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Conformity effects in memory for actions

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The goal of this research was to examine whether memories for actions can be affected by information reported by another person. In two studies, pairs of participants performed 48 of a set of 96 actions. In Study 1, both members of the pairs performed the same actions, and in Study 2, they performed different actions. One week later, the members of the pairs were questioned together about whether they had or had not done all 96 actions. What one person reported greatly influenced what the other person reported for both correct and incorrect responses. This influence was maintained when the participants were later tested individually, and the participants described having pictorial memories for doing many of the actions that they had not done but had merely been suggested.

Memories can be systematically distorted by information encountered after an event, a finding called the *postevent information* (PEI) effect. The main goal of this study was to test whether memories for performed and nonperformed (but observed) actions could be altered by information presented by another person. Specifically, could people be made to believe they had or had not done a particular action? We briefly describe some aspects of memory for actions and then describe how they can be distorted.

Memories for self-performed actions tend to be better than memories for the same actions when they are not performed (for reviews, see Engelkamp, 1998; Zimmer et al., 2001). For example, Engelkamp and Krumnacker (1980) had participants listen to someone read a list of actions and instructed them to perform the actions or simply to imagine themselves doing the actions. When asked to recall these items, people were best able to recall performed actions and were worst at recalling the actions that they had just heard. Some researchers (e.g., Nilsson & Kormi-Nouri, 2001) have argued that the basic memory processes for actions are the same as those for other episodic memories. They have claimed that the self-performing advantage is due to more depth of processing at encoding, because the person interacts with the objects both visually and tactilely. The authors have added that actions tend to be easier to imagine than static events. Others (e.g., Engelkamp, 2001) have argued that the self-performed advantage is due to a qualitatively different memory system (see Zimmer, 2001, for a summary of this debate).

Goff and Roediger (1998) showed that asking people to imagine doing an action led many participants to report having done the action. Our research extended their work by testing the impact of social influence on participants' responses about whether or not they performed an action. In particular, can we make people report that they did something when they did not? Moreover, can we make them report that they did not perform an action when, in fact, they did? The way we tested this was by presenting information after the original event, the PEI. In the next section, the relevant literature is reviewed.

Memory Conformity

In most laboratory research, the PEI is embedded either in biased questions or within a narrative about the event. PEI can cause participants to report memories for events that they did not see and to fail to report memories for events that they did see (Wright, Loftus, & Hall, 2001). PEI effects have been shown in studies of word and face recognition, of details of videos, and even of entire autobiographical events (for a review, see E. F. Loftus, 2005). In nonlaboratory situations, people often encounter PEI when talking with others who have seen the same event or have taken part in the same activities. For example, witnesses of crimes often talk with other witnesses about the crime and about the perpetrator (Paterson & Kemp, 2006b; Skagerberg & Wright, 2008b).

During the past decade, several laboratories have introduced both accurate and inaccurate PEI via another person (for examples, see Af Hjelmsäter, Granhag, Strömwall, & Memon, 2008; Axmacher, Gossen, Elger, & Fell, 2010; Bodner, Musch, & Azad, 2009; French, Gerrie, Garry, & Mori, 2009; Gabbert, Memon, & Wright, 2007; Hope, Ost, Gabbert, Healey, & Lenton, 2008; Merckelbach, Van Roermund, & Candel, 2007; Mori, 2007; Paterson & Kemp, 2006a; Reysen, 2005; Skagerberg, 2006; for reviews, see Blank, 2009; Echterhoff & Hirst, 2009; Hirst & Manier, 2008; Wright, Memon, Skagerberg, & Gabbert, 2009). In a typical study, pairs of participants are shown an event and then are tested. One of the participants in a pair reports first, and then the second participant reports. Sometimes the first participant is accurate and sometimes inaccurate. Therefore, the second person is exposed to both

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accurate and inaccurate PEI. The studies find that what the first participant reports influences what the second person reports. Several other methods have been used to show social influences on memory, and they consistently find that what one person reports affects other people's reports—a finding referred to both as *memory conformity* (Wright, Self, & Justice, 2000) and as the *social contagion of memory* (Meade & Roediger, 2002; Roediger, Meade, & Bergman, 2001). Roediger (2010) recently argued for the phrase *memory conformity*, because the word *contagion* suggests a negative outcome and, often, accurate reports enhance other people's memories. We will use the phrase *memory conformity*.

Researchers have described two sets of psychological processes that can lead people to report false information provided by another person within a social setting (Deutsch & Gerard, 1955; see also Kelman, 1958). These processes are driven by the basic psychological desire to feel accepted by others (normative influence) and by the desire to be correct (informational influence). Figure 1 shows these two sets within a memory conformity context (Wright, London, & Waechter, 2010).

The top route to memory conformity (normative influence) corresponds to people's reporting the PEI even when they do not believe it themselves. People report errant information because they believe that the cost of disagreeing with the other person is greater than the value of being correct. Normative influence is the explanation usually given for Asch's (1955) conformity findings, in which people judged the relative lengths of three lines. In Asch's research, the participants knew that they were answering incorrectly, but some conformed to the group because they assessed the cost of disagreeing with the other people as being higher than the cost of being wrong.

Research on memory conformity shows that normative influences can lead people to report false information. For example, when Baron, Vandello, and Brunsman (1996) presented participants with an easy identification task (control participants' performance was almost perfect) and told them that accuracy was unimportant, the participants tended to agree with others' responses, because the cost of answering incorrectly was low. However, when told that accuracy was important, the participants were less likely to conform to other people's responses. The cost of disagreeing can also be varied when a social hierarchy is created in which there are high-power roles and low-power roles. In such scenarios, the cost of disagreeing between participants is affected. In a memory conformity context, Skagerberg and Wright (2008a) showed that participants in low-power roles conformed more often on memory conformity tasks than did participants in high-power roles.

The top part of Figure 1 shows how the costs of an error and of disagreeing (or alternatively, the values of a correct answer and of agreeing) combine within a payoff matrix to produce a value for a response. A payoff matrix like this can be used to predict whether a participant will conform or not. Consider the following example, which shows how this could work. Hope et al. (2008) found more memory conformity between two people who knew each other than between strangers. They argued that this was because disagreeing with a stranger has lower social costs than does disagreeing with an acquaintance. From Figure 1, this

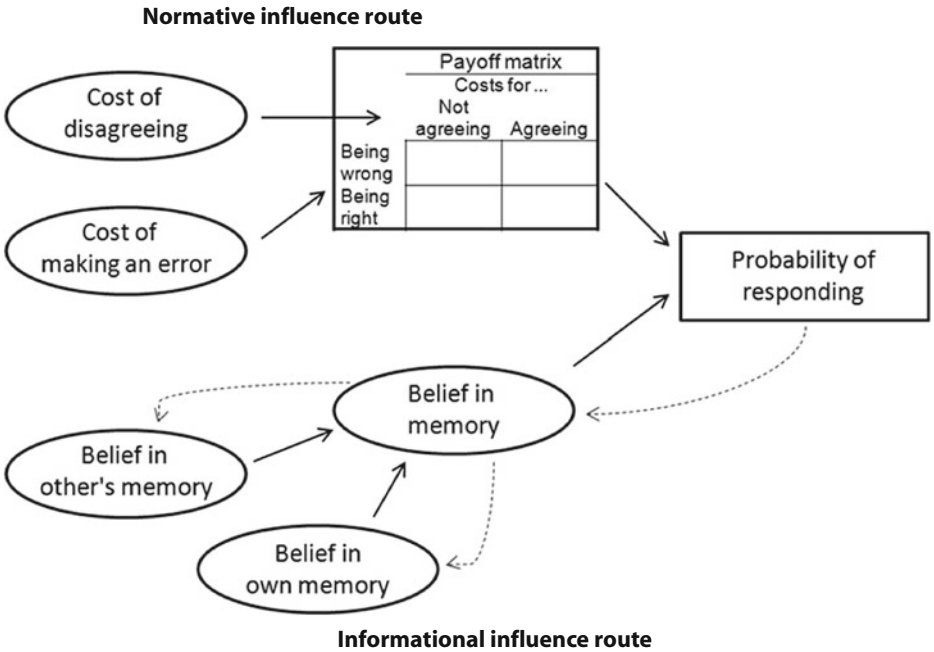

Figure 1. A framework for exploring memory conformity effects. From "Social Anxiety Moderates Memory Conformity in Adolescents," by D. B. Wright, K. London, and M. Waechter, 2010, *Applied Cognitive Psychology*, *24*, p. 1036. Copyright 2009 by John Wiley & Sons. Adapted with permission.

would mean that the costs of disagreeing were greater than the costs of an error for people interacting with acquaintances than for people interacting with strangers.

The second route to memory conformity is when participants report the PEI, rather than what they remember, because they believe that the other person's memory is more accurate than their own. This is driven by informational influence and is an explanation often given for Sherif's (1936) findings for suggestibility, using the autokinetic effect. In the autokinetic effect, a stationary light against a dark uniform background appears to move. Because they had difficulty making judgments in autokinetic tasks, Sherif argued that participants conformed to other people's responses, since they did not trust their own judgments. A common example in forensic circles is the case in which an eyewitness's memory of an event is severely impaired from the use of drugs. The person will often rely on other people's memories. This can occur even when the information is self-incriminating, creating a false confession (called the *memory distrust syndrome*; Gudjonsson & MacKeith, 1982). When people are unsure of a belief, the belief is more malleable (Cialdini, 2008).

Gabbert et al. (2007) demonstrated this within a memory conformity context. They showed pairs of participants a series of complex drawings. One of the pair was told that he or she had seen these pictures for half as long as the other person. The other in the pair was told that he or she had seen the pictures for twice as long. In fact, both participants had viewed the pictures for the same amount of time, but each believed that the viewing times differed. Gabbert et al. (2007) found that participants conformed more to the other person if they felt that the other person had seen the pictures for longer. Studies also show that people are more influenced by confident people and by people who they think should have good memories. For example, Skagerberg and Wright (2009) told participants that their memories were either the same as or different from memories of either children or police officers. They found that providing information about children's memories did not affect the participants' beliefs, but telling them about police officers' memories did. Understanding how belief in one's own memory combines with belief in another person's memory is important.

Figure 1 shows two routes for somebody to report a false memory. Mazzoni (2002) described the typical steps that individuals go through to internalize a false memory. First, the person must believe that the event is possible and that it happened. Over time, this belief may lead the participant to have an actual episodic memory of the event. The participant may remember the information but forget the source of the memory. This is called a *source-monitoring error* (Johnson, Hashtroudi, & Lindsay, 1993; Lindsay & Johnson, 1989).

In the present study, we tested whether participants' memories had a picture-like quality to them. Since Tulving (1985) introduced the remember–know (R–K) method, thousands of participants have been asked whether their memory is a *know* or a *remember* memory. The R–K method was designed to differentiate episodic memories from semantic memories. According to Tulving, episodic memories are those that allow you to mentally travel back in time to the event and evoke self-awareness, or what he called *autonoetic consciousness*. Here, we opted for a simpler distinction, and one that is purposefully designed for memory for actions. We asked participants whether, from memory, they could picture themselves doing the action. This is likely a much lower criterion than *remember* responses. It is similar to the distinction G. R. Loftus and Bell (1975) made between people remembering specific details in a picture and just having general visual information.

Social Recognition Test Procedure

The social recognition test (SRT) procedure (Schneider & Watkins, 1996; Wright, Mathews, & Skagerberg, 2005) has been used in much memory conformity research. The SRT procedure allows a small but controlled amount of social interaction among the participants and provides a large amount of data per person. Both the method and how data are analyzed warrant discussion.

The basic SRT method involves participants' being presented with a large number of items and then being tested with another person on those items plus several filler items. In the test, one person responds first, and then the second person responds. The test is conducted such that the second person can see or hear how the first person responds. The second person's response therefore can be based on a combination of memory for the event and the influence of how the first person responded. In our studies, the initial presentation involved the participants' doing several actions and then, at test, being asked whether they had done these actions.

The analysis involved predicting the second participant's response from whether the action was performed and from what the first participant said. The model being tested is

Probability second person reports "did"	$\sim$	$\beta 0$	+ $\beta 1$	Whether they did it
			+ $\beta 2$	What the first person reports.

"Probability second person reports 'did'" is predicted by the model on the right-hand side of the ~ sign. The estimate of $\beta 1$ provides a measure of memory. It shows whether participants' responses depend on whether they did the action or not. The estimate of $\beta 2$ provides a measure of memory conformity. It shows whether responses are affected by what the other person reports. Interactions can be examined to see, for example, whether other variables moderate the size of either of these effects. A second measure of memory can be found using the SRT procedure by predicting what the first participant reports from whether or not the participant actually did the action.

Because the response variable is binary—whether the person says that he or she did or did not do the action—a logistic regression is used. The β values in logistic regression are in different units than the β values in a normal regression. The β values in logistic regressions are log-odds ratios (LORs). In the 2×2 case, this is the natural

logarithm of the odds ratio. If there is no effect, its value is 0. If it is around 0.4, it is usually considered a small effect; around 1.25, it is considered a medium-sized effect; and around 4.3, it is considered a large effect (on the basis of Cohen's [1992] terminology). These are the effect sizes reported in the Results section. See Agresti (2002) for an introduction to logistic regression.

A further consideration arises because each participant provides multiple nonindependent data points. Therefore, multilevel modeling, sometimes called *mixed*, *random coefficient*, and *hierarchical* modeling, was necessary (Goldstein, 2003; see Wright & London, 2009, for an introduction aimed at psychologists). The R package lme4 (Bates & Maechler, 2009) was used. Random intercepts for both the pair and the action are included, which make this a crossed random effects models (Baayen, Davidson, & Bates, 2008).

After the SRT procedure, the participants were tested on an Individual Recognition Test (IRT; details below). Because participants can respond without the other person knowing whether they disagree, this may lessen the normative influences (Gabbert, Memon, & Allan, 2003; Wright, Gabbert, Memon, & London, 2008). However, because participants respond publicly first, it is possible that they would remain with their response in order to show consistency, even if they thought that their response was in error. A second purpose of the IRT was to ask the participants about the quality of their memories. During the IRT, the participants were asked whether they could actually picture themselves performing an action or whether they just thought that they had done it. We call these reports *pictorial memories* (see the Method section).

Overview of the Studies

There are many situations in which people remember past events together. Sometimes this is family and friends reminiscing, sometimes classmates studying for an exam, and sometimes eyewitnesses discussing an event they have just seen. Often, the question will be whether somebody did or did not do a particular action. This can be a mundane task, such as turning off a light switch. Errors on tasks such as this can be problematic, with extreme levels of perseverative checking in people with obsessive–compulsive disorder (MacDonald & Davey, 2005). Other action memories may be of importance to insurance companies (e.g., did you lock the door?) or may have legal importance (e.g., did you punch the victim?).

The main goal of this research was to test whether participants could be led to report having done actions that they had not done and to fail to report having done actions that they had done. In addition, we compared actions that required a physical prop with those that did not to see whether either set was more or less memorable and whether either was more or less susceptible to conformity effects. We had no directional hypotheses about this factor. Two studies were done to test these hypotheses. In both studies, participants arrived in pairs at the laboratory and performed 48 out of a set of 96 actions. The pair returned 1 week later and took part in the SRT and the IRT. The 1-week delay was based on Goff and Roediger (1998, Study 2). A 1-week delay ensured that memory was poor and thus increased the likelihood of informational processes leading to memory conformity. Because of the similarity between the studies, they are described together.

The difference between the two studies was whether participants had performed the same actions as their partner in the original session or had performed different actions. Performing different actions may have created a more difficult memory task, because watching somebody else perform an action may make the action more memorable, as compared with actions that were not performed by either participant. However, if the participants actually remembered the other person's doing the action, this would mean that they would know that they had not done the action. We had no specific predictions about whether the effect sizes would differ between the two studies.

METHOD

Participants

The participants were undergraduate psychology students who received extra credit in exchange for completing the study. In Experiment 1, there were 48 participants (34 women, 14 men; age, M = 20.54 years, SD = 2.94; 73% Hispanic). In Experiment 2, there were 86 participants (54 women, 32 men; age, M = 20.26 years, SD = 4.09; 70% Hispanic). The participants were recruited through an online experiment management system administered by the Psychology Department at Florida International University. The difference in sample sizes was due to more participants volunteering during the time period in which the second study was run.

Design

There was a single between-subjects variable. The participants were randomly allocated to respond first to the first 48 actions of the SRT or to respond first to the second 48 actions of the SRT. Within-subjects variables were whether the actions were performed, whether the actions required props, and what the other participant said.

Materials

The 96 actions were identical for the two studies and were taken from those used in Goff and Roediger (1998).[1] Half of the actions required the use of small props (e.g., a ring for "put on the ring" and clay for "flatten the clay"). Props were arranged on a table in the experimental room, so that participants could see all of them and have easy access to them while performing actions.

Three questionnaires were used: the SRT, the IRT, and a basic demographics questionnaire (asking for age, gender, and ethnicity). The SRT was a single two-sided sheet of paper given to each pair of participants, with space for each person to check either "did not do" or "did do" for all 96 actions. Each person could see the other's responses. Each individual in the pair completed their own IRT and could not see the other's responses. The IRT listed all 96 actions, with space to record one of three response options: "did not do," "know," and "pictorial memory." The "did not do" response option indicated that the participant thought that the action had not been self-performed. The "know" option indicated that the participant thought the action had been self-performed but that the participant did not have a pictorial memory of having done the action. The "pictorial memory" option indicated that the participant was able to picture himself or herself performing the action. Detailed instructions (see the Procedure section) were provided to the participants for the meaning of "pictorial memory."

Procedure

The participants signed up for two appointments 1 week apart. The recruiting information stated that this was a two-part study

and that the participants were required to sign up for both parts. On the first day, the participants arrived at the laboratory and were led to the experimental room, which had a computer, chairs for the participants, and a table with the props. The participants were presented with brief descriptions of the 96 actions, 1 at a time, in one of four random orders. In Study 1, the computer instructed either both participants to do the action or neither participant to do the action. In Study 2, the computer told one person to do each action and the other person not to do the action. Thus, in Study 1, the pair did the same actions, and in Study 2, they did different actions. In Study 1, they read a description of the actions that they did not do; in Study 2, they read a description of the actions they did not do *and* watched the other person perform these actions. After performing the actions, the participants were thanked, were reminded that they needed to return to the lab the following week, and were told not to discuss the study.

The second session was identical in both studies. The participants sat in front of the computer and were told that they would be presented with the same phrases for the 96 actions that they had been exposed to the week before. There were no novel fillers. The participants were reminded that they had performed 48 of these actions the previous week. The actions were presented in one of four random orders (different from those used in the original presentation). The pair was given the SRT and were told that, as each action was presented on the screen, they should indicate on the SRT whether they "did not do" or "did do" the action. A coin was flipped to determine which person would respond first to the first 48 items. Once the first person responded, the sheet was handed to the second person. When the second person responded, the sheet was returned to the first person, and the research assistant prompted the computer to display the next action. After 48 actions, the order for the 2 people responding was switched. Thus, each person responded first for 48 actions and second for 48 actions.

After the SRT, the participants were led to separate tables and were told that we were interested in the qualities of their memories. They were given the IRT. The 96 actions were listed in the same random order for all the participants. We told the participants that they should indicate, on their own, the quality of their memory and that they could change their responses from the SRT.

The instructions given were the following:

> We are interested in whether people have a pictorial memory. That is, one in which they can actually see themselves doing an action. It may be that people do not have this pictorial memory, but still remember doing an action. On the response sheet please check the box next to each of the listed actions that indicates whether you DO have a pictorial memory of doing the action, you do NOT have a pictorial memory but know that you DID the action, or that you know you did NOT perform the action. Please check only one answer per item. You are allowed to respond differently than you did on the previous questionnaire. Do you have any questions?

The research assistant then answered any questions and made sure that the participants understood the instructions.

After completing the IRT, the participants were given the demographics questionnaire, debriefed, thanked, and given 2 h of course credit. We asked the pair whether they had known each other prior to the study, and none said that they had.

RESULTS

SRT: Measuring Memory and Memory Conformity

When the participants responded first, their answers could not be affected by the other person's responses for those trials, so these responses were treated as control trials. This allowed memory to be estimated by comparing the percentage of people reporting that they had done actions that they had (i.e., the hit rate) with the percentage of people reporting that they had done actions that they had not done (i.e., the false alarm rate). It is important to stress that the false alarms were to items that were presented to participants, and not to novel items. This made the memory task more difficult than if novel items had been included.

For Study 1, when the participants for the control trials had not done the action, 40.80% of them falsely said they had done the action (i.e., the false alarm rate). This compares with 49.91% when the action was performed (i.e., the hit rate). The estimate of the LOR was 0.51 ($SE = 0.10$), which was significantly different from zero [$\chi^2(1) = 27.01, p < .001$]. For Study 2, the corresponding percentages were 41.96% and 45.44%. The LOR was 0.14 ($SE = 0.06$), which was smaller but also significantly different from zero [$\chi^2(1) = 5.10, p = .02$]. Although these memory effects are statistically significant, in Cohen's (1992) terms, they are small effects (by design with the 1-week delay and not having any novel fillers).

The critical analyses were those in which the participant responded second. In Study 1, for actions that they had not done, the participants falsely said that they had done the action only 15.40% of the time if the first responders said that they had not done it. This increased to 77.23% if the first responders said that they had done it [LOR = 2.99, $SE = 0.16$; $\chi^2(1) = 420.24, p < .001$]. The values for actions that they had done were 18.37% and 81.91%, respectively [LOR = 3.10, $SE = 0.17$; $\chi^2(1) = 420.01$, $p < .001$]. The conformity effects were between medium and large in Cohen's (1992) terms. When main effects for both memory and what the other person said were included in the model, each had additional predictive value. The main effects were the following: for memory, LOR = 0.25 [$SE = 0.12$; $\chi^2(1) = 4.44, p = .04$], and for conformity, LOR = 2.95 [$SE = 0.11$; $\chi^2(1) = 800.94, p < .001$]. In Cohen's terms, the memory effect remained small, and the conformity effect remained relatively large. The interaction was nonsignificant [$\chi^2(1) = 0.22, p = .64$].

The results for Study 2 were similar to those for Study 1, with the exception that conformity referred to responding contrary to the other person's response. This means that the prediction was that the LORs would be negative for conformity. For actions the participant had not done, the participants falsely said that they had done the action only 13.04% of the time when the first responders indicated that it was they who had done it. This went up to 64.32% if the first responders said that they had not done it [LOR = -2.68, $SE = 0.12$; $\chi^2(1) = 608.69, p < .001$]. The values for actions that the participants had done were 15.74% and 68.95% [LOR = -2.61, $SE = 0.12$; $\chi^2(1) = 587.75$, $p < .001$]. When main effects for both memory and what the other person said were included in the model, each had additional predictive value. The main effects were the following: for memory, LOR = 0.23 [$SE = 0.08$; $\chi^2(1) = 8.79, p = .003$], and for conformity, LOR = -2.65 [$SE = 0.08$; $\chi^2(1) = 1{,}261.57, p < .001$]. The interaction was nonsignificant [$\chi^2(1) = 0.002, p = .96$]. As with Study 1, the memory effect was small, and the conformity effect

Table 1
False Alarm (FA) and Hit Rates (in Percentages) for Studies 1 and 2 for the Social Recognition Test

	Study 1		Study 2	
Trials	FA	Hits	FA	Hits
Control	40.80	49.91	41.96	45.44
Implies did not do	15.40	18.37	13.04	15.74
Implies did do	77.23	81.91	64.32	68.95

Note—*Control* trials are those on which the person responds first. *Implies did not do* trials are those on which the first person's response implies that the second person did not do it (in Study 1, the first person reporting "did not do"; in Study 2, the first person reporting "did do"). *Implies did do* trials are those on which the first person's response implies that the second person did do it (in Study 1, the first person reporting "did do"; in Study 2, the first person reporting "did not do").

was much larger. Table 1 shows the hit and false alarm rates for the different conditions.

Did Props Affect Memory and Memory Conformity?

We examined whether memory was better or worse for actions that required a prop. A variable for whether a prop was required for the action was added to the model, which included effects for memory and accuracy, in order to predict whether the participant said that they had done or had not done the action. The main effect for prop was nonsignificant for both studies (ps $> .65$) but is retained in order to examine interactions. Next, the interaction between whether an action involved a prop and whether a participant did the action was included. This is the effect that tests whether memory for actions is different if the action requires a prop. All the comparisons were nonsignificant (ps $> .20$). Thus, these data did not show an overall memory advantage or disadvantage for actions that required props.

Having props moderated the size of the memory conformity effects. In Study 1, when there was no prop on 79.5% of the trials, the second person conformed to what the first said, as compared with 83.9% of the trials when there was a prop. This difference was statistically significant [$\chi^2(1) = 6.10$, $p = .01$]. In Study 2, when there was no prop, the second person conformed on 72.7% of the trials. When there was a prop, the second person conformed on 77.3% of the trials. This difference was also statistically significant [$\chi^2(1) = 15.18$, $p < .001$].

IRT

After completing the SRT, the participants individually completed the IRT. There are several different ways to analyze these data. The two that directly address our hypotheses are the following: Does the memory conformity effect continue when people are tested individually, and what proportion of people report on the SRT that they have pictorial memories for actions that were only suggested to them? Because readers may be interested in other possible hypotheses, the cell means for all the conditions are included in an Appendix.

To determine whether memory conformity persisted when participants were tested individually, we used whether or not the person did the action and the other person's SRT response to predict whether or not the participant reported doing the action (combining familiar and pictorial memories). Table 2 shows the percentages of time the participants said, during the IRT, that they had performed an action during the first session. In Study 1, there were main effects for whether the person did do the action [i.e., the memory effect; LOR $= 0.66$, $SE = 0.10$; $\chi^2(1) = 43.22$, $p < .001$], and for what the first person said on the SRT [i.e., the conformity effect; LOR $= 1.06$, $SE = 0.10$; $\chi^2(1) = 259.57$, $p < .001$]. In comparison with the SRT results, the memory effect was larger, and the conformity effect was smaller. The interaction between whether the participant did the action and what the other person said was nonsignificant. The results of Study 2 were similar. There were main effects for memory [LOR $= 0.17$, $SE = 0.07$; $\chi^2(1) = 6.32$, $p = .01$] and for conformity [LOR $= -1.07$, $SE = 0.07$; $\chi^2(1) = 5{,}951.65$, $p < .001$]. Their interaction was nonsignificant. Figure 2 compares the memory conformity effects across the two studies and the two types of tests. The signs of the LORs in Study 2 have been changed so their magnitudes could be compared more easily with the LORs in Study 1.

We now focus on when the participant falsely reported doing an action in the SRT after the other participant had suggested that the participant had done the action. In Study 1, this suggestion was made by the person claiming to have done the action. In Study 2, the suggestion was made by the person claiming to have not done the action. Figure 3 shows that the participants continued reporting doing the event when tested individually (62% and 66% in Studies 1 and 2, respectively) and that they often reported these false memories as pictorial memories. About two thirds of these false memories (76% and 60% in Studies 1 and 2, respectively) are ones where the participants reported having mental pictures of themselves doing the action.

These proportions of pictorial false alarms are high, as compared with those usually found with the R–K procedure. This is likely to be due to our instructions suggesting a threshold lower than the remember threshold. Because the props were in the testing room, this may have also increased the false pictorial memory rate. We compared these proportions with those in all other conditions. In Study 1, the only statistically significant effect [$\chi^2(1) =$

Table 2
Percentages of Trials for the Individual Recognition Test on Which the Person Said That They Did the Action, Broken Down by Whether They Did Do the Action and What the First Responder Reported in the Social Recognition Test (SRT)

	What the First Person Said in SRT	
	Not Do	Did
Study 1		
Action not done	31.23	54.68
Action done	43.33	72.00
Study 2		
Action not done	52.61	30.69
Action done	58.80	31.09

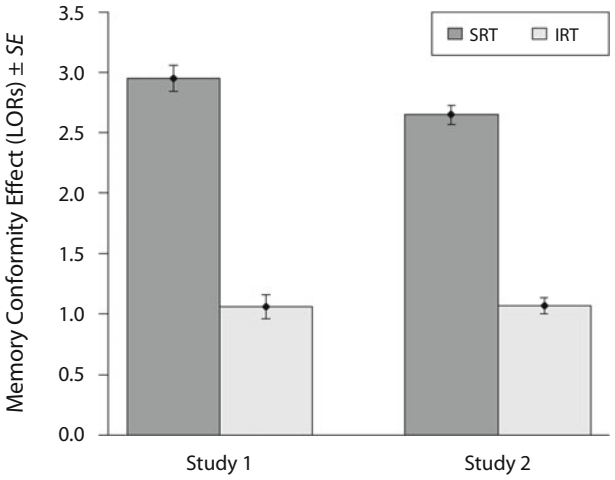

Figure 2. The memory conformity effect (measured in log-odds ratios, or LORs) with the standard errors for Studies 1 and 2 and for the Social Recognition Test (SRT) and the Individual Recognition Test (IRT). The sign is changed for LORs in Study 2 so that their magnitudes can be compared with those in Study 1.

7.40, $p = .007$] was that the percentage of pictorial memories was 77.31% if the other person reported having done the action in the SRT and 64.50% if the other person reported not having done the action in the SRT. The ratios of pictorial to nonpictorial memories did not vary significantly for Study 2.

DISCUSSION

People can be made to report that they have done actions that they, in fact, have not done. These false memories occur both when tested with the person who suggested the errant information present and when tested individually. The method we used to suggest memories for actions was having participants take part in an SRT where the other participant's response implied that either they had or had not done the action. When this procedure was used, when errant information was presented, the participants were made less likely to report that they had done actions that they, in fact, had done and were more likely to report that they had done actions that they had not done. Accurate PEI increased accuracy.

With respect to theories of memory, there is discussion about whether memory for self-performed actions is qualitatively different from memories for observed events (see the discussion in Zimmer et al., 2001). If memories for actions are qualitatively different, these memories might be immune from the distorting effects of PEI. We showed that memories for actions are affected by PEI presented by another person. When participants were tested 1 week after they had performed the actions, memory was poor overall, and the participants' responses were greatly affected by what the other person said on the SRT. In Cohen's (1992) terms, the conformity effect in this social situation was between a medium and a large effect. In this social situation, memory conformity can be a combination of normative and informational influences (e.g., Gabbert et al., 2003; Wright et al., 2008). We also tested the participants individually. They continued to be influenced by what the other person had said on the SRT, albeit to a lesser extent. The conformity effects, when the participants were tested individually, were about half the size as when they were tested in the social setting. This difference could be due to several reasons. These include memory's decaying for what the other person had said during the SRT and the fact that the participants chose from three options in the IRT, as opposed to two options in the SRT, but having less normative influences may also have lessened the effect.

Using a difficult memory task increased the likelihood that informational influences would create memory conformity, but normative influences can also influence performance. Other situations could be devised in which the importance of each of these influences could be lessened. For example, if we tested people for actions that they had done only moments before and, therefore, could clearly remember, any memory conformity effects would likely be due only to normative influences. Also, if completely novel items had been used at test, memory rates likely would have increased.

We had no a priori hypotheses about how props could affect conformity. With many tasks, props can facilitate

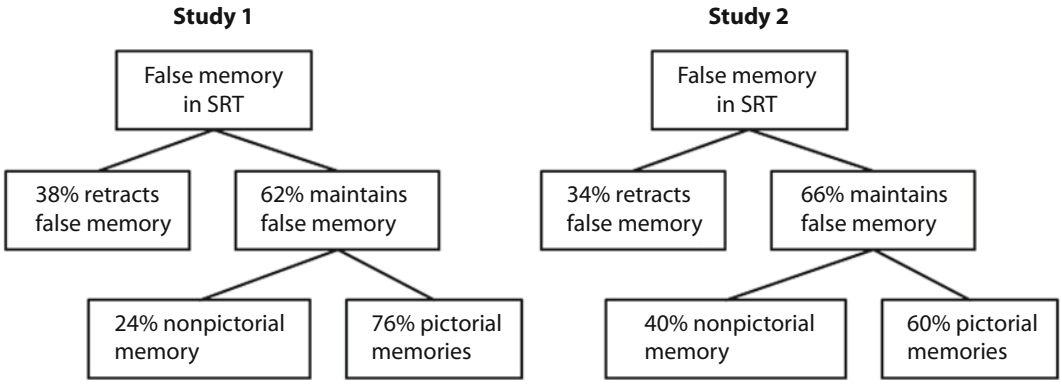

Figure 3. A breakdown of responses on the Individual Recognition Test (IRT) for responses where the participants errantly said during the Social Recognition Test (SRT) that they had done an action when the other participants' SRT responses implied that they had done the action.

memory, but given the 1-week delay, memory was poor, and we observed no differences in the memory effects. However, we did observe differences in the memory conformity effects. There was greater memory conformity for actions with props. The following post hoc explanation might account for this finding. Because it is likely that people believe that memory for actions involving props is good, they may trust the other person's memory more if it is for an action requiring a prop than if it is for an action not requiring a prop. In terms of Figure 1, if the belief in the other person's memory is heightened and belief in the participant's own memory is not heightened, this should produce more memory conformity.

We also showed that it was possible to get people to report pictorial memories for actions that they did not do. There is much debate about Tulving's (1985) distinction between remember/episodic memories and know/semantic memories. We used a different label, pictorial memory, and described the construct differently to our participants. The responses found here should not be compared directly with those from R–K studies. The instructions used were specifically designed for self-performed actions and are closer to G. R. Loftus and Bell's (1975) phrases. G. R. Loftus and Bell asked participants to indicate whether their memory was based on a particular detail or just on familiarity. Because we were asking participants whether they actually had performed the task (not just remembering either seeing the props or, in Study 2, watching the other person perform the task), our question asked whether they could actually "see" themselves doing the task. The participants reported pictorial memories for approximately 60%–70% of the actions remembered during the IRT. These percentages were about the same across conditions. Given the low memory rates overall, this suggests that the participants had a low threshold for reporting a pictorial memory.

Having some form of image incorporated within a memory is important in developing full-blown episodic memories. According to Mazzoni (2002), false memories usually develop through a series of stages. First, the person has to think that the event is plausible, which is likely true for all the actions used. Second, it has to seem familiar, which could occur from exposure to the event at encoding or hearing the other person's response. Third, the person has to make a source-monitoring error, mistakenly believing that the action is familiar because he or she did the action. This allows our dynamic memories to fill in gaps with other information, including imagery, that can lead to a pictorial memory.

Memories for actions can be affected by information suggested by another person. Besides supporting theories of social influences on memory, this research has important applications. It is worth highlighting two of these from clinical and forensic psychology. First, some people with obsessive–compulsive disorder continually check whether they have done different actions. At high levels of perseverative checking, this can become debilitating. Our research shows that in our undergraduate population, many people trusted other people's memory for actions less than they did their own. Memory conformity research might shed light on the memory distrust some obsessive–compulsive people have. Second, in legal cases, people often are asked whether they did something, and in some forms of aggressive interviewing, the questioning is designed explicitly to get the person to report having done some action (Kassin, 2008). Here, we showed that much more subtle persuasion can create false reports of having done noncriminal actions.

AUTHOR NOTE

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REFERENCES

Af Hjelmsäter, E. R., Granhag, P. A., Strömwall, L. A., & Memon, A. (2008). The effects of social influence on children's memory reports: The omission and commission error asymmetry. *Scandinavian Journal of Psychology*, **49**, 507-513. doi:10.1111/j.1467-9450.2008.00679.x

Agresti, A. (2002). *Categorical data analysis* (2nd ed.). New York: Wiley.

Asch, S. E. (1955). Opinions and social pressure. *Scientific American*, **193**, 31-35.

Axmacher, N., Gossen, A., Elger, C. E., & Fell, J. (2010). Graded effects of social conformity on recognition memory. *PLoS ONE*, **5**, e9270. doi:10.1371/journal.pone.0009270

Baayen, R. H., Davidson, D. J., & Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory & Language*, **59**, 390-412. doi:10.1016/j.jml.2007.12.005

Baron, R. S., Vandello, J. A., & Brunsman, B. (1996). The forgotten variable in conformity research: Impact of task importance on social influence. *Journal of Personality & Social Psychology*, **71**, 915-927. doi:10.1037/0022-3514.71.5.915

Bates, D., & Maechler, M. (2009). *lme4: Linear mixed-effects models using S4 classes* (R package Version 0.999375-32). Retrieved from http://CRAN.R-project.org/package=lme4.

Blank, H. (2009). Remembering: A theoretical interface between memory and social psychology. *Social Psychology*, **40**, 164-175. doi:10.1027/1864-9335.40.3.164

Bodner, G. E., Musch, E., & Azad, T. (2009). Reevaluating the potency of the memory conformity effect. *Memory & Cognition*, **37**, 1069-1076. doi:10.3758/MC.37.8.1069

Cialdini, R. B. (2008). *Influence: Science and practice* (5th ed.). Boston: Allyn & Bacon.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, **112**, 155-159. doi:10.1037/0033-2909.112.1.155

Deutsch, M., & Gerard, H. B. (1955). A study of normative and informational social influences upon individual judgment. *Journal of Abnormal & Social Psychology*, **51**, 629-636. doi:10.1037/h0046408

Echterhoff, G., & Hirst, W. (2009). Social influence on memory. *Social Psychology*, **40**, 106-110. doi:10.1027/1864-9335.40.3.106

Engelkamp, J. (1998). *Memory for actions*. Hove, U.K.: Psychology Press.

Engelkamp, J. (2001). Action memory: A system-oriented approach. In H. D. Zimmer, R. L. Cohen, M. J. Guynn, J. Engelkamp, R. Kormi-Nouri, & M. A. Foley (Eds.), *Memory for action: A distinct form of episodic memory?* (pp. 49-96). New York: Oxford University Press.

Engelkamp, J., & Krumnacker, H. (1980). Imaginale und motorische Prozesse beim Behalten verbalen Materials. *Zeitschrift für Experimentelle und Angewandte Psychologie*, **27**, 511-533.

FRENCH, L., GERRIE, M. P., GARRY, M., & MORI, K. (2009). Evidence for the efficacy of the MORI technique: Viewers do not notice or implicitly remember details from the alternative movie version. *Behavior Research Methods*, **41**, 1224-1232. doi:10.3758/BRM.41.4.1224

GABBERT, F., MEMON, A., & ALLAN, K. (2003). Memory conformity: Can eyewitnesses influence each other's memories for an event? *Applied Cognitive Psychology*, **17**, 533-543. doi:10.1002/acp.885

GABBERT, F., MEMON, A., & WRIGHT, D. B. (2007). I saw it for longer than you: The relationship between perceived encoding duration and memory conformity. *Acta Psychologica*, **124**, 319-331. doi:10.1016/j.actpsy.2006.03.009

GOFF, L. M., & ROEDIGER, H. L., III (1998). Imagination inflation for action events: Repeated imaginings lead to illusory recollections. *Memory & Cognition*, **26**, 20-33.

GOLDSTEIN, H. (2003). *Multilevel statistical models* (3rd ed.). London: Edward Arnold.

GUDJONSSON, G. H., & MACKEITH, J. A. (1982). False confessions: Psychological effects of interrogation. A discussion paper. In A. Trankell (Ed.), *Reconstructing the past: The role of psychologists in criminal trials* (pp. 253-269). Deventer, The Netherlands: Kluwer.

HIRST, W., & MANIER, D. (2008). Towards a psychology of collective memory. *Memory*, **16**, 183-200. doi:10.1080/09658210701811912

HOPE, L., OST, J., GABBERT, F., HEALEY, S., & LENTON, E. (2008). "With a little help from my friends . . .": The role of co-witness relationship in susceptibility to misinformation. *Acta Psychologica*, **127**, 476-484. doi:10.1016/j.actpsy.2007.08.010

JOHNSON, M. K., HASHTROUDI, S., & LINDSAY, D. S. (1993). Source monitoring. *Psychological Bulletin*, **114**, 3-28. doi:10.1037/0033-2909.114.1.3

KASSIN, S. M. (2008). The psychology of confessions. *Annual Review of Law & Social Science*, **4**, 193-217. doi:10.1146/annurev.lawsocsci.4.110707.172410

KELMAN, H. C. (1958). Compliance, identification, and internalization: Three processes of attitude change. *Journal of Conflict Resolution*, **2**, 51-60.

LINDSAY, D. S., & JOHNSON, M. K. (1989). The eyewitness suggestibility effect and memory for source. *Memory & Cognition*, **17**, 349-358.

LOFTUS, E. F. (2005). Planting misinformation in the human mind: A 30-year investigation of the malleability of memory. *Learning & Memory*, **12**, 361-366. doi:10.1101/lm.94705

LOFTUS, G. R., & BELL, S. M. (1975). Two types of information in picture memory. *Journal of Experimental Psychology: Human Learning & Memory*, **1**, 103-113.

MACDONALD, C. B., & DAVEY, G. C. L. (2005). A mood-as-input account of perseverative checking: The relationship between stop rules, mood and confidence in having checked successfully. *Behaviour Research & Therapy*, **43**, 69-91. doi:10.1016/j.brat.2003.11.003

MAZZONI, G. (2002). Naturally occurring and suggestion-dependent memory distortions: The convergence of disparate research traditions. *European Psychologist*, **7**, 17-30. doi:10.1027//1016-9040.7.1.17

MEADE, M. L., & ROEDIGER, H. L., III (2002). Explorations in the social contagion of memory. *Memory & Cognition*, **30**, 995-1009.

MERCKELBACH, H., VAN ROERMUND, H., & CANDEL, I. (2007). Effects of collaborative recall: Denying true information is as powerful as suggesting misinformation. *Psychology, Crime & Law*, **13**, 573-581. doi:10.1080/10683160601160679

MORI, K. (2007). A revised method for projecting two different movies to two groups of viewers without their noticing the duality. *Behavior Research Methods*, **39**, 574-578.

NILSSON, L.-G., & KORMI-NOURI, R. (2001). What is the meaning of a memory-systems approach? Comments on Engelkamp. In H. D. Zimmer, R. L. Cohen, M. J. Guynn, J. Engelkamp, R. Kormi-Nouri, & M. A. Foley (Eds.), *Memory for action: A distinct form of episodic memory?* (pp. 136-143). New York: Oxford University Press.

PATERSON, H. M., & KEMP, R. I. (2006a). Comparing methods of encountering post-event information: The power of co-witness suggestion. *Applied Cognitive Psychology*, **20**, 1083-1099. doi:10.1002/acp.1261

PATERSON, H. M., & KEMP, R. I. (2006b). Co-witnesses talk: A survey of eyewitness discussion. *Psychology, Crime & Law*, **12**, 181-191. doi:10.1080/10683160512331316334

REYSEN, M. B. (2005). The effects of conformity on recognition judgements. *Memory*, **13**, 87-94. doi:10.1080/09658210344000602

ROEDIGER, H. L., III (2010). Reflections on intersections between cognitive and social psychology: A personal exploration. *European Journal of Social Psychology*, **40**, 189-205. doi:10.1002/ejsp.736

ROEDIGER, H. L., III, MEADE, M. L., & BERGMAN, E. T. (2001). Social contagion of memory. *Psychonomic Bulletin & Review*, **8**, 365-371.

SCHNEIDER, D. M., & WATKINS, M. J. (1996). Response conformity in recognition testing. *Psychonomic Bulletin & Review*, **3**, 481-485.

SHERIF, M. (1936). *The psychology of social norms*. New York: Harper Collins.

SKAGERBERG, E. M. (2006). Co-witness feedback in lineups. *Applied Cognitive Psychology*, **21**, 489-497. doi:10.1002/acp.1285

SKAGERBERG, E. M., & WRIGHT, D. B. (2008a). Manipulating power can affect memory conformity. *Applied Cognitive Psychology*, **22**, 207-216. doi:10.1002/acp.1353

SKAGERBERG, E. M., & WRIGHT, D. B. (2008b). The prevalence of co-witnesses and co-witness discussions in real eyewitnesses. *Psychology, Crime & Law*, **14**, 513-521. doi:10.1080/10683160801948980

SKAGERBERG, E. M., & WRIGHT, D. B. (2009). Susceptibility to post-identification feedback is affected by source credibility. *Applied Cognitive Psychology*, **23**, 506-523. doi:10.1002/acp.1470

TULVING, E. (1985). Memory and consciousness. *Canadian Psychology*, **26**, 1-12.

WRIGHT, D. B., GABBERT, F., MEMON, A., & LONDON, K. (2008). Changing the criterion for memory conformity in free recall and recognition. *Memory*, **16**, 137-148. doi:10.1080/09658210701836174

WRIGHT, D. B., LOFTUS, E. F., & HALL, M. (2001). Now you see it; now you don't: Inhibiting recall and recognition of scenes. *Applied Cognitive Psychology*, **15**, 471-482. doi:10.1002/acp.719

WRIGHT, D. B., & LONDON, K. (2009). Multilevel modelling: Beyond the basic applications. *British Journal of Mathematical & Statistical Psychology*, **62**, 439-456. doi:10.1348/000711008X327632

WRIGHT, D. B., LONDON, K., & WAECHTER, M. (2010). Social anxiety moderates memory conformity in adolescents. *Applied Cognitive Psychology*, **24**, 1034-1045.

WRIGHT, D. B., MATHEWS, S. A., & SKAGERBERG, E. M. (2005). Social recognition memory: The effect of other people's responses for previously seen and unseen items. *Journal of Experimental Psychology: Applied*, **11**, 200-209. doi:10.1037/1076-898X.11.3.200

WRIGHT, D. B., MEMON, A., SKAGERBERG, E. M., & GABBERT, F. (2009). When eyewitnesses talk. *Current Directions in Psychological Science*, **18**, 174-178. doi:10.1111/j.1467-8721.2009.01631.x

WRIGHT, D. B., SELF, G., & JUSTICE, C. (2000). Memory conformity: Exploring misinformation effects when presented by another person. *British Journal of Psychology*, **91**, 189-202.

ZIMMER, H. D. (2001). Why do actions speak louder than words? Action memory as a variant of encoding manipulations or the result of a specific memory system. In H. D. Zimmer, R. L. Cohen, M. J. Guynn, J. Engelkamp, R. Kormi-Nouri, & M. A. Foley (Eds.), *Memory for action: A distinct form of episodic memory?* (pp. 151-198). New York: Oxford University Press.

ZIMMER, H. D., COHEN, R. L., GUYNN, M. J., ENGELKAMP, J., KORMI-NOURI, R., & FOLEY, M. A. (EDS.) (2001). *Memory for action: A distinct form of episodic memory?* New York: Oxford University Press.

NOTE

1. We replaced three of Goff and Roediger's (1998) phrases with our own: "slapping the jack" with "spin the top," because "slap the jack" was not a well-known game among our participant pool; "light the lighter" with "look under the table" for safety concerns; and "ring the bell" with "shake the rattle," since the latter phrase was clearer to our pilot participants for the props we used.

(*Continued on next page*)

APPENDIX

Table A1
Percentages of Trials in the IRT That the Person Said That They Had Not Done the Action, That They Had Done It but Did Not Have a Pictorial Memory for Doing It, and That They Had a Pictorial Memory for Doing the Action, Broken Down by Whether They Did the Action, What They Reported in the SRT, and What the First Responder Reported in the SRT

		What Participant Said in SRT			
		Did Not Do		Did	
What Other Person Said in SRT		Not Do	Did	Not Do	Did
Study 1					
Action not done	New	72.22	69.16	50.48	38.29
	Nonpictorial	9.38	12.15	14.29	14.88
	Pictorial	18.40	18.69	35.24	46.83
Action done	New	61.36	58.65	35.85	21.28
	Nonpictorial	14.44	10.58	25.47	15.74
	Pictorial	24.20	30.77	38.68	62.98
Study 2					
Action not done	New	71.22	74.00	34.33	41.60
	Nonpictorial	13.41	11.00	26.32	20.00
	Pictorial	15.37	14.99	39.35	38.40
Action done	New	67.22	74.54	29.60	39.10
	Nonpictorial	13.50	10.97	25.62	21.05
	Pictorial	19.28	14.49	44.77	39.85

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