task, and as a way to allow all participants to interact with the robot, a list of trivia questions was developed. The list consisted of 103 questions that were randomly presented to participants in two sessions (pre- and post-interview), such as "What is Japanese for a 17 syllable poem?"

Additional materials included an informed and audio/video consent form, a debriefing form, a demographic form that asked about participants' gender, age, and other related information, an interviewer assessment that asked questions about the interviewer (human or robot), a robot assessment that evaluated the robot during the trivia interactions, and an overall study assessment that asked questions related to how participants felt about the study.

C. Apparatus

The NAO humanoid robot manufactured by Aldebaran Robotics (www.aldebaran-robotics.com/en) was used in the study (See Fig. 1). This robot was selected for the study

Figure 1: The NAO Humanoid Robot.

because the investigator had two available to provide redundancy in case of robot failure. The NAO robot is 58 cm tall and has 21 degrees of freedom. The robot does not have an expressive face; however face tracking was enabled to allow the robot to track the movements of participants to indicate engagement, and when the robot spoke to participants its LED eyes displayed a brighter white color to indicate active interaction and would dim when it was finished speaking a phrase or sentence. The robot's LED eyes were shut off when not actively participating as an interviewer in the study and all face tracking and movement features were disabled to indicate the robot was not actively listening during the human interviewer condition. The robot remained in the room during all studies due to logistic problems encountered with trying to remove the robot during the human interviewer condition.

D. Procedure

1) Pre-Interview Tasks

Participants entered the lab, gave their consent to participate and to be audio/video recorded, and completed the demographics form. The procedures for this study are outlined in Fig. 2 of this paper. The procedure for the human interviewer condition started with viewing of the slideshow. Participants were told to pay close attention to details in the show and that their memory for details would be tested later. The slideshow was presented twice, and this phase lasted for a total of eight minutes. This is a common protocol in this type of study. After viewing the slideshow, the human interviewer left

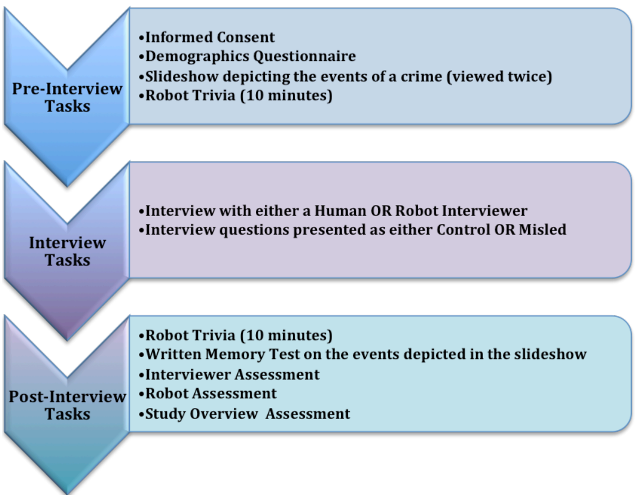

Figure 2: Summary of Study Procedures

the lab and participants interacted with the NAO robot by answering trivia questions posed by the robot for a total of 10 minutes as an interval filler task. This also allowed participants to become familiar the NAO robot to overcome any novelty effects that may occur from the initial interaction with the robot. We used the Wizard of Oz technique to control the speech of the robot [23]. The robot operator was concealed behind a partition in the laboratory space and not visible to the participants at any time during the study. White noise was generated in the study space to mask any noise from the robot operator.

2) Interview Tasks

The initial trivia phase was followed by the interview phase. The robot asked the participant to bring the human interviewer back into the lab, upon which the human interviewer asked the participant the 15 interview questions (Refer to Fig. 3). In the robot interviewer condition the participants did not request the human to return to the room until a later time period.

3) Post-Interview Tasks

After the interview the human interviewer left the lab once again, the NAO robot asked trivia questions for another 10-minute interval period. Then, the interviewer returned to the lab and the cued recall test was administered via paper-pencil. Finally, participants completed the post-experiment assessments (interviewer, robot, and study), were debriefed, and assigned credit or provided a raffle ticket for a chance to win one of four $50 gift cards to Amazon.com. The above procedures were the same for the robot interviewer condition except that the NAO robot was also the interviewer and asked the participants the 15 questions related to the events of the slideshow instead of having the human interviewer return to the lab to interview the participants (Refer to Fig. 4). All of the procedures were video and audio recorded.

Figure 3: Human Interviewer with Participant (Interviewer on Right)

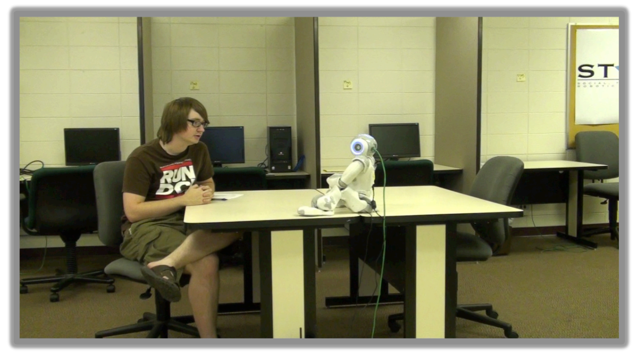

Figure 4: Robot Interviewer with Participant

IV. Results

Although a total of 105 people participated in the study, nine participants were eliminated from the analysis of the memory results. Four participants reported having seen the slides in a previous study, and five participants in the control condition failed to recall any information from the slide show. The memory analysis was conducted, therefore, on 96 participants and the Interviewer Assessment analysis was conducted on 101 participants; the five control participants were not eliminated from that analysis as they were still able to evaluate the interviewer, whether human or robot.

To test whether a significant misinformation effect was obtained in the human interviewer condition, an *a priori* planned comparison independent t-test was conducted on the probability of recalling the correct slide show version of each critical item. Recall accuracy was compared between the control and misled conditions. A significant misinformation effect was obtained, $t(46) = 2.79$, $p < 0.01$, $d = 0.83$. People in the control condition obtained higher scores on the recall test than those who were misled (see Fig. 5).

To test whether a significant misinformation effect was obtained in the robot interviewer condition, an *a priori* planned comparison independent t-test was conducted on the probability of recall between the control and misled conditions. Contrary to the human interviewer condition, the comparison did not produce significant results, $t(46) = 0.34$, $p > 0.05$. People in the misled condition were not less accurate than those in the control condition (see Figure 5).

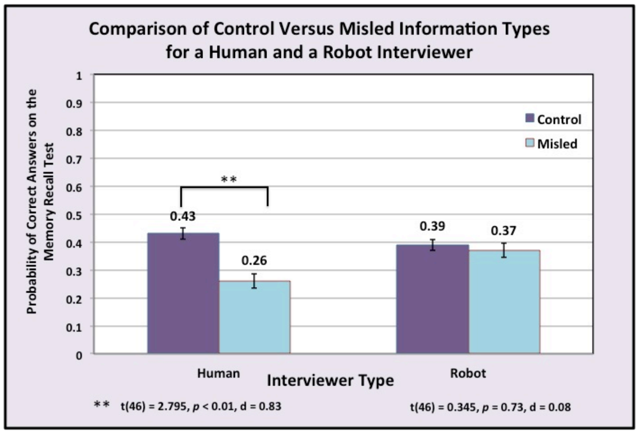

Figure 5: Independent t-test results evaluating control versus misled information types for a human interviewer versus robot interviewer.

Additionally, we conducted a Multivariate Analysis of Variance (MANOVA) on the responses to questions on an Interviewer Assessment to evaluate if there were any differences in perception of the human interviewer versus the robot interviewer. There was a significant difference found between the Interviewers, $F(22, 77) = 4.91$, $p < 0.01$, $\eta_p^2 = .58$; means and standard errors for the human and robot interviewer responses are listed in Table 1. Further examination of individual questions revealed that questions about the *trustworthiness*, $F(1, 98) = 6.99$, $p = 0.01$, $\eta_p^2 = 0.07$; *honesty*, $F(1, 98) = 17.19$, $p < 0.01$, $\eta_p^2 = 0.15$; *competitiveness/cooperativeness*, $F(1, 98) = 5.98$, $p < 0.05$, $\eta_p^2 = 0.06$; *believability*, $F(1, 98) = 4.79$, $p < 0.05$, $\eta_p^2 = 0.05$; and *comfort*, $F(1, 98) = 8.12$, $p < 0.01$, $\eta_p^2 = 0.08$ produced significant differences between the human and robot interviewers, favoring the human interviewer. Participants *trusted the human interviewer more than participants who interacted with the robot interviewer,* $F(1, 98) = 14.16$, $p < 0.01$, $\eta_p^2 = 0.13$. Participants also found the *robot significantly more difficult to understand*, $F(1, 98) = 97.37$, $p < 0.01$, $\eta_p^2 = 0.50$; and *found it harder to answer questions by the robot*, $F(1, 98) = 16.45$, $p < 0.01$, $\eta_p^2 = 0.14$, than the human interviewer. Finally, they experienced more *stress*, $F(1, 98) = 37.20$, $p < 0.01$, $\eta_p^2 = 0.28$ and *pressure*, $F(1, 98) = 20.66$, $p < 0.01$, $\eta_p^2 = 0.17$, when the robot, rather than the human, served as the interviewer.

Table 1: Descriptive statistics from the significant MANOVA results.

Question (Scale of 1 to 7)	Human Interviewer Mean	Human Interviewer Std. Error	Robot Interviewer Mean	Robot Interviewer Std. Error
How untrustworthy/trustworthy was the interviewer?	6.47	0.17	5.82	0.18
How dishonest/honest was the interviewer?	6.75	0.14	5.92	0.14
How competitive/cooperative was the interviewer?	6.69	0.12	6.27	0.12
How difficult/easy was it to answer the questions you were asked by the interviewer?	5.12	0.24	3.71	0.25
To what extent did you feel stressed (very much → very little) by the interviewer?	6.69	0.15	5.35	0.16
How hard was it to understand (very much → very little) by the interviewer?	6.80	0.18	4.20	0.19
How much did you trust the interviewer (very little → very much)?	5.90	0.20	4.82	0.21
How believable was the interviewer (very little → very much)?	6.22	0.16	5.71	0.16
How much pressure did you feel from the interviewer (very much → very little)?	6.49	0.19	5.25	0.20
How uncomfortable/comfortable did you feel with the interviewer?	6.22	0.18	5.49	0.19

V. Discussion

Consistent with prior research examining the impact of exposure to misleading information after witnessing an event (e.g., [2, 5, 6]), we found a misinformation effect when a human interviewer presented the misleading information. After witnessing a slideshow event, eyewitnesses who were exposed to misleading information merely by including that information in a question about the witnessed event were less able to accurately remember what they witnessed. Prior literature on the misinformation effect provides several potential theoretical explanations for the effect. One predominant theory suggests that the misinformation (e.g., hammer) linked to the test cue (e.g., tool) competes for retrieval of the witnessed information (e.g., screwdriver). Retrieval of the misleading information blocks access to the witnessed information. The Search of Associative Memory (SAM) [24] model of memory suggests that retrieval of the misleading information, given the cue, strengthens the association between the two, which in turn increases the likelihood that the misleading information will be retrieved whenever that cue is presented. Repeated retrieval of the misleading information blocks access to the witnessed information, resulting in poor memory for the witnessed information. Because people in the control condition never encounter competing information, the cue produces the witnessed target without competition, resulting in better memory for the witnessed information in that condition.

If response competition is the explanation for the misinformation effect, the question is why the effect was not obtained when a robot interviewer presented the misleading information. Memory for the witnessed information was not less accurate for people in the misled and control conditions when the interviewer was a robot. This finding is consistent with other research demonstrating that the misinformation effect can be obtained or ameliorated by factors other than memory. For instance, Eakin et al. [2] found that warning participants about the presence of misleading information immediately after they were exposed to it eliminated the misinformation effect. Other researchers have argued that when the misinformation effect is measured using a typical cued recall test, such as the one used in our study, social demands—as opposed to any memory factors— can impact the findings (e.g., [8]). People might provide the misleading information on the final test, rather than what they remember from the witnessed event, because they think that is what the researcher (who presented the misinformation) wants them to write. They may even think that the researcher has more accurate information, and supersede what they remember with what the researcher presented in the interview.

That social demands might have occurred with the human, but not the robot, could have been due to how people perceived the robot. In a comparison of participant perceptions and attitudes regarding several qualities of the interviewer, significant differences were found for characteristics including trustworthiness, honesty, believability, and comfort between the human and robot interviewer; the robot always received lower ratings than the human interviewer. The perceptions of the robot may have been different had the participants been able to interact with the robots for a longer period of time. Research indicates that the more frequent the interactions or the longer the time duration of interaction the more likely humans will bond with the robot [12, 16, 17].

Regardless, these negative perceptions of the robot all could have resulted in reduced social influence from the robot on the participants than from the human interviewer. Cialdini and Goldstein [25] cite several goals of participants that could explain the differential influence of the human versus the robot interviewer in our study, including the goals of accuracy, affiliation, and maintaining a positive self-concept. All three goals can lead people to comply with the researcher, even if the researcher opposes their own views. When a position of authority is added, the likelihood of compliance to social demands increases. The literature clearly shows the role of authority in producing social demands (e.g., [26]), and in our study participants may have perceived the human interviewer as more of an authority figure than the robot. When people interact with a robot that they perceive as exhibiting negative behaviors, they are more likely to overlook the behaviors as poor software, or assume that the behaviors are not intentional [12]. They do not assume that information presented by the robot is entirely valid and therefore may not view the robot as an authority figure. Humans are more forgiving of "bad" behaviors that could be irritating (e.g., repeating questions instead of rephrasing for improved understanding) when presented by a robot versus a human [12]. In the study, the robot would ask the participants if they wanted to have a question repeated if they were slow to respond to a question. This lack of feedback during robot trivia may have contributed to the lower ratings on the question related to cooperativeness for the robot, especially in the robot interviewer condition, in which the robot remained in the room and continued interaction immediately following the first round of trivia.

On the issue of trustworthiness and honesty, research studies have shown that humans have a tendency to not hold a robot morally accountable when it is deceptive [27, 28]. Kahn *et al*. [27] commented in their research that humans reported a robot as less accountable than a human but more accountable than a refrigerator when it causes harm. Short *et al.* [28] reported that participants were more likely to attribute the cheating behaviors exhibited by a robot to its programming or a malfunction in the system, than to the actual intelligence or behaviors exhibited by the robot. Factors such as this may have also impacted the believability of the robot interviewer compared to the human interviewer resulting in participants not considering the information presented by the robot as believable thereby not being misled when the information was presented.

The robot interviewer for this study was positioned in a stationary position on a table in front of participants. Although the robot did have face-tracking capabilities to exhibit appropriate gaze behaviors, and used lighting features to exhibit aliveness when speaking, there was an overall lack of non-verbal behaviors, which may have impacted the believability and level of comfort participants felt while interacting with the robot interviewer.

Another possible factor influencing participants' perceptions of the robot may have occurred during the interval filler trivia tasks. During both rounds of trivia, participants were not provided feedback on their answers to the trivia questions, although a few participants made anecdotal comments that they wanted to know if they answered the trivia questions correctly. The protocol was setup this way for consistency, because it was important that the participants did not have expectations that they would receive feedback on the questions presented in the interview portion of the study. However, the lack of feedback may have impacted perceptions of intelligence and anthropomorphism associated with the robot interviewer.

The fact that the robot was perceived more stressful to interact with and that people felt more pressure when they interacted with the robot could have impacted the memory findings over and above the differential impact of social demands for the two interviewer conditions. Factors such as stress and pressure negatively impact memory, including eyewitness memory (e.g., [29]), especially at retrieval (e.g., [30]).

Finally, the fact that people found the robot difficult to understand begs the question of whether the misleading information was fully understood and processed by those interviewed by the robot as compared to those interviewed by the human. If the misleading information was never understood, that information would not have been available to deter memory for the witnessed event. Because this factor likely also led to the increased stress and pressure experienced by participants, future research will strive to equate the understandability of the robot and human interviewer.

VII. Conclusions and Future Work

The results from this study indicate that there was a statistically significant difference in memory for details about an eyewitnessed event between a control and misled group when the misleading information was presented by a human interviewer (See Fig. 5). This result was not unexpected because it replicated the robust misinformation effect obtained by prior research. The implication of this finding on reliance on the veracity of eyewitness memory in criminal cases is clear. Memory for a witnessed event can be hindered by exposure to misleading information after the event. Misleading information that is counter to what is witnessed can be presented via repeated interviews by the police and/or attorneys, via news reports about the crime, and via discussing the witnessed event with other witnesses. Avoiding all sources of misleading information is a daunting, if not impossible, task. Therefore the credibility of eyewitness testimony must be measured by collaborating physical evidence; it should not be taken alone as evidence in a court case.

Because humans are prone to inexact interviewing techniques, we hypothesized that having a robot interview eyewitnesses would ameliorate the effect of misleading information on memory for a witnessed event; this finding was obtained. There was no difference in memory for the eyewitnessed event when a robot interviewer presented the misleading information. Although the robot presented the same misleading information as the human interviewer, memory for the witnessed information was not impacted by this misinformation; people in the misled condition remembered as many details as those in the control condition. This result could have strong implications for the gathering of sensitive information from an eyewitness about the events of a crime [18]. With a criminal justice system that relies heavily on eyewitness testimony, it is important to provide accurate information. The use of robots to gather eyewitness testimony and sensitive information may be beneficial in future criminal investigations, though further research needs to be performed.

Because human interviewers can inadvertently influence eyewitness testimony by the inclusion—intentionally or unintentionally— of misleading information into questioning, using virtual agents and/or robots to gather eyewitness testimony could be beneficial [22]. Based on research by Daugherty *et al.* [22], a virtual police officer did no worse than a human administrator on eyewitness performance during a photographic lineup, and it was possible to control the behaviors exhibited by the virtual officer and to provide clearer instructions. The result was less confusion by the eyewitnesses interacting with this virtual system. It is expected that a robot investigator may have similar results because of the ability to control the behaviors and communications performed. This conclusion cannot be held convincingly until future research addresses some of the limitations of the present study.

It is unclear based on the results of this study whether the reason for the lack of a misinformation effect is because of amelioration of the social demands applied by a human interviewer or was simply an issue of lack of comprehension of the misleading information because participants reported that the robot was not understood because of its text-to-speech system. Future studies will improve the understandability of the robot by using recorded voices or an improved text-to-speech system.

Future research needs to be performed evaluating the impact of social demand of humans versus robots especially as it relates to eyewitness memory and information gathering. There are two possible routes that could be taken. First, we could reduce the influence of social demands by the human by either making the human less likeable or by using a special type of cued recall test designed to eliminate the influence of social demands on memory. This test provides a hint—along with the cued recall test question—that tells participants not to answer the question with the misleading information. For instance, the test about the tool would include the hint “NOT hammer [2].” Participants who want to comply with the perceived demands of the researcher by reporting the misleading information would be dissuaded from doing so by the hint. In fact, complying with the social demands of the experiment would require that they not give the misleading post-event information as a response. Second, we could increase the likelihood that the robot would produce social demands by using a cover story, perhaps that this experiment is the robot’s last chance at “working” on the experiment and will be sent to the scrap heap if people do not pay attention to what he says.

Another open question is related to the gathering of sensitive information and/or eyewitness testimony from children. Will the effect in which a robot interviewer is less likely to mislead an eyewitness hold true with children? An issue of concern is that children that have been maltreated have had their trust betrayed by adult authority figures they should be able to trust and then they are interviewed by adult authority figures, which causes children to withhold important and sensitive information [9, 18]. A future application of this research is to use a robot alone in a room to serve as an non-threatening interviewer in the case of traumatized children. An adult interviewer or therapist could inadvertently ask leading questions or intimidate the child into providing false answers in order to comply with an authority figure. Demonstrating that a robot is less likely than a human interviewer to mislead eyewitness accounts could have a dramatic impact on how veridical information can be obtained from victims of crime, especially children.

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