

5-2014

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Submitted to the LSU Honors College in partial fulfillment of
the Upper Division Honors Program.

May, 2014

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& Agricultural and Mechanical College
Baton Rouge, Louisiana

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Abstract

In previous research (Vieira & Lane, 2012; Vieira, Lane & Moffett, 2013), repeatedly truthfully denying you had experienced something sometimes increased false memories and sometimes did not. One hypothesis is that these false memories are familiarity-based, and that they are more likely when people have poor memory for their original experience. In this experiment, participants either performed a series of actions or watched the experimenter perform them. Following the encoding phase, participants either lied or told the truth about these actions once or three times by describing them or denying they had performed/observed them. One week later, participants completed a source test, where they were asked to indicate their original experience (whether or not they performed/observed an action) and what they did subsequently (lied or told the truth about their experience by describing or denying it). For each recognition (i.e., whether they performed/observed the action) response, participants indicated their confidence and the subjective basis for their decision. Results showed that engaging in an action versus viewing an action influenced participants' ability to accurately remember a previous experience. Further, we replicated findings that the type of lie told, and the amount of times it is done so, impacts memory as well.

The Influence of Repeated Denials on Memory for Actions

Lying is an unavoidable aspect of human nature. People sometimes lie about relatively trivial things, such as whether one likes a friend's haircut. Other times, lies can be more significant, such as when someone invents an alibi to cover up the fact they stole money from an employer. While the intentions behind deception can vary by situation, there are several common ways in which we deceive: telling a lie explicitly, omitting or exaggerating the truth, or discrediting the truth (Hippel & Trivers, 2011). More broadly, these lies can be characterized as "a deliberate attempt to mislead others" (DePaulo, et al., 2003). Scientists have been interested in the nature of lying, with the vast majority of the literature focusing on identifying different verbal and non-verbal cues to these deceptions (e.g., DePaulo, et al., 2003; Lancaster, Vrij, Hope, & Waller, 2013; Warmelink, Vrij, Mann, & Granhag, 2012; Warmelink, Vrij, Mann, Jundi, & Granhag, 2013). A smaller amount of research has focused on the effects of lying on memory (e.g., Pickel, 2004; Polage, 2004, 2012; Vieira & Lane, 2012).

As a result of the ubiquity of lying in everyday life, it is important to know whether or not lying has an effect on memory for one's original experience and for the act of lying. For example, lying could lead someone to "believe their own lies" and falsely remember experiencing something they did not. Alternatively, forgetting that one lied about something previously could lead people to later contradict themselves and thus get caught. This suggests that people's ability to differentiate between the origins of memories, known as source monitoring, (Johnson, Hashtroudi, & Lindsay, 1993), might play a critical role in these situations. According to the source-monitoring framework (SMF; Johnson, et al., 1993), memories have features (e.g. perceptual, contextual, and affective information; cognitive operations) that reflect the conditions under which they were encoded. On average, different features are associated with different sources of memories, and thus can be used in making

source decisions. For example, perceived events (e.g., externally derived) are associated with more perceptual, spatial/temporal contextual and affective details and fewer cognitive operations, whereas imagined events (e.g., internally derived) will have more cognitive operations compared to other details. There are several ways in which errors in source monitoring decisions can occur. Source attributions can be compromised when encoding is impaired or cues to retrieval are poor, as well as when there is a high degree of similarity (perceptual, semantic, contextual) between two or more sources (Lindsay, 2008). Accuracy of source decisions is thus dependent on the information available and the circumstances of the source-monitoring judgment.

The impact of lying on source monitoring has been explored in a handful of studies (e.g., Polage, 2004, 2012; Vieira & Lane, 2012). Polage (2004; 2012) explored this issue in context of autobiographical memory using a procedure based on the imagination inflation paradigm (Garry, Manning, Loftus, & Sherman, 1996). Participants completed a Life Events Inventory (LEI) twice, where they rated the likelihood of different events happening to them before they were ten years old (Polage, 2004). The first LEI served two purposes as a baseline: 1) to derive two target events participants had rated as unlikely to have occurred to them for the lie session, and 2) to compare post-lying results. Two weeks later in an interview, participants were instructed to write believable stories about events that had happened to them and one target event that had not. Participants returned one week later and this time provided the same stories verbally. At test a week later, participants demonstrated a “deflation” effect on memory whereby they rated the lies as less believable than target events that were not lied about; in other words, the majority of participants became more confident that these events did not happen to them. In a follow-up experiment that varied the retention interval, comparable results were attained. Polage (2004) postulates that the act of fabrication produced memories of the cognitive processes involved in generating the stories (cognitive operations; Johnson, et al., 1993) that later served as cues that

the memory had not actually been experienced. To further explore this, Polage (2012) looked at disruptions in source monitoring via individual differences in frequency, stress, and dissociation (Exp. 1) as well as reduced temporal proximity of the lie session to the second LEI (Exp. 2), both of which resulted in susceptibility to “fabrication inflation,” or believing the self-generated lies. The results suggested that separating the lie session from the test session decreased the availability of information about cognitive operations, and as a result people had greater false beliefs.

Although Polage’s work (Polage, 2004; 2012) suggests factors that influence source memory for lies, there are some limitations to this research. For instance, source memory for the event was assessed using LEI and memory for lying was assessed in a separate questionnaire. Prior research in source memory suggests that the format of the test influences the degree to which participants systematically assess source memory (e.g., Zaragoza & Lane, 1994). Furthermore, Polage examined only one type of lie, namely fabricating a description for an event that did not happen. Li and Kemp (2013) also provided evidence for the salience of false descriptions, wherein participants who lied about critical items on an initial memory recall task were able to remember the items that they lied about on a subsequent recall task. After viewing three minutes of robbery footage, participants completed an initial memory task and were either 1) told to tell the truth for all items, and report the time for critical items; 2) told to lie about the critical items only; or 3) asked to write about an autobiographical event. One week later, participants returned to complete another memory questionnaire and a source monitoring task. Results showed that although liars may have better remembered the items they lied about better than truth-tellers, some aspects of their lies were still incorporated into their memory. Additionally, though there were no significant differences between truth-tellers and liars for memory accuracy, truth tellers incorporated more self-generated false information into their

memories and were less able to identify those items for which they provided that false information. The authors posit that this may have occurred because actively generating false information made the information more plausible to the participants, and this increased plausibility increased truth-tellers' errors.

Vieira and Lane (2012) extended this previous work by examining the impact of different types of lies and the effects of repetition. In the first phase of the experiment, participants studied a series of pictures with object labels. They then proceeded to the rehearsal phase where they were prompted to lie or tell the truth about having studied these items by describing them or denying they had seen them. The authors argued that the process of creating descriptions should increase memory for the cognitive operations relative to simple denials, and thus should lead to better source memory. After two days, participants completed a source memory test and identified whether items were studied or not, rehearsed or not, and if so, how were they rehearsed. As predicted, source memory accuracy was higher for items that had been described (truthfully or not) than for items that were denied (truthfully or not). However, they also found that repeated truthful denials increased false memories of having seen a nonstudied picture relative to an unrehearsed control item. The authors argued that repetition increased the familiarity of the denied items in combination with poor memory for the source of this familiarity (i.e. poor memory for the act of denial). They also noted that such findings are consistent with the findings of research examining familiarity-based memory errors (e.g., the *illusory truth effect*, Begg, Anas, & Farinacci, 1992). For applied reasons, these errors are also of interest because they could play a role in situations where people falsely confess to a crime after repeated interrogation (e.g., see Henkel & Coffman, 2004).

Although repeated truthful denials increased false memory in Vieira and Lane (2012), false descriptions did not. The authors argued that this might be the case because the objects did

not lend themselves to rich, detailed descriptions (and therefore were lacking in perceptual detail), and because participants still had strong memories for the act of generating descriptions at test. In a subsequent experiment, Vieira, Lane, and Moffett (2013) repeated the procedure from Vieira and Lane (2012) with two modifications: 1) instead of pictures of objects, interactions with objects were used to increase the descriptiveness of lies, and 2) the interval between the rehearsal and test phases was increased to one week. Participants again demonstrated better source monitoring accuracy for descriptions than denials. More, false recognition for unperformed actions was significantly higher than for an unrehearsed control item when participants repeated their lies only once (but not when they had done so three times), signifying a “fabrication inflation” effect when memory for the cognitive operations involved in creating the lies was weak. However, false memory was not significantly increased by repeated truthful denials. One hypothesis for this finding is that these errors were reduced in this experiment because participants’ memory for the actions was strong and detailed, and thus it was easier to reject items that were simply highly familiar.

The current study extended this line of research by examining the nature of false memories that result from repeated truthful denials and factors that may increase or decrease them (Vieira & Lane, 2012; Vieira, et al. 2013). There were two major changes to the procedure of Vieira, et al. (2013). First, the type of role a participant performed during the encoding phase was manipulated in order to vary the strength and vividness of memory. Participants were randomly assigned to either the Actor condition, where they performed a set of actions themselves (replicating Vieira, et al. 2013), or to the Observer condition, where they witnessed the experimenter perform a set of actions. Manipulating the type of role served two purposes in this experiment. Source monitoring relies on the quality of information that is encoded initially (Johnson, Hashtroudi, & Lindsay, 1993), so manipulating whether the participant performs the

actions himself or watches the actions being performed by another effectively manipulates memory for that original action. Specifically, prior research has found the people are more likely to recall their own actions than the actions of others (“the enactment effect,” e.g., Roediger & Zaroomb, 2010). Due to the impoverished encoding, we expected to find more source monitoring errors in the Observer condition, particularly the errors resulting from truthful repeated denials seen previously (Vieira & Lane, 2012). The Actor v. Observer conditions will additionally simulate the difference between lying about self- and other-related actions, as it has been found that these distinctive types of lies have different neural processes and activation patterns (Ganis, Morris, & Kosslyn, 2008). Specifically, the activation centers of rate-limiting processes (the efficiency of which greatly affects performance) were found to be close but non-overlapping for self- and other-related lies (Ganis et al., 2008, p. 551).

The current study also added confidence and subjective memory judgments after each item’s source judgment, in order to determine whether false memories arising from repeated denials are familiarity based, as suggested in Vieira and Lane (2012). Following each source judgment, participants were asked to provide confidence in their judgment about whether they performed or observed the action. Subsequently, participants chose between three bases for their memory judgments — recollection, familiarity, or guessing. These categories (described in more detail in the method section) were used when participants said they performed/observed an action, and when they said they did not. In other words, this allowed us to study the subjective bases for “old” decisions and for situations when a person rejected an item as being old (e.g., Marsh, et al., 2009). We hypothesized that if repeated truthful denials are based on familiarity rather than recollection of perceptual details, then these false memories would be endorsed with less confidence than false memories resulting from false descriptions, and should more often said to be made on the basic of familiarity rather than recollection. Additionally, if Vieira, et al.

(2013) is correct that false memories resulting from repeated truthful denials are reduced when memory for actions is strong and vivid, this might suggest an increased use of “distinctiveness heuristic” (Schacter, Israel, & Racine, 1999) for these items in the Actor than in the Observer condition. Specifically, we expected Actor condition participants to be more likely than Observer participants to claim that they did not perform the action because, if it had been performed, they would be able to recollect doing it (i.e., lack of recollection when it would be expected).

So, to sum, the main hypotheses are as follows:

H1: Source monitoring errors will be greater in the Observer condition than in the Actor condition.

H2: False recognition for truthful repeated denials will be higher in the Observer than in the Actor condition.

H3: Repeated truthful denial errors will be associated with lower confidence than false memories resulting from false descriptions, and should more often be claimed to be made on the basis of familiarity rather than recollection.

H4: Actor condition participants will be more likely than Observer participants to claim that they did not perform the action because, if it had been performed, they would be able to recollect doing it (i.e., lack of recollection when it would be expected)

Method

Participants

A total of 48 students (37 females; 11 males) at Louisiana State University participated in the experiment for partial course credit. For his or her participation, everyone who completed the study was considered for a \$25 prize, a reward for being judged the most believable. Sign-ups were conducted through the Sona system. Normal or corrected to normal vision, speech, and

hearing was required. Ages of participants varied between 18 and 38 years of age ($M = 20.44$, $SD = 2.91$). Random assignment determined to which condition a participant was assigned: Actor or Observer.

Design and Materials

This study was a 2 (Type of role: Actor, Observer) x 2 (Veracity: Lie, Truth) x 2 (Rehearsal Type: Deny, Describe) x 2 (Repetition: Once, Thrice) mixed model factorial design. All factors, with the exception of type of role, were manipulated within-subjects. Participants were assigned to either perform a set of actions (Actor condition) or watch the experimenter perform the same actions (Observer condition). The stimuli were comprised of a set of simple objects. The actions (as well as the associated objects) are from a previous study (Vieira, et al., 2013) and can be found in Appendix A.

The source-monitoring test for each participant was comprised of 10 types of items: 1) *studied lie-deny once* items (actions that participants performed/observed and later rehearsed one time by falsely denying having performed/observed the corresponding action), 2) *studied lie-deny thrice* items (actions that participants performed/observed and later rehearsed three times by falsely denying having performed/observed the corresponding action), 3) *studied truth-describe once* items (actions that participants performed/observed and later rehearsed one time by truthfully described the corresponding action), 4) *studied truth-describe thrice* items (actions that participants performed/observed and later rehearsed three times by truthfully describing the corresponding action), 5) *studied no-rehearsal* items (i.e., items that participants performed/observed but did not rehearse), 6) *unstudied truth-deny once* items (i.e., actions that participants did not perform/observe and later rehearsed by truthfully denying the corresponding action one time), 7) *unstudied truth-deny thrice* items (i.e., actions that participants did not perform/observe and later rehearsed by truthfully denying the corresponding action three times),

8) *unstudied lie-describe once* items (i.e., actions that participants did not perform/observe and later rehearsed by falsely describing the action as if it had been performed/observed one time), 9) *unstudied lie-describe thrice* items (i.e., actions that participants did not perform/observe and later rehearsed three times by falsely describing the action as if it had been performed/observed), and 10) *unstudied no-rehearsal* items (i.e., actions that participants did not perform/observe and did not later rehearse). Item type was counterbalanced so that across the experiment, each item was presented as each item type.

Procedure

This study was divided into three phases across two sessions: a study phase and a rehearsal phase in Session 1, and a test phase in Session 2. Prior to the first phase (the Action Phase), participants provided informed consent and received instructions about the actions they would either perform (in the Actor condition) or watch the experimenter perform (in the Observer condition). The participant sat across a table from the experimenter. Next to the experimenter was a partition that hid from the participants' view the objects that would be used for the 24 actions. The experimenter set an object on the table in front of the participant, read an action statement, then began the timer. Each action was carried out for 10 seconds. In the Actor condition, participants themselves performed the actions. In the Observer condition, the experimenter would begin the timer and perform the action for 10 seconds. After 10 seconds had passed, the experimenter would stop the timer, remove the object from the table and replace it with another object, and move on to the next action statement. This continued until all 24 actions had been completed in a predetermined, random order.

Immediately afterwards, participants began the Rehearsal Phase. Participants were told that they would be lying and telling the truth about numerous actions. In the Actor condition, these actions included those they just performed and other actions that are new. In the Observer

condition, these actions included those they just witnessed and others that are new. A video camera was set up on a tripod behind the experimenter, positioned so that it could see the participant but not the prompts for the rehearsed items. In both conditions, participants were instructed to lie or tell the truth, by describing an action or denying they had performed/observed an action, all while being video recorded. They were told their goal was to be as believable as possible, as another group of people would later watch their videotaped responses and judge their believability. As motivation, participants were told of a \$25 incentive that the participant who is judged to be the most believable would receive.

Participants were also given specific information about the format of each trial. Specifically, they were informed that a series of action statements would appear on the computer screen describing actions that they may or may not have performed (or observed) in the previous phase (i.e., “studied” actions). Under each action statement appeared instructions to (truthfully or deceptively) deny or describe performing the action (i.e., “*tell the TRUTH by accurately describing this action*”, “*tell the TRUTH by saying that you did not perform (observe) this action*”, “*LIE by saying that you did not perform (observe) this action*”, or “*LIE by falsely describing this action as if you had done (observed) it*”). Participants saw the instructions on the computer screen for each item, then turned directly to the camera to provide a response. After four practice trials, one for each type of response given, participants began the actual rehearsal phase. For each trial, the participant saw an action statement on the computer with instructions to tell the truth or lie by denying or describing the action, then turned to the video camera to give their response, and turned back to the computer for the next action statement. The experimenter was responsible for clicking and moving on the next statement; however, participants were informed that the experimenter moving on was not an indication of belief in the correctness of the participant’s response.

During this rehearsal phase, participants responded to a total of 32 items, with eight items for each of four item types: studied truth-describe, studied lie-deny, unstudied truth-deny, and unstudied lie-describe. During the rehearsal phase, half of each type of item appeared once; the other half appeared three times. That is, four of the eight studied truth-describe items appeared once, and four of those eight appeared three times. For those items that are repeated, participants were told to keep their responses as consistent as possible. Two types of control items not in the rehearsal phase were also included on the final source test — items that were performed/observed in the study phase only (i.e., studied no rehearsal items) or items that had not been viewed at all (i.e., unstudied no rehearsal items). See Figure 1 for a graphic representation of rehearsed item types. After completing the rehearsal phase, participants rated the difficulty of responding for each item type on a 1-7 scale (1= Not at all difficult, 7 = Very Difficult). Participants were then dismissed and asked to return in one week for the second session.

After a one-week delay, participants returned for the final phase (the test phase). At this point in time, participants completed a 48-item source test. Source test items included the 32 items from the rehearsal phase, as well as the 16 unrehearsed control items. Participants were informed that their responses in Session 2 should be completely truthful. A series of action statements describing both performed (observed) and unperformed (unobserved) actions appeared on the screen. To assess source accuracy, participants chose from response options of how they had encountered the action in Session 1 (i.e., did they perform/observe the action in the study phase, did they rehearse the action, and did they do so truthfully or deceptively?) Each participant was offered the same six response options: 1) I performed (observed) this action but denied performing (observing) it on camera, 2) I performed (observed) this action and truthfully described it on camera, 3) I performed (observed) this action but did not talk about it on camera,

4) I did not perform (observe) this action and truthfully said so on camera, 5) I did not perform (observe) this action but falsely described it on camera, and 6) I did not perform (observe) this action and did not talk about it on camera. Participants typed in the number that corresponded to their answer choice. Eight test items corresponded to each response option, or source. If the participants chose a source option indicating that they performed (or observed) the action, they were then asked to rate their confidence that they had performed (or observed) that action. Participant confidence was measured on a scale of 1 to 5, where 1 = Not at all Sure and 5 = Definitely Sure. After that decision, they were given three response options from which to choose describing the basis for their memory judgment for that action: 1) I recollect performing (or observing) the action, 2) The action is familiar to me, and 3) I am guessing. Alternatively, if the participants chose a source option that indicated they did not perform (or observe) the action, they were asked to rate their confidence that they did not complete (or observe) the action. Again, participant confidence was assessed on the same 1 to 5 scale, with 1 = Not at all Sure and 5 = Definitely Sure. Participants were also asked to choose one of three response options that best describes the basic for their memory judgment: 1) I would have recollected the action if I had performed it (or observed it), 2) The action is not familiar to me, or 3) I am guessing. Due to a programming error, confidence and the subjective memory bases for “not performed (observed)” judgments was not collected for most participants in this sample (although this is currently being collected in the ongoing study). Because of this, it was not possible to test H4.

Response time was recorded for each item. Following the source test, participants completed a descriptions test, wherein they were asked to type out the exact description that they gave to the camera during the Rehearsal Phase. The descriptions test was comprised of 16 items that the participant had described in the Rehearsal Phase; eight of the items had been rehearsed truthfully (i.e., the participants had performed/observed the action and accurately described it)

and eight had been rehearsed deceptively (i.e., the participants had not performed/observed the action and provided a false description of that action). After typing out their descriptions, they were asked to indicate their confidence in how accurate they believed their descriptions to be. Following completion of the tests, participants then provided demographic information about their background and other post-test information. Participants were then debriefed and dismissed from the study.

Results

Due to a programming error, 32 of the participants in the study saw a portion of the test items a second time. To be able to assess performance in these participants, only the response the first time an item appeared on the test was scored. In the analyses that follow, all effects are reported as significant at $p < .05$.

Source Memory Accuracy

Source memory accuracy for participants' original experience was assessed with a 48-item source test, where participants chose one of six response options (described above) describing their session 1 experience. A participant's source test response was considered accurate if he or she correctly identified what happened with that action in both the study and rehearsal phases. For example, an unstudied lie-describe item for participants in the Actor condition would be correctly classified as "I did not perform this action but falsely described it on camera." See Tables 1, 2, and 3 for descriptive statistics.

Source test accuracy for the different item types was assessed with a 2 (Type of Role: Actor, Observer) X 2 (Veracity: Lie, Truth) X 2 (Rehearsal type: Deny, Describe) X 2 (Repetition: Once, Thrice) mixed model ANOVA conducted on the mean proportion of accurate source test responses for all rehearsed item types (See Figure 2). The between subjects variable was Type of Role; Veracity, Rehearsal type, and Repetition were within-subjects variables.

There was a significant main effect of Type of Role, $F(1, 46) = 6.74$, $\eta_p^2 = .13$ in that source accuracy was significantly higher for items that participants performed themselves (Actor condition; $M = .50$, $SE = .03$) than for actions that they saw the experimenter perform (Observer condition; $M = .40$, $SE = .03$). There was a significant effect of Veracity, $F(1, 46) = 5.68$, $\eta_p^2 = .11$, such that source accuracy for items that had been truthfully described or denied ($M = .49$, $SE = .02$) was significantly higher than for items that had been lied about ($M = .42$, $SE = .03$). There was a significant effect of Repetition, $F(1, 46) = 75.22$, $\eta_p^2 = .62$. Source accuracy was significantly higher for items rehearsed three times ($M = .56$, $SE = .02$) than for once rehearsed items ($M = .35$, $SE = .02$). There was a significant main effect of Rehearsal, $F(1, 46) = 213.11$, $\eta_p^2 = .82$. Source accuracy was significantly higher for items that were described ($M = .64$, $SE = .02$) than for items that were denied ($M = .27$, $SE = .02$). This main effect is qualified by a significant interaction between Veracity and Rehearsal Type, $F(1, 46) = 34.37$, $\eta_p^2 = .43$. Follow-up t-tests revealed that accuracy was significantly higher for items that were falsely denied ($M = .32$, $SE = .03$) than for items that were truthfully denied ($M = .22$, $SE = .03$), $t(47) = 2.55$. For described items, this pattern was reversed, as accuracy was higher for items that were truthfully described ($M = .76$, $SE = .03$) compared to falsely described items ($M = .52$, $SE = 0.04$), $t(47) = -5.81$.

Accurate and False Memory for Having Performed or Observed Actions

To evaluate accurate and false memory for performing or observing an action, responses of “I performed/observed this action but denied performing it on camera”, “I performed/observed this action and truthfully described it on camera”, and “I performed/observed this action but did not talk about it on camera” were collapsed into a “*performed/observed*” response category. Additionally, to evaluate accurate and inaccurate memory for NOT performing or observing an action, responses of “I did not perform/observe this action and truthfully said so on camera”, “I

did not perform/observe this action but falsely described it on camera”, and “I did not perform/observe this action and did not talk about it on camera” were collapsed into a “*Not performed/observed*” response category. Descriptive statistics for source accuracy can be found in Table 4.

A 2 (Type of Role: Actor, Observer) X 5 (Item Type) mixed model ANOVA was conducted to compare the effect of each performed item type (i.e. performed lie deny once, performed lie deny thrice, performed truth describe once, performed truth describe thrice, and performed no rehearsal) and each observed item type (i.e. observed lie deny once, observed lie deny thrice, observed truth describe once, observed truth describe thrice, and observed no rehearsal) on the mean proportion of accurate “studied” responses (i.e. **accurate recognition**; see Figure 3). No rehearsal items served as control items to which experimental items were compared. There was no significant main effect of Role, $F(1, 46) = .72, p > .05$. Therefore, accurate recognition will be discussed without regard to condition. There was a significant effect of Item Type, $F(3.26, 149.79) = 9.22^1, \eta_p^2 = .167$. Pairwise comparisons from an LSD post hoc test revealed that all rehearsed item types were more often accurately categorized as “present” than the no rehearsal items ($M = .84, SE = .02$). There was no statistical significance between once falsely denied items ($M = .93, SE = .02$) and thrice falsely denied items ($M = .91, SE = .02$), or between truthfully described once items ($M = .97, SE = .01$) and truthfully described thrice items ($M = .98, SE = .01$). The difference between truth-describe items (both once and thrice) and lie-deny thrice items was also significant.

A 2 (Type of Role: Actor, Observer) X 5 (Item type) mixed model ANOVA was conducted to examine the effect of each unperformed item type (i.e. unperformed truth deny once, unperformed truth deny thrice, unperformed lie describe once, unperformed lie describe thrice, and unperformed no rehearsal) and each unobserved item type (i.e. unobserved truth deny

once, unobserved truth deny thrice, unobserved lie describe once, unobserved lie describe thrice, and unobserved no rehearsal) on the mean proportion of inaccurate “performed/observed” responses (i.e., **false recognition**; see Figure 4). There was a significant effect of type of role, $F(1, 46) = 4.66, \eta_p^2 = .092$ such that participants who observed actions had higher rates of false recognition ($M = .15, SE = .02$) compared to participants who performed actions ($M = .09, SE = .02$). There was a significant effect of Item Type, $F(2.56, 117.86) = 12.40^2, \eta_p^2 = .212$. The interaction between type of role and item type was nonsignificant $F(2.56, 117.86) = .11^2, p > .05$. Pairwise comparisons from an LSD post hoc test revealed that unstudied and unrehearsed items had lower rates of false recognition ($M = .03, SE = .01$) compared to the four types of rehearsed items. There was no statistically significant difference in items that were truthfully denied once ($M = .07, SE = .02$) compared to truthfully denied thrice ($M = .07, SE = .02$), or between items that were falsely described once ($M = .19, SE = .03$) compared to falsely described thrice ($M = .22, SE = .04$). All rehearsed item types – truth-deny once ($M = .07, SE = .02$), truth-deny thrice ($M = .07, SE = .02$), lie-describe once ($M = .19, SE = .03$), and lie-describe thrice ($M = .22, SE = .04$) – differed significantly from each other, such that both types of false descriptions had higher rates of false recognition.

Confidence

Participants rated their level of confidence in their source memory judgments using a 1 to 5 scale, where a response of “1” indicated “Not sure at all” and a response of “5” indicated “Definitely sure.” Analysis of participant confidence parallels that of accuracy as described above; a 2 (Type of Role: Actor, Observer) X 5 (Item Type) mixed model ANOVA was used to evaluate confidence in memory judgments for each item type for accurate recognition (see Figure 5 for descriptives). There was no significant effect of type of role, $F(1, 45) = .003, p > .05$. There was a significant effect of Item Type, $F(3.23, 145.12) = 10.48^3, \eta_p^2 = .189$. Pairwise

comparisons from an LSD post hoc test revealed that while the mean confidence ratings for falsely denied once items ($M = 4.48$, $SE = .09$), falsely denied thrice items ($M = 4.54$, $SE = .10$), and no rehearsal items ($M = 4.50$, $SE = .08$) did not differ significantly, they were significantly lower than confidence in truthfully described once items ($M = 4.73$, $SE = .07$) and truthfully described thrice items ($M = 4.90$, $SE = .04$). Additionally, truthfully described once items differed significantly from truthfully described thrice items.

In order to run the omnibus ANOVA test on confidence in false recognition, a participant's data would be included if they had falsely recognized something in each item type. As there were no participants who satisfied all conditions of the test (i.e., not everyone had an answer for each item type, so there were no valid cases), the omnibus ANOVA could not be run to analyze confidence in false recognition (see Figure 6 for descriptives). However, as stated in our hypotheses, we expected to find that thrice-repeated truthful denials would be associated with lower confidence when compared to falsely described once items. A paired samples t-test was conducted to assess this planned comparison. Though confidence was found to be lower for these repeated truthful denials ($M = 3.64$, $SE = .45$) rather than lie-describe once items ($M = 3.77$, $SE = .40$), the difference between the two was not statistically significant, $t(10) = -.389$, $p > .05$.

Subjective Memory Judgments

Participants who indicated that they performed (or observed) an action on the source test were given three options of describing the basis of their memory judgments: 1) I recollect performing (or observing) the action, 2) The action is familiar to me, and 3) I am guessing. Again, analysis of memory judgments parallels those of memory accuracy and confidence. A 2 (Type of Role: Actor, Observer) X 5 (Item type) mixed model ANOVA was conducted to evaluate memory basis judgments for each item type for accurate recognition. Not all

participants were counted in the analysis, due to the ANOVA test's requirement that participants have an accurate response in each item type to be included. For items that were *recollected*, there was no significant effect of item type, $F(2.34, 49.11) = 1.92^4$, $p > .05$, $\eta_p^2 = .08$. There was a marginally significant effect of type of role, $F(1, 21) = 3.95$, $p = .06$, $\eta_p^2 = .16$ such that participants who observed an action indicated more of their responses were based on recollection ($M = .96$, $SE = .05$) than participants who performed an action themselves ($M = .84$, $SE = .04$). There was no significant interaction between type of role and item type, $F(2.34, 49.13) = 1.49^4$, $p > .05$. Correct items that participants indicated were *familiar* did not differ significantly based on Item Type, $F(2.536, 53.260) = 1.28^5$, $p > .05$, $\eta_p^2 = .057$, or Type of Role, $F(1, 21) = 2.61$, $p > .05$, $\eta_p^2 = .11$.

A 2 (Type of Role: Actor, Observer) X 5 (Item type) mixed model ANOVA was also conducted to evaluate memory basis judgments for each item type on false recognition. The omnibus ANOVA encountered the same analysis problems as with confidence: no participants satisfied all conditions, so there were no valid cases. However, descriptive statistics can be informative (see Table 5). For instance, the majority of these false alarms were based on recollection, with the exception of falsely described once and no rehearsal items. Thrice repeated items also tended to be more based on recollection than once repeated items. For correct recognition, descriptions were more based on recollection than denied items; items once rehearsed were also more based on recollection than items thrice rehearsed. As these are only descriptive statistics, we cannot determine if these patterns are statistically significant. *A priori*, however, we expected to find that repeated truthful denials would be more based on familiarity than 1) singular truthful denials, and 2) repeated false descriptions. A paired samples t-test was conducted to assess these planned comparisons (see Table 6). In comparing repeated truthful denials and repeated false descriptions, more items were based on “familiarity” when falsely

described three times ($M = .29$, $SE = .10$) rather than truthfully denied three times ($M = .27$, $SE = .14$); however, this difference was not significant, $t(10) = -0.80$, $p > .05$. The difference between truth-deny once items ($M = .10$, $SE = .10$) and truth-deny thrice items ($M = .60$, $SE = .25$) was marginally significant, $t(4) = -2.24$, $p = .09$.

Discussion

This study was intended to explore factors that influence false recognition errors of repeated truthful denials. Previous research (Vieira & Lane, 2012; Vieira, Lane & Moffett, 2013) has shown that repeatedly truthfully denying you had experienced something sometimes increased false memories and sometimes did not. The current study examined the hypotheses that these false memories may be familiarity-based, and that they may also be more likely when people have poor memory for their original experience. The manipulation of role had the intended effect of reducing memory for the actions, as source memory was better in the Actor than Observer conditions. When participants performed actions themselves, they were more accurate at categorizing what happened in both the study and rehearsal phases, compared to when they merely observed actions. This manipulation also influenced rates of false recognition overall, such that participants who witnessed actions more often incorrectly identified unobserved actions as actions they *had* seen, compared to those who performed actions themselves. The increased false recognition rate for those who merely observed an action provides evidence for the importance of initial encoding. However, the hypothesis about the effect of role on false recognition was not supported. Repetition did not increase false memories of truthful denials in either condition relative to unperformed, unrehearsed control items. On the surface, this appears to replicate the findings of Vieira, Lane, and Moffett (2013), who similarly failed to find a significant increase in errors from repetition (although there was a nominal increase from control items). But the current results are inconsistent with that study as well, as

Vieira, et al found that false recognition increased from truthful denials that been made once versus thrice. In the current study, repetition had no effect. In fact, repetition also failed to affect false recognition for descriptions in the current study, which conflicts with the Vieira et al's finding of reduced false recognition in descriptions that had been made once versus thrice. There are two potential reasons for the discrepancy of results between the two studies. The first is a methodological difference between the studies. In Vieira et al., participants simply made source decisions for each item, but in the current study, participants made source decisions, confidence, and bases judgments for all items. It is possible that these additional judgments made participants evaluate their memories more closely and thus effects of repetition may have been countered. The second concerns the programming error that resulted in many participants seeing test items multiple times. Although the response to a second presentation was never counted, it is possible that this may have influenced participants' judgments.

In comparison to the unrehearsed control items, rehearsing an item increased both false alarms (false recognition) and hits (accurate recognition). People's ability to correctly identify "old," or already seen, actions as "old" was not influenced by whether or not they performed or observed actions; rather, rehearsal itself, and to some extent the veracity of that rehearsal, played a substantial role. Surprisingly, repeating the item three times did not offer an advantage for either descriptions or denials in correctly saying that they performed or observed an action, though it was found for overall source memory. As accuracy was so high for truthful descriptions, the task may have been too easy for participants and thus shrouded a possible effect. Our results align with others (Polage, 2004; 2012) in that deceptively rehearsing the information, in this case falsely denying the item, allowed participants memory for the generation of that deceptive information. While items that were truthfully described were the

most accurately recognized as having been performed (or observed), fabricated denials were categorized more accurately than unrehearsed items. This may suggest a general rehearsal effect, wherein rehearsing an item at all, either truthfully or deceptively, increases accuracy. Deceptive rehearsal may benefit more when memory for cognitive operations is low, as in denying an item (as suggested in the source-monitoring framework; Johnson, et al., 1993), whereas truthful rehearsal itself and in combination with description generation produces an abundance of memorable processes. The interaction between veracity and rehearsal supports this suggestion.

Though manipulating the type of role did not influence rates of accurate recognition, there was a marginally significant effect on the proportion of correct responses that were endorsed with a “recollection” judgment. Observers were more likely to say that they recollected witnessing an action when they correctly identified that action as having been seen, compared to participants in the Actor condition who said they recollected performing an action. However, due to the small number of participants who met criteria and the size discrepancy between conditions, there are limitations to how this effect can be interpreted. For instance, the smaller portion of participants in the Observer condition (about half the size of the amount of people in the Actor condition) could have biased the results. Participant’s decision-making behavior could also account for the results and the small number of eligible comparable participants, e.g. if people who viewed actions were conservative in their source decisions, they may have only chosen to say that they did see an action if they could recollect it. Although we found no between-subjects effect in this experiment, the moderate partial-eta squared of .158 and the lack of an effect may be due to our low-power sample.

In terms of predicted results, the four main effects that I expected to find – source attribution advantages for items performed, described, truthfully rehearsed, and repeated three

times – were in fact found. The results also replicated the interaction between Veracity and Rehearsal, as found in Vieira et al. (2012). Though overall participants were better at categorizing source when truthfully rehearsing items, the interaction revealed that this trend was found only for descriptions; participants were more accurate for items that were falsely denied than items that were truthfully denied the items. However, the expected interactions between Role x Rehearsal and Role x Veracity x Rehearsal were not found. Though it was expected that memory for accurate recognition with performed actions than for observed actions, there was no significant effect of type of role. There was also a partial replication of the Vieira et al. (2013) finding that only items truthfully described once and truthfully described thrice were significantly more accurate than the no-rehearsal control; in our study, all rehearsed items were more accurate than the no-rehearsal items, with truthful descriptions being more accurate than false denials. For false recognition, the expected Role x Item Type interaction was not obtained wherein repeated truthful denial errors would be significantly higher than the unrehearsed control items in the Observer condition.

As a result of programming errors, I was unable to evaluate the manner in which participants rejected actions, as well as to what degree they were confident in that rejection. Additionally, the relatively small number of participants per condition, due to sign up and show up issues, limited statistical power. However, additional data is currently being collected, and this should provide information about recognition rejection decisions as well as increase statistical power.

Overall, the results of this study indicate that lying does have an impact on one's memory for a previous experience. The replication of previous findings that denials are more likely to be forgotten than fabricated descriptions may be particularly important in situations where witnesses are interviewed multiple times, because this susceptibility could lead them to

contradict themselves. In addition, the type of lie (whether a person generates a description or provides a denial) can affect people's ability to remember that they lied (e.g., Vieira & Lane, 2012), and lead them to false remember the action associated with their lie. We found that people were more likely to believe their own lies when generating descriptions of events that did not happen. The study also provided evidence that whether one is actively involved in an event versus observing event can influence source memory. Altogether, these findings from a laboratory context can provide insights into real-world lies, from those told in everyday social situations to more consequential circumstances as might occur in police interviews. Paradoxically, in avoiding telling the truth people may inadvertently harm themselves. Lying appears to not only influence our memories for an event, but also what we come to believe about the past.

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Footnotes

1. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi^2(9) = 23.54, p = .005$. Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .81$).
2. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi^2(9) = 65.25, p = .000$. Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .64$).
3. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi^2(9) = 23.51, p = .005$. Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .81$).
4. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi^2(9) = 37.51, p = .000$. Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .59$).
5. Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi^2(9) = 32.00, p = .000$. Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .63$).

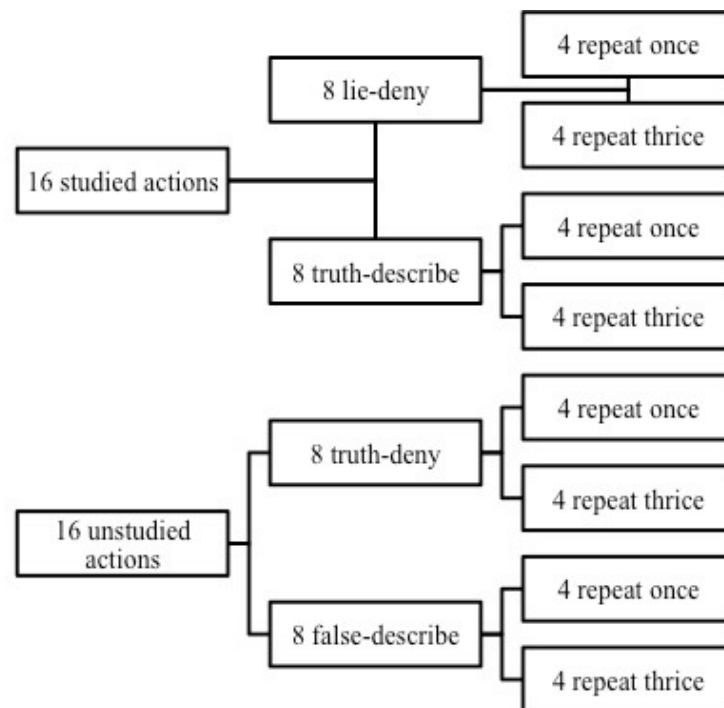


Figure 1. Graphic representation of item types presented to the participants in the Rehearsal Phase in Session 1. Studied and unstudied no-rehearsal items, 8 each, were added to the source test in Session 2 as control items.

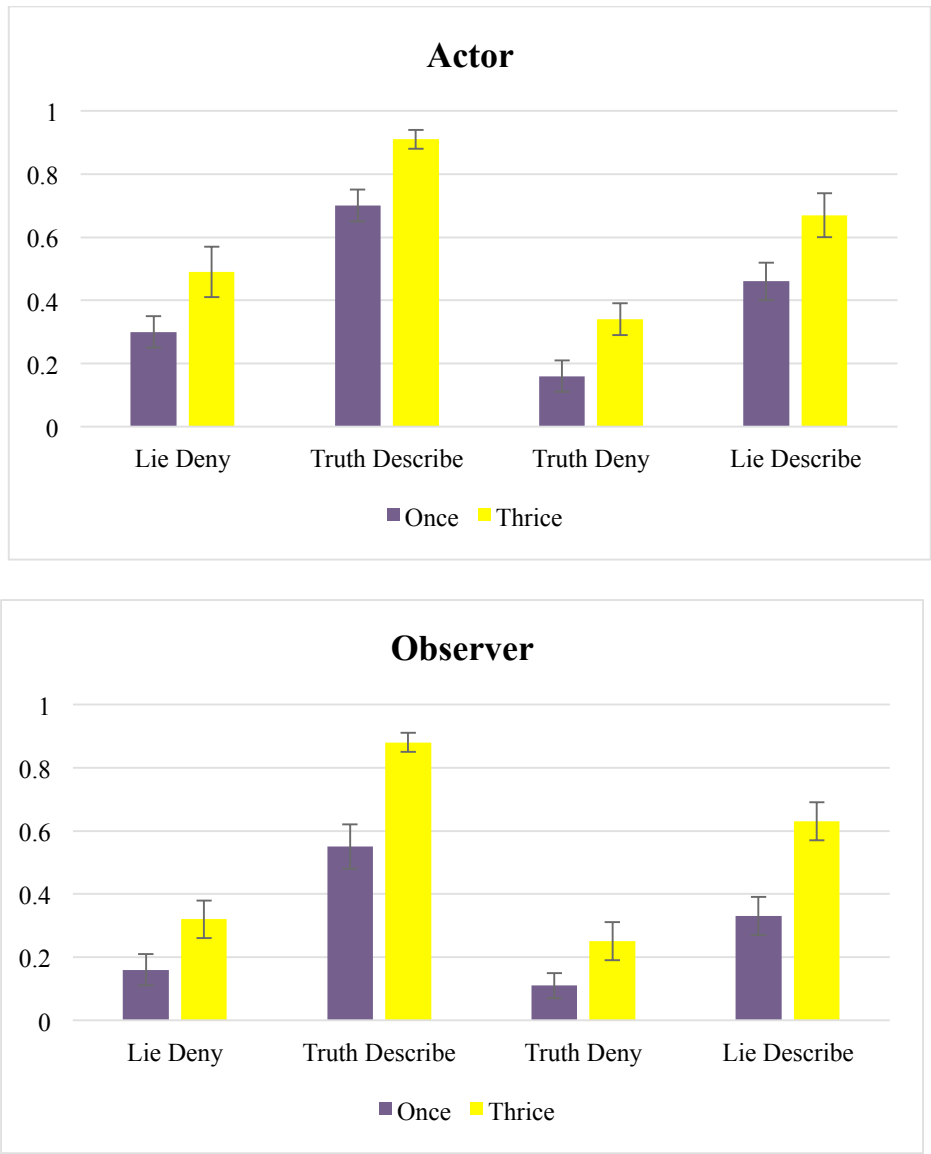


Figure 2. Mean proportion of correct source responses for each item type (a) for participants who performed actions in the Actor condition, and (b) for participants who witnessed actions in the Observer condition Error bars represent standard errors.

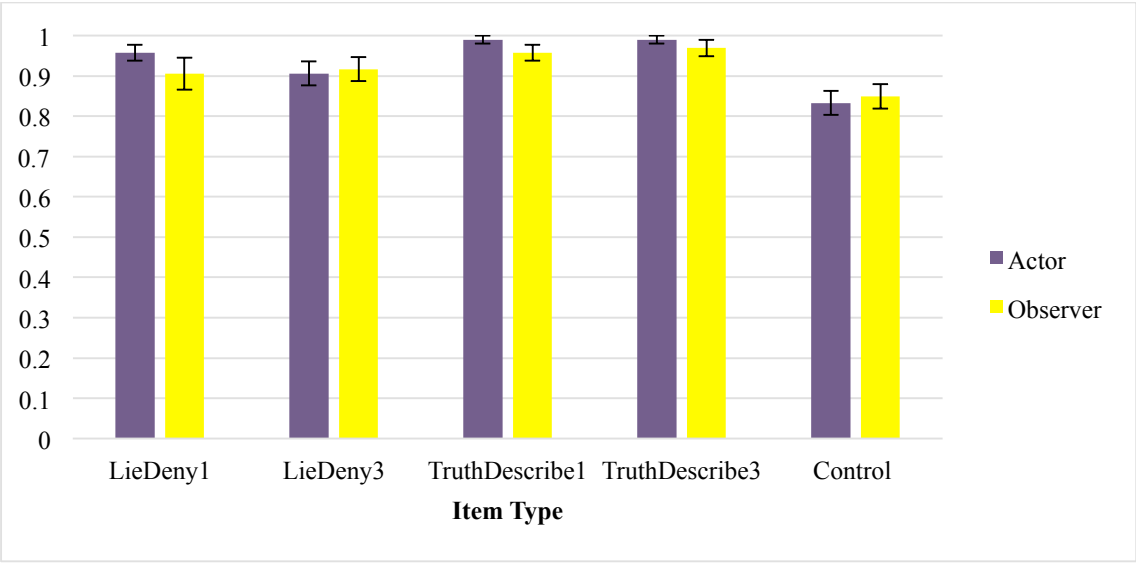


Figure 3. Mean proportion of accurate “performed or observed” responses. Error bars represent standard errors.

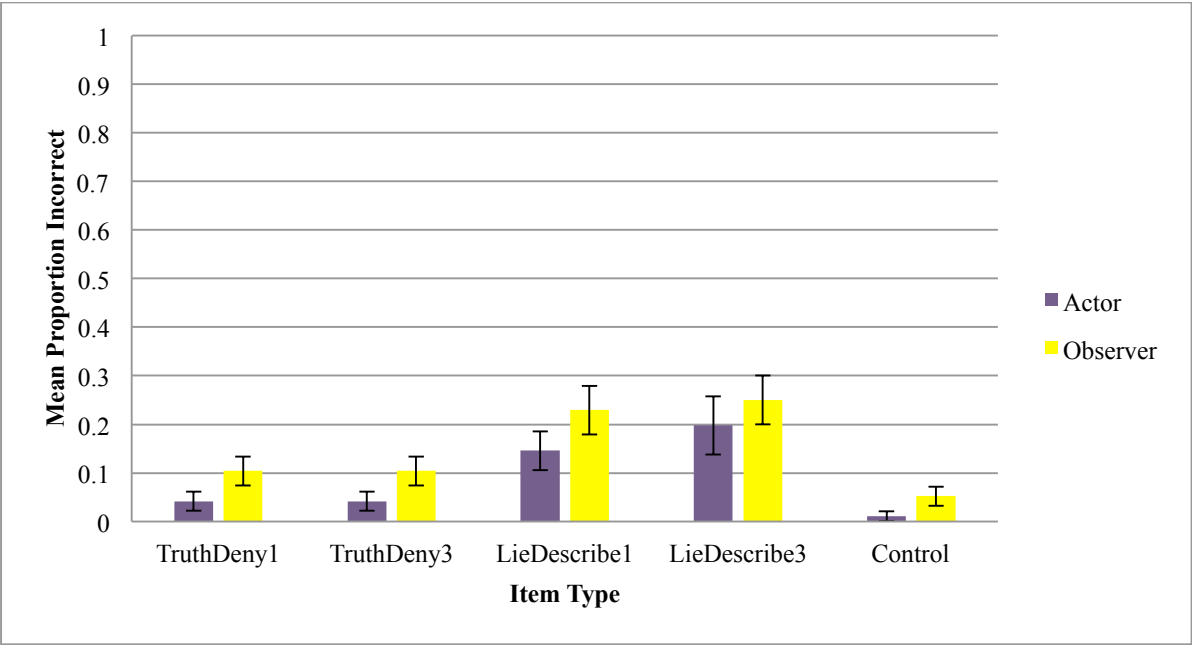


Figure 4. Mean proportion of inaccurate “performed or observed” responses. Error bars represent standard errors.

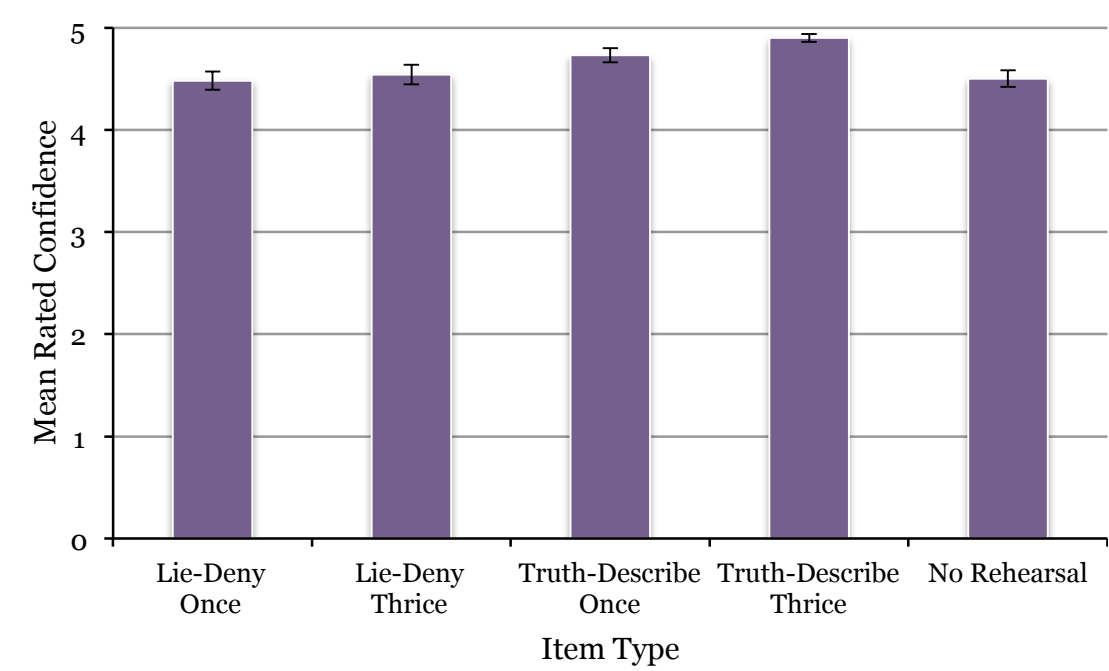


Figure 5. Mean rated confidence judgments for accurate recognition. Error bars represent standard errors.

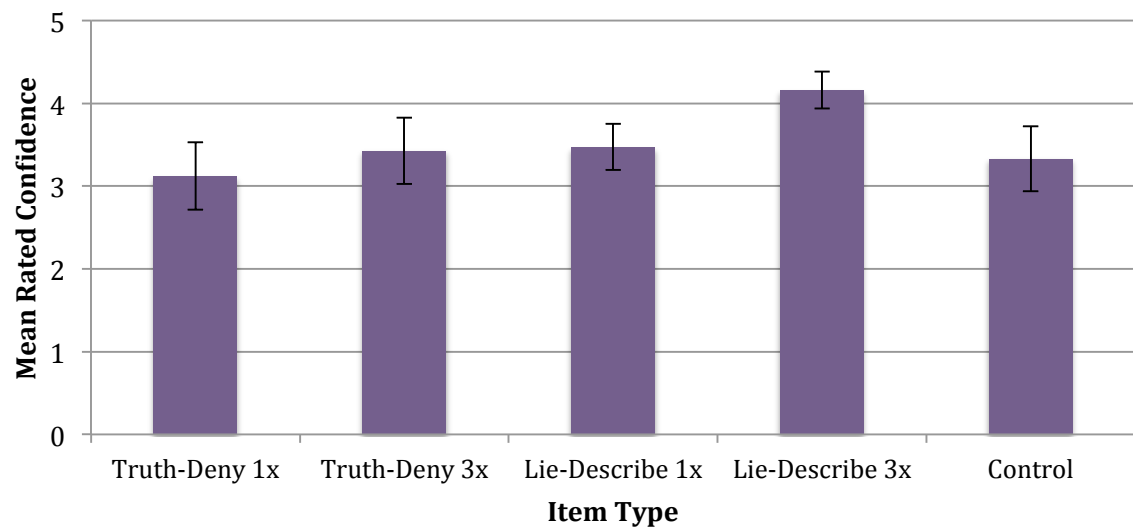


Figure 6. Mean rated confidence judgments for false recognition. Error bars represent standard errors.

Table 1
Mean Proportion of Source Responses for Each Item Type

Item Type	Response Options					
	“I studied this action but denied studying it on camera.”	“I studied this action and truthfully described it on camera.”	“I studied this action but did not talk about it on camera.”	“I did not study this action and truthfully said so on camera.”	“I did not study this action but falsely described it on camera.”	“I did not study this action and did not talk about it on camera.”
Studied Lie Deny Once	.23 (.03)	.18 (.03)	.52 (.04)	.01 (.01)	.02 (.01)	.04 (.02)
Studied Lie Deny Thrice	.41 (.05)	.16 (.04)	.35 (.05)	.04 (.01)	.02 (.01)	.04 (.01)
Studied Truth Describe Once	.11 (.03)	.63 (.04)	.23 (.03)	.00 (.00)	.01 (.01)	.02 (.01)
Studied Truth Describe Thrice	.06 (.02)	.89 (.02)	.03 (.01)	.00 (.00)	.01 (.01)	.01 (.01)
Studied No Rehearsal	.10 (.02)	.08 (.02)	.66 (.03)	.02 (.01)	.01 (.01)	.13 (.02)
Unstudied Truth Deny Once	.02 (.01)	.02 (.01)	.04 (.02)	.14 (.03)	.11 (.03)	.68 (.05)
Unstudied Truth Deny Thrice	.03 (.01)	.01 (.01)	.03 (.01)	.30 (.04)	.27 (.04)	.36 (.04)
Unstudied Lie Describe Once	.03 (.01)	.02 (.01)	.14 (.03)	.10 (.02)	.40 (.04)	.32 (.04)
Unstudied Lie Describe Thrice	.04 (.01)	.13 (.03)	.06 (.02)	.06 (.02)	.65 (.05)	.07 (.02)
Unstudied No Rehearsal	.01 (.00)	.00 (.00)	.02 (.01)	.05 (.01)	.02 (.01)	.89 (.02)

Note. Values for correct source responses are in boldface. Standard errors are in parentheses. Response options for studied items said “I performed this action / I did not perform this action...” for the Actor condition and “I observed this action / I did not observe this action...” for the Observer condition.

Table 2
Mean Proportion of Source Responses for Each Item Type, for Actor Condition

Item Type	Response Options					
	“I performed this action but denied performing it on camera.”	“I performed this action and truthfully described it on camera.”	“I performed this action but did not talk about it on camera.”	“I did not perform this action and truthfully said so on camera.”	“I did not perform this action but falsely described it on camera.”	“I did not perform this action and did not talk about it on camera.”
Performed Lie Deny Once	.30 (.05)	.14 (.04)	.52 (.05)	.00 (.00)	.03 (.02)	.01 (.01)
Performed Lie Deny Thrice	.49 (.08)	.12 (.05)	.30 (.07)	.06 (.02)	.00 (.00)	.03 (.02)
Performed Truth Describe Once	.08 (.03)	.70 (.05)	.21 (.04)	.00 (.00)	.00 (.00)	.01 (.01)
Performed Truth Describe Thrice	.02 (.01)	.91 (.03)	.06 (.02)	.00 (.00)	.00 (.00)	.01 (.01)
Performed No Rehearsal	.11 (.03)	.03 (.01)	.69 (.04)	.03 (.02)	.01 (.01)	.13 (.03)
Unperformed Truth Deny Once	.01 (.01)	.00 (.00)	.03 (.02)	.16 (.05)	.13 (.04)	.68 (.07)
Unperformed Truth Deny Thrice	.03 (.02)	.00 (.00)	.01 (.01)	.34 (.05)	.22 (.04)	.40 (.06)
Unperformed Lie Describe Once	.02 (.01)	.03 (.02)	.09 (.03)	.13 (.04)	.46 (.06)	.27 (.05)
Unperformed Lie Describe Thrice	.01 (.01)	.14 (.04)	.05 (.02)	.05 (.02)	.67 (.07)	.08 (.04)
Unperformed No Rehearsal	.00 (.00)	.00 (.00)	.01 (.01)	.05 (.02)	.02 (.01)	.93 (.02)

Note. Values for correct source responses are in boldface. Standard errors are in parentheses.

Table 3
Mean Proportion of Source Responses for Each Item Type, for Observer Condition

Item Type	Response Options					
	“I observed this action but denied observing it on camera.”	“I observed this action and truthfully described it on camera.”	“I observed this action but did not talk about it on camera.”	“I did not observe this action and truthfully said so on camera.”	“I did not observe this action but falsely described it on camera.”	“I did not observe this action and did not talk about it on camera.”
Observed Lie Deny Once	.16 (.05)	.23 (.05)	.52 (.07)	.01 (.01)	.01 (.01)	.07 (.04)
Observed Lie Deny Thrice	.32 (.06)	.20 (.05)	.40 (.06)	.01 (.01)	.03 (.02)	.04 (.02)
Observed Truth Describe Once	.15 (.04)	.55 (.07)	.26 (.05)	.00 (.00)	.01 (.01)	.03 (.02)
Observed Truth Describe Thrice	.09 (.03)	.87 (.03)	.00 (.00)	.00 (.00)	.02 (.01)	.01 (.01)
Observed No Rehearsal	.09 (.03)	.13 (.03)	.64 (.06)	.02 (.01)	.02 (.01)	.12 (.03)
Unobserved Truth Deny Once	.02 (.01)	.03 (.02)	.05 (.03)	.11 (.04)	.10 (.04)	.68 (.06)
Unobserved Truth Deny Thrice	.03 (.02)	.02 (.01)	.05 (.02)	.25 (.06)	.31 (.06)	.33 (.06)
Unobserved Lie Describe Once	.03 (.02)	.01 (.01)	.19 (.05)	.07 (.03)	.33 (.06)	.36 (.06)
Unobserved Lie Describe Thrice	.06 (.02)	.13 (.04)	.06 (.03)	.07 (.04)	.63 (.06)	.05 (.02)
Unobserved No Rehearsal	.01 (.01)	.01 (.01)	.04 (.02)	.06 (.02)	.03 (.02)	.86 (.03)

Note. Values for correct source responses are in boldface. Standard errors are in parentheses.

Table 4
Mean Proportion of “Performed” or “Observed” Responses per Item Type

Item Type	Actor		Observer	
	Mean	SE	Mean	SE
<i>Hits</i>				
Studied Lie Deny Once	.96	.02	.91	.04
Studied Lie Deny Thrice	.91	.03	.92	.03
Studied Truth Describe Once	.99	.01	.96	.02
Studied Truth Describe Thrice	.99	.01	.97	.02
Studied No Rehearsal	.83	.03	.85	.03
<i>False Alarms</i>				
Unstudied Truth Deny Once	.04	.02	.10	.03
Unstudied Truth Deny Thrice	.04	.02	.10	.03
Unstudied Lie Describe Once	.15	.04	.23	.05
Unstudied Lie Describe Thrice	.20	.06	.25	.05
Unstudied No Rehearsal	.01	.01	.05	.02

Note: Values for correct responses (i.e., accurate recognition) are in boldface.

Table 5
Descriptive Statistics for Subjective Memory Bases of “Present” Items by Item Type

Accurate Recognition					False Recognition				
Item Type	Recollection	Familiarity	Guessing	<i>N</i>	Item Type	Recollection	Familiarity	Guessing	<i>N</i>
Lie-Deny Once	.74 (.08)	.16 (.06)	.10 (.05)	29	Truth-Deny Once	.38 (.14)	.29 (.13)	.33 (.13)	12
Lie-Deny Thrice	.81 (.06)	.17 (.06)	.01 (.01)	35	Truth-Deny Thrice	.57 (.14)	.36 (.13)	.07 (.07)	14
Truth-Describe Once	.93 (.03)	.06 (.02)	.01 (.01)	45	Lie-Describe Once	.36 (.09)	.49 (.09)	.15 (.07)	24
Truth-Describe Thrice	.95 (.02)	.04 (.02)	.01 (.01)	48	Lie-Describe Thrice	.66 (.08)	.22 (.07)	.12 (.06)	25
No Rehearsal	.82 (.03)	.16 (.03)	.03 (.01)	47	No Rehearsal	.27 (.14)	.53 (.16)	.20 (.13)	10
	Valid N (listwise) 23					Valid N (listwise) 0			

Note: Values of standard errors are in parentheses. “Valid *N*” refers to the number of cases where participants had accurate or inaccurate recognition in all 5 item types.

Table 6
Mean Items Based on Familiarity for Truth-Deny Once, Truth-Deny Thrice, and Lie-Describe Thrice

	Truth-Deny Thrice	Lie-Describe Thrice	<i>N</i>	<i>t</i>	<i>df</i>
Familiarity	.27 (.14)	.29 (.10)	11	-.080	10
	Truth-Deny Once	Truth-Deny Thrice		<i>t</i>	<i>t</i>
Familiarity	.10 (.10)	.60 (.24)	5	-2.24	4

Note: Values of standard errors are in parentheses.

Appendix A

List of Actions

Remove a tissue

Tie a knot in the string

Put your hand in the bag

Shake the rattle

Take the lid off the box

Light the lighter

Roll the dice

Drop the marble in the cup

Stretch the rubber band

Unzip the zipper

Staple the paper

Cut the cloth with the scissors

Spin the top

Stack the checkers

Look through the magnifying glass

Pat the toy dog

Measure your middle finger with the ruler

Play the drums with the pencils

Screw the top on the jar

Stick the pins in the cushion

Flatten the clay

Tap the thimble

Cut the cards

Flip the coin

Blow into the bottle

Seal the card in the envelope

Put on the hat

Fold the piece of paper

Point to the picture

File your nails

Button the shirt button

Close the purse

Pick up the paper clips

Slide the pen across the table

Push the toy car

Read the time on the watch

Smell the flower

Draw with the chalk

Ring the bell

Open the book

Break the toothpick

Put on the ring

Crumple the plastic

Bounce the ball

Fasten the safety pin

Lift the stamp with the tweezers

Look in the mirror

Make the twist tie into a "V"