American Psychological Association

Journal of Experimental Psychology: Applied


ISSN: 1076-898X

2021, Vol. 27, No. 2, 258–275
https://doi.org/10.1037/xap0000346

# Differential Effects of Pressure on Social Contagion of Memory

Jessica Andrews-Todd[1], Nikita A. Salovich[2], and David N. Rapp[2, 3]
[1] Cognitive and Learning Sciences, Educational Testing Service, Princeton, New Jersey, United States
[2] Department of Psychology, Northwestern University
[3] School of Education and Social Policy, Northwestern University

Collaboration can support performance on a variety of tasks, but recent projects have indicated that group collaborations can also be associated with memory decrements. For example, when people discuss ideas, any shared inaccurate information can be used by group members to complete subsequent tasks. Across two experiments, we examined whether this social contagion is influenced by performance pressures that regularly emerge during group interactions. In Experiment 1, participants under individual-directed pressure, goal-directed pressure, or control conditions studied word lists before completing a collaborative recall with a confederate partner who occasionally recalled incorrect words. We examined whether partner-produced inaccuracies contaminated participants' memories for the list contents on a subsequent individual recall. Goal-directed pressure, focused on monitoring partner accuracy, facilitated subsequent individual recall, as demonstrated by reduced reproductions of partner-generated inaccuracies. In contrast, individual-directed pressure, focused on appearing competent, resulted in greater use of those inaccuracies. Experiment 2 ruled out that the benefits associated with goal-directed pressure were solely due to warning participants about the possibility of social contagion. These results demonstrate that different instantiations of pressure can help or hinder memory-related performance in collaborative settings. Under the right conditions, pressure can help overcome the effects of exposure to inaccurate information.

***Public Significance Statement***
This study provides evidence that different kinds of performance pressure can help or hinder memory-related activities in collaborative settings. Under certain conditions, pressure can help people resist being influenced by inaccurate information shared by others. Pressure that motivates monitoring the accuracy of others' contributions can usefully reduce reproductions of partner-generated inaccuracies. In contrast, pressure that motivates individuals to appear competent, unfortunately, can result in a greater use of partner-generated inaccuracies.

*Keywords:* memory, social contagion of memory, false memory, performance pressure



People routinely participate in situations that require accurate memory recall, such as when they take an exam or offer testimony. Recall is influenced by reconstructive processes that can distort what people believe they remember and know, which has most often been studied with people working alone (Bartlett, 1932; Deese, 1959; Loftus & Palmer, 1974; Roediger, 2001; Roediger & McDermott, 1995; Shaw & Porter, 2015; Thomas & Loftus, 2002). However, the consequences of reconstructive memory are also relevant during collaborative remembering, as people's memories are shaped and influenced by others (Hirst & Echterhoff, 2012; Hyman et al., 2014; Marsh & Tversky, 2004). Remembering in groups can at times be beneficial, as when group members contribute information that others do not know, have forgotten, or may have inadvertently ignored, to support accurate and effective recall (Blumen & Rajaram, 2008; Rajaram & Pereira-Pasarin, 2007). But when the information that group members contribute is inaccurate, collaborative remembering can have negative effects on the contents of memory and subsequent performance outcomes.

Previous work has demonstrated that people incorporate inaccurate information provided by collaborative partners into memory (Garry et al., 2008; Meade & Roediger, 2002; Ross et al., 2004). In a seminal study, Roediger et al. (2001) asked participants to memorize items from household scenes with a partner who was actually a confederate (i.e., a research assistant who posed as another naïve participant). During a collaborative recall task, the confederate sometimes produced items that had not actually appeared in the studied scenes. When tested individually after their collaborative recall, participants' memories were contaminated by their partner's inaccurate productions. Their recalls often included their partner produced inaccuracies, with participants identifying those items as having actually appeared in the scenes rather than having only been produced by their partner. People's general reliance on the

This article was published Online First March 22, 2021.
Jessica Andrews-Todd https://orcid.org/0000-0003-0501-9782
The authors declare that there were no conflicts of interest with respect to the authorship or publication of this article.

This material is based upon work supported by the National Science Foundation under Grant DGE-0824162 awarded to the first author. We thank Carlie Cope and Bethany Tuten for their help with data collection.

All data and materials are publicly available online at https://osf.io/dpu6a/.

Correspondence concerning this article should be addressed to Jessica Andrews-Todd, Educational Testing Service, 660 Rosedale Road, MS 16-R, Princeton, NJ 08541, United States. Email: jandrewstodd@ets.org

information provided by others, with reliance defined as recalling information and reporting it as if it had been personally experienced, is termed the social contagion of memory (Meade & Roediger, 2002; Roediger et al., 2001).

Several accounts emphasize that social pressure can increase the production of and reliance on inaccurate information during collaborative tasks (Basden et al., 1997; Reysen, 2007; Thorley & Dewhurst, 2007). For example, participants taking turns to recall information with partners produce more inaccuracies when under pressure as compared to when pressure is reduced or omitted (e.g., Alper et al., 1976; Reysen, 2003), such as when they can freely recall items or recall alone (Basden et al., 1997; Thorley & Dewhurst, 2007; Weldon & Bellinger, 1997). Participants are also more likely to *reproduce* inaccurate items offered by their partners (referred to as "contagion items") when collaborative recall requires versus encourages responses, and as the number of partners in a recall group increases (e.g., Basden et al., 1997; Reysen, 2007; Thorley & Dewhurst, 2007). These findings exemplify the negative effects of social pressures on the social contagion of memory. But are pressure effects always problematic, or do they depend on the type of pressure experienced during collaborative remembering? Identifying the conditions under which pressure enhances, reduces, or fails to influence social contagion should prove useful for contemplating the design and appropriateness of collaborative recall activities, including but not limited to group study experiences and jury deliberations of testimony.

## The Effects of Pressure on Task Performance

Pressure-based disruptions in individual task performance are often attributed to compromises in the allocation of cognitive resources necessary to complete an activity (Beilock, 2008; Mousavi et al., 1995; Schmader & Johns, 2003). As an example, consider the results of Croizet et al. (2004), which reported that psychology majors performed worse than other students on an assessment of general cognitive ability when told they might be lower in intelligence than science majors, but performed as well as other students when the test was framed as nondiagnostic of their ability. The pressure instantiated via negative information about their group detrimentally affected performance on the assessment. Instantiated pressure can enact physiological (e.g., increased stress levels) and psychological (e.g., increased self-monitoring and regulation of thoughts and feelings) processes that consume cognitive resources required for successful task performance (Schmader et al., 2008). The effects reported in Croizet et al. (2004) were mediated by physiological measures associated with increased mental workload (e.g., heart rate variability), consistent with the idea that thoughts and worries about confirming the negative view of their group were associated with performance decrements.

Similar decrements have been linked to pressure induced using a variety of task contingencies (e.g., Beilock & Carr, 2005; Crouzevialle & Butera, 2013; DeCaro et al., 2010). In one demonstration, participants in low or high-pressure conditions were asked to solve arithmetic problems that varied in the demands placed on working memory (Beilock et al., 2004). While low-pressure participants were simply asked to solve the problems, high-pressure participants were told they would be video recorded and receive financial compensation based on both their performance and that of an assigned partner. They were also informed that their partner had already performed at a level necessary to receive the reward, placing responsibility on the participant to secure the money. High-pressure participants performed worse on the task than did low-pressure participants, most notably for math problems with high working memory demands. Several accounts, again, attribute these decrements as at least partially due to participants' performance concerns recruiting attentional resources necessary to successfully complete the task (e.g., Beilock, 2008; DeCaro et al., 2010; Gimmig et al., 2006).

Pressure, however, does not always seem to lead to performance decrements, with some studies instead highlighting beneficial increases in motivation and performance in pressure-filled situations (Aronson, 2002; Gardner, 2012). For example, Reysen (2003) reported that participants experiencing social pressure showed better recall performance when paired with virtual partners who exemplified high as compared to low performance. Motivation to align with a partner's ability overcame potential pressure concerns, extending even to subsequent tasks that participants completed on their own. Therefore, in some cases, pressure can seemingly support rather than impinge upon attention allocation (Coull et al., 2001; Fisher & Ford, 1998; Kanfer, 1996). Why then might differential pressure effects obtain? Accounts such as Attentional Control Theory contend that feelings of pressure operate on two attentional systems: a goal-directed, top-down system involved in resource allocation toward task-relevant activities, and a stimulus-driven, bottom-up system that operates in response to salient stimuli (Corbetta & Shulman, 2002; Eysenck et al., 2007; Wood et al., 2016). Pressure therefore can disrupt individual performance by eliciting thoughts or arousal that reduces optimal operation of the goal-directed system, shifting focus to the stimulus-driven system that responds more to external stimuli, feelings, and even those task-irrelevant thoughts (e.g., cognitive heuristics or emotional cues). As a result, resources can be drawn away from task-relevant activities (Ansari & Derakshan, 2010; Miyake et al., 2000), and allocated to task-irrelevant features or to the self, resulting in performance decrements (Baumeister, 1984).

By this account, pressure could also conceivably have beneficial effects on task performance when resources are allocated *toward* the goal-directed system and away from the stimulus-driven system. Indeed, pressure elicited via specific and difficult goals has repeatedly been found to enhance task engagement by focusing attention on task-relevant versus task-irrelevant activities (Hofmann, 1993; Locke & Latham, 1990; Mento et al., 1987). Goal-directed pressure (e.g., the desire to achieve specific performance criteria) can motivate self-regulatory activities that direct resources *toward* a task, supporting performance (Corbetta & Shulman, 2002; Kanfer & Ackerman, 1989). The previously described performance improvements in Reysen (2003) thus may have been at least partially due to participants' focus on the recall task given evidence that the goal was achievable since their partner was able to complete it. Goal-directed pressure contrasts with individual-directed pressures (e.g., the desire to demonstrate competence) that can motivate self-regulatory activities by directing resources *away* from a task and toward concerns irrelevant to performance, such as ego management, with potentially negative consequences (Baumeister, 1984; Kanfer & Ackerman, 1989; Wood et al., 2016). This highlights the importance of resource allocation on task performance, which is a crucial component of effective group activity. It also suggests the possibility that allocation

of attentional resources toward task-relevant activities may benefit collaborative memory tasks.

## Cognitive Resources and Collaborative Contexts

Based on the preceding considerations, situational pressures should impede performance in collaborative contexts if and when they disrupt the allocation of resources toward task-related activities. Processes including monitoring, detecting, and correcting the errors mentioned by others during group discussions require effective resource allocation. In best-case scenarios, people detect and discount errors during collaboration, providing feedback to partners regarding the accuracy of their productions to support later performance (Ross et al., 2008; Salovich & Rapp, 2020; Yaron-Antar & Nachson, 2006). But in many instances, inaccurate contributions from collaborative partners go undetected. These contributions can thus be encoded and relied upon for subsequent tasks (Roediger et al., 2001; Wright et al., 2000). For example, participant pairs who viewed discrepant videos of a criminal event and discussed them were more likely to incorporate unseen and potentially inconsistent information into their subsequent individual recalls than were participants who viewed but did not discuss the videos (Gabbert et al., 2003). These results exemplify social contagion, with the information provided by a collaborative partner problematically contaminating participants' memories for the experience.

Warnings and tasks that encourage evaluation help protect against memory errors in some cases (Andrews & Rapp, 2014; Brashier et al., 2020; Chambers & Zaragoza, 2001; Echterhoff et al., 2005; Lindsay & Johnson, 1989; Salovich & Rapp, 2020; Sparks & Rapp, 2011). They can do so by motivating people to consider and track the accuracy and origins of information while completing a task. Memory representations are accompanied by perceptual, spatial, semantic, and affective details reflecting the conditions under which they were encoded. People can leverage these characteristics to determine the origins of their memories (Johnson et al., 1993), potentially reducing the use of information that was produced by a partner rather than personally experienced. Evaluative processes such as source monitoring also require sufficient attentional resources to enact. When these resources are reduced, source misattributions can result (Lane, 2006), such as information being believed to have been personally experienced rather than encoded based on descriptions from another person (Hyman et al., 2014; Lindsay et al., 1991; Mitchell et al., 2003; Zaragoza et al., 1997; Zaragoza & Lane, 1994, 1998). Explicit instructions to source monitor can reduce people's tendency to rely on others' productions or claim them as their own memories (Hyman et al., 2014). This suggests that explicit instructions to engage in source monitoring should reduce people's reliance on inaccurate partner contributions, as associated with the availability and effective application of cognitive resources.

## The Present Study

The current project investigated whether instantiated pressure differentially affects social contagion of inaccurate partner productions depending on whether that pressure is oriented toward or away from task-relevant activities. In Experiment 1, we randomly assigned participants to individual-directed pressure, goal-directed pressure, or no-pressure (control) conditions. The individual- and goal-directed conditions used methodological manipulations from social and clinical projects to provoke feelings of arousal associated with stress or anxiety (e.g., social evaluation, ego considerations, group membership concerns; Baumeister & Showers, 1986; Beilock et al., 2004; Croizet et al., 2004). The individual-directed pressure condition directed attention to the self by instantiating concerns about competency. Based on previous work, this should divert attentional resources away from the task toward less relevant considerations including obtrusive thoughts about competence and self-consciousness about how one might be perceived (Beilock, 2008; Corbetta & Shulman, 2002; Eysenck et al., 2007). In the goal-directed pressure condition, participants received explicit instructions on how to achieve successful performance on the task, which involved warnings to monitor and avoid inaccuracies provided by their partner. This should shift resources toward task-relevant considerations (Corbetta & Shulman, 2002; Kanfer & Ackerman, 1989). Both of these conditions contrasted with the no-pressure condition which received no manipulated directions or warnings.[1]

We hypothesized differential effects of goal-directed and individual-directed pressure on social contagion. First, we predicted that recall performance in the individual-directed pressure manipulation would be associated with increased contagion errors, as compared to recall performance in the goal-directed or control conditions. This was based on the view that individual-directed pressure should involve allocation of resources toward task-irrelevant factors (e.g., concerns about self-image) rather than to task-relevant processes (e.g., monitoring and evaluation) that should facilitate performance. In contrast, participants in the goal-directed pressure condition should be less likely to recall contagion items as the performance criteria should motivate attending to the monitoring and detecting of errors during collaboration. Second, we predicted that participants experiencing individual-directed pressure would show poorer source monitoring than would participants in the other two conditions, with goal-directed pressure potentially enhancing participants' monitoring of the source of inaccuracies.

Warnings have at times proven generally useful for reducing people's encoding and retrieval of inaccurate information (Brashier et al., 2020; Christiaansen & Ochalek, 1983; Echterhoff et al., 2005; Greene et al., 1982; Meade & Roediger, 2002; Peshkam et al., 2011; Rapp et al., 2014; Salovich & Rapp, 2020). Thus, any benefits observed in the goal-directed pressure condition might be due to warnings about the potential for social contagion, rather than due to the processing benefits of goal-directed pressure. To rule out this potential explanation, in Experiment 2 we included a condition in which participants were warned, without pressure, about the possibility that their partner might provide inaccurate information. We compared recall performance in this condition with performance in a goal-directed pressure condition. The results from these two experiments identify differential effects of pressure on collaborative recall, a critical issue for accounts that link pressure to resource allocation and performance, and a necessary design consideration for applications intended to support group memory activities.

[1] The control condition included the standard pressures associated with completing a recall task in an experimental lab setting. It might therefore be characterized as a low pressure rather than a no pressure situation. Nevertheless, to avoid confusion between conditions, and because it involved the standard, baseline pressures accompanying all conditions in the study while omitting the goal- or individual-directed manipulations, we refer to it as the control condition.

## Experiment 1

We first examined whether individual- and goal-directed pressure differentially affect the likelihood that individuals will recall contagion items produced by a partner. Participants began by studying categorized word lists with a confederate partner. Next, the participant–confederate pairs were randomly assigned to an individual-directed, goal-directed, or no-pressure manipulation. The individual-directed pressure manipulation encouraged participants to consider their performance on a task that measured "competence relative to the performance of students at a nearby institution." These instructions were intended to instantiate pressure without providing the defined goal of avoiding inaccurate productions from their partner. In contrast, the goal-directed pressure manipulation encouraged participants to consider their performance on a task that measured "resistance to partner-produced inaccuracies" relative to the performance of students at a nearby institution. These latter instructions, unlike the instructions provided in the individual-directed pressure condition, explicitly define a useful, task-relevant goal.

As a means of increasing their feelings of pressure, participants in both conditions were told they would be video-recorded (Beilock et al., 2004; Beilock & Carr, 2005; Mesagno et al., 2012). Participant–confederate pairs assigned to the control condition, in contrast, received no pressure manipulations and were not told they would be video-recorded. Across all three conditions, during the collaborative recall task, the confederate partner occasionally produced items that had not appeared in the lists. A subsequent individual recall and source-monitoring test assessed the frequency with which participants recalled a partner's inaccurate productions, and whether they recognized those productions as having been provided by their partner.

If individual-directed pressure diverts resources *away* from task-relevant behaviors (e.g., error detection and source monitoring), participants in the individual-directed pressure condition should show greater social contagion effects (i.e., their individual recalls should include incorrect information produced by their partner but that was not actually studied) and more source monitoring errors than will participants in the control or goal-directed pressure conditions. Additionally, if goal-directed pressure directs cognitive resources *toward* task-relevant behaviors, participants in the goal-directed pressure condition should show reduced social contagion (i.e., fewer recalled partner-produced inaccuracies) and fewer source monitoring errors than do participants in the control or individual-directed pressure conditions.

### Method

All materials and data described in this study are publicly available online at https://osf.io/dpu6a/.

#### *Participants*

Eighty-one Northwestern University undergraduates (42 female) participated in the experiment for course credit. Data from three participants were discarded due to confederate error, from two participants for not following directions, and from one participant because of suspicion of the confederate, leaving 75 participants.

#### *Materials*

The study items were six categorized word lists, as used in previous projects, on the topics of birds, human body parts, vegetables, four-footed animals, articles of clothing, and flowers (Battig & Montague, 1969; Meade & Roediger, 2006). Two items from each corresponding Battig and Montague (1969) list were added to the Meade and Roediger (2006) lists for a total of 24 items per list. The first and last two items from each list were designated for use as inaccurate productions by the confederate (i.e., *contagion items*). The first two items (i.e., items 1 and 2) were *high-expectancy contagion items* (i.e., items typical of list categories), with the first word serving as the primary contagion item for use by the confederate. If this primary contagion item was spontaneously produced by a participant, the second item served as a backup contagion item for the confederate to use. The last two items (i.e., items 23 and 24) were *low-expectancy contagion items* (i.e., items less typical of list categories), again with the first word serving as the primary contagion item produced by the confederate and the second word serving as an alternate. To illustrate, in the word list for the category "birds," robin was a high-expectancy contagion item and owl was a low-expectancy contagion item, as robins are a more typical member of the category "birds" than are owls (Rosch & Mervis, 1975). Excluding these four contagion words from the to-be-studied lists left a total of 20 items in each list. A 36-item paper and pencil recognition source-monitoring test (Meade & Roediger, 2002) included 18 list items (three items from each studied list), 12 contagion items (one high- and one low-expectancy contagion item from each list, half mentioned by the confederate), and six unrelated, non-presented items. The materials also included a filler sheet of multiplication problems, individual recall sheets for each studied list, a video camera, and a manipulation check questionnaire.

#### *Design*

The experiment used a $3 \times 2 \times 2$ mixed design. Pressure (individual-directed, goal-directed, and control) was manipulated between subjects; after aforementioned exclusions, 29 participants were included in the individual-directed pressure condition, 22 in the goal-directed pressure condition, and 24 in the control condition. Exposure to social contagion (contagion or unmentioned) and item expectancy (high expectancy or low expectancy) were manipulated within subjects, as in previous work (Andrews & Rapp, 2014; Roediger et al., 2001). The dependent variables were participants' recall of contagion items on the individual recall test, and recognition of the source of contagion items. Thus, performance was examined with respect to the proportion of contagion items participants produced during the individual recall, and the amount of source monitoring errors made by each participant. Analyses included repeated measures ANOVAs and *t*-tests, with significance levels set at .05.

#### *Procedure*

Each participant completed the experiment working for part of the session with a physically co-present confederate (a college-aged, White female) who memorized all word lists and followed a script to maintain a consistent order for her recalled words. Participants were told that the purpose of the study was to determine how groups

process information. The experiment began with a study phase in which participant–confederate pairs were presented with six categorized word lists on a computer screen. The lists and list categories appeared in the same order for each pair. Each word was presented for 1.5 s, as in previous work (Andrews & Rapp, 2014; Meade & Roediger, 2006; Reysen, 2003; Roediger & McDermott, 1995). After presenting each list, participants pressed the "P" key to begin a new list until all six lists were viewed. Participants were instructed to pay close attention to the lists to prepare for a subsequent memory test. After the study phase, each participant (and the confederate) was given 4 min to individually complete multiplication problems at their own pace.

Next, participants completed the collaborative recall task for the word lists with the confederate. The instructions asked participants to recall as many items from the word lists as they could without guessing. In addition, participants in the individual-directed pressure condition learned about research showing the supposed consistently inferior performance of Northwestern University students in comparison to University of Chicago students on experimental tasks assessing higher-order cognition. They were told they would engage in a group recall task used in previous experiments assessing higher-order cognition, and were informed they would be video-recorded while completing the task in order to understand why Northwestern students were performing so poorly. This manipulation included multiple sources of pressure. Specifically, we utilized elements of competition that can invoke performance pressure by comparing people's performance to that of others who may be in a different social group (Baumeister & Showers, 1986; Robinson, 2016). Participants were told about the consistent poor performance of students in their social group (i.e., Northwestern students) on tasks similar to the one they were assigned, intended to increase pressure to work harder so as to compare favorably with others. This manipulation also invoked pressure by presenting the task as ego-relevant, framing it as diagnostic or evaluative so as to position performance as reflective of important aspects of the self (Baumeister & Showers, 1986). Additionally, social evaluation or audience concerns were introduced by informing participants that their performance was being video-recorded. This is common in social and clinical psychological studies to induce performance pressure by heightening self-awareness and fear of performing poorly in front of others (Baumeister & Showers, 1986; Beilock et al., 2004; Beilock & Carr, 2001, 2005; Bögels et al., 2002; Eysenck et al., 2007; Mesagno et al., 2012).

Participants in the goal-directed pressure condition, in contrast, learned about the social contagion effect. They were told that students at the University of Chicago were able to overcome it when they knew about the effect whereas Northwestern University students could not. Participants were also told that their performance would be video-recorded. This manipulation therefore also leveraged elements of performance pressure and social evaluation, but with the instructions specifically instantiating an explicitly stated performance goal (Hofmann, 1993; Locke & Latham, 1990; Mento et al., 1987).

Participants in the control condition were simply told they would be completing a group recall task without any additional information about potential comparison groups or performance expectations (the instructions for the three different conditions appear in Appendix A).

The collaborative recall task was the same across all three conditions. For each list the experimenter named, the confederate and participant took turns recalling items until each had recalled six items. For three of the six lists, the confederate recalled one high- and one low-expectancy contagion item that had not appeared during the study in the fourth and sixth recall positions (i.e., "contagion" lists). The second excluded item from each list served as an alternate contagion item the confederate could use if a participant spontaneously and incorrectly recalled the first contagion item. The three lists in which no contagion items were recalled by the confederate were used as controls (i.e., "unmentioned" lists). Lists were counterbalanced so exposure to lists with and without contagion items was equal across participants.

Following the collaborative recall, participants received instructions for the individual recall, which again potentially instantiated pressure-ridden considerations. Participants in the individual-directed pressure condition were told that the individual recall task also assessed higher-order cognition, and that Northwestern students perform worse than University of Chicago students on this task. Participants in the goal-directed pressure condition were told that the task specifically assessed people's resistance to partner-produced inaccuracies, and that Northwestern students also perform worse than University of Chicago students on this task. The experimenter pretended to readjust the camera to keep the video-recording salient in both pressure conditions. Participants in the control condition were only provided with instructions for completing the individual recall (see Appendix A for the individual recall instructions).

After the individual recall, all participants individually completed the 36-item recognition source-monitoring test. Participants were provided with a list of words with instructions to place a check beside the source of each word they may have been exposed to in the previous tasks (list only, partner only, both sources, or neither source). Half of the presented words were items from the studied lists and half were lures that did not appear on the studied lists. Twelve of the 18 lures, split evenly, were high- and low-expectancy contagion items, six of which were provided by the confederate partner (contagion items) and six of which were not (unmentioned items). The remaining six lures were unrelated items that had not appeared in the lists. Participants were asked to check "list only" if they remembered seeing the word in one of the studied lists, "partner only" if their partner provided the word but it had not appeared in any of the studied lists, "both sources" if their partner provided the word and it had also appeared in one of the studied lists, or "neither" if the word had not appeared in any of the studied lists and had not been mentioned by their partner.

Following this task, participants completed a six-question manipulation check similar to questions found in Beilock et al. (2004) and Osborne (2006). On a 7 point scale, participants were asked to rate (a) how much performance pressure did you feel to resist inaccurate information from your partner during the collaborative recall, with 1 representing *very little performance pressure* and 7 representing *extreme performance pressure*; (b) how much pressure did you feel to resist inaccurate information during the individual recall, with 1 representing *very little performance pressure* and 7 representing *extreme performance pressure*; (c) how much pressure did you feel to perform better than University of Chicago students, with 1 representing *very little performance pressure* and 7 representing *extreme performance pressure*; (d) how well do

Northwestern students resist inaccurate information from partners relative to University of Chicago students, with 1 representing *much worse than University of Chicago students* and 7 representing *much better than University of Chicago students*; (e) how do Northwestern students perform on higher-order cognition tasks relative to University of Chicago students, with 1 representing *much worse than University of Chicago students* and 7 representing *much better than University of Chicago students*; and (f) how strongly do you identify with being a Northwestern student, with 1 representing *not strongly at all* and 7 representing *very strongly*. After completing these tasks, participants were debriefed.

## Results and Discussion

### Manipulation Check

Participants' responses to the manipulation check questions, overall, indicated that the intended manipulations were successful. Group differences were observed for the first manipulation check question regarding feelings of pressure to resist inaccurate information from their partner during the collaborative recall, $F(2,72) = 10.35$, $p < .001$, $\eta_p^2 = .22$. Participants in the goal-directed ($M = 4.18$) and individual-directed ($M = 4.17$) pressure conditions reported feeling more pressure than did participants in the control condition ($M = 2.71$) ($p = .001$, $d = 1.23$ and $p < .001$, $d = 1.15$, respectively). There were no differences between the goal-directed and individual-directed conditions for this question ($p = 1.00$, $d = 0.01$). A similar pattern emerged for the second [$F(2,72) = 7.99$, $p = .001$, $\eta_p^2 = .18$] and third [$F(2,72) = 30.24$, $p < .001$, $\eta_p^2 = .46$] questions. Participants in the goal-directed ($M = 4.68$) and individual-directed ($M = 4.03$) pressure conditions reported feeling more pressure to resist inaccurate information from their partner during the individual recall than did participants in the control condition ($M = 2.96$) ($p = .001$, $d = 1.19$ and $p = .03$, $d = 0.70$, respectively). There were no differences between the goal-directed and individual-directed conditions for this question ($p = .28$, $d = 0.45$). Participants in the goal-directed ($M = 4.14$) and individual-directed ($M = 4.17$) pressure conditions also reported feeling more pressure to perform better than University of Chicago students than did participants in the control condition ($M = 1.38$) ($p < .001$, $d = 2.02$ and $p < .001$, $d = 2.13$, respectively), with no differences between the goal-directed and individual-directed conditions ($p = 1.00$, $d = 0.02$).

For the fourth question there were group differences in the expected directions, $F(2,72) = 4.70$, $p = .01$, $\eta_p^2 = .12$: Participants in the goal-directed pressure condition ($M = 3.50$) reported that Northwestern students are worse than University of Chicago students at resisting inaccurate information in comparison to participants in the individual-directed pressure ($M = 4.21$; $p = .05$, $d = 0.83$) and control ($M = 4.38$; $p = .01$, $d = 0.75$) conditions. There was no significant difference between the individual-directed pressure and control conditions ($p = .82$, $d = 0.16$). There were also group differences for the fifth question, $F(2,72) = 10.78$, $p < .001$, $\eta_p^2 = .23$: Participants in the individual-directed pressure condition ($M = 3.24$) indicated Northwestern students perform worse than University of Chicago students on higher-order cognition tasks in comparison to participants in the goal-directed pressure condition ($M = 4.00$; $p = .02$, $d = 0.88$) and the control condition ($M = 4.50$; $p < .001$, $d = 1.17$). There was no difference in ratings for participants in the goal-directed pressure and control conditions ($p = .21$, $d = 0.48$). Finally, participants reported similar levels of identifying as a Northwestern student [$F(2,72) = 1.12$, $p = .33$, $\eta_p^2 = .03$] in the goal-directed pressure ($M = 5.36$), individual-directed pressure ($M = 5.86$), and control ($M = 5.79$) conditions.

### False Recall

The results for false recall appear in Table 1. A 2 (contagion or unmentioned) × 2 (high- or low-expectancy) × 3 (goal-directed pressure, individual-directed pressure, control) repeated measures ANOVA revealed a main effect of contagion, $F(1, 72) = 28.28$, $p < .001$, $\eta_p^2 = .28$. Participants recalled more contagion items (high- and low-expectancy items produced by the confederate; $M = .37$) than unmentioned items (the same high- and low-expectancy items never produced by the confederate; $M = .22$). There was also a main effect of expectancy, $F(1, 72) = 88.57$, $p < .001$, $\eta_p^2 = .55$, with participants recalling more high-expectancy ($M = .43$) than low-expectancy items ($M = .15$).

The main effect of pressure group was significant, $F(2,72) = 11.63$, $p < .001$, $\eta_p^2 = .24$. Tukey post-hoc comparisons indicated that participants in the individual-directed pressure condition ($M = .39$) recalled more contagion items than did participants in the goal-directed pressure ($M = .19$, $p < .001$, $d = 1.37$) and control conditions ($M = .29$, $p = .04$, $d = .68$). Participants in the goal-directed pressure condition recalled marginally fewer contagion items than did participants in the control condition ($p = .06$, $d = .67$). We also observed a contagion by pressure group interaction, $F(2, 72) = 3.28$, $p = .04$, $\eta_p^2 = .08$. Simple effects analyses revealed a significant group effect for the conditions in which contagion items were suggested by the confederate partner [$F(2, 72) = 14.98$, $p < .001$, $\eta_p^2 = .29$], but no group effect when contagion items were unmentioned by the confederate partner [$F(2, 72) = 2.22$, $p = .12$, $\eta_p^2 = .06$]. Specifically, participants in the individual-directed pressure condition recalled a greater proportion of contagion items suggested by the partner ($M = .51$) than did participants in the goal-directed pressure ($M = .22$, $p < .001$, $d = 1.65$) and control conditions ($M = .37$, $p = .02$, $d = .70$). Participants in the goal-directed pressure condition also recalled fewer contagion items produced by the partner than did participants in the control condition ($p = .03$, $d = .80$). The groups

**Table 1**
*Mean Proportion of False Recall of High- and Low-Expectancy Items for Goal-Directed Pressure, Individual-Directed Pressure, and Control Groups*

| Condition | High expectancy | Low expectancy | *M* |
|---|---|---|---|
| | Goal-directed pressure | | |
| Contagion | .32 | .12 | .22 |
| Unmentioned | .29 | .03 | .16 |
| | Individual-directed pressure | | |
| Contagion | .64 | .38 | .51 |
| Unmentioned | .43 | .13 | .28 |
| | Control | | |
| Contagion | .51 | .22 | .37 |
| Unmentioned | .39 | .04 | .22 |

did not differ in their recall of contagion items when the partner never mentioned them. Simple effects analyses examining inaccurate recalls within each group showed a social contagion effect (i.e., greater recall of contagion items when mentioned in comparison to when they were not mentioned) for participants in the individual-directed pressure [$F(1, 72) = 27.46$, $p < .001$, $\eta_p^2 = .28$] and control conditions [$F(1, 72) = 9.56$, $p = .003$, $\eta_p^2 = .12$], but not in the goal-directed pressure condition [$F(1, 72) = 1.38$, $p = .24$, $\eta_p^2 = .02$]. Goal-directed participants recalled a similar, small proportion of contagion items regardless of whether they were suggested by the confederate ($M = .22$) or not ($M = .16$). No other interactions were significant, all $p$s $> .05$.

### Correct Recall

A one-way ANOVA revealed no differences in overall recall accuracy, $F(2, 72) = 2.03$, $p = .14$, $\eta_p^2 = .05$, with participants in the goal-directed pressure ($M = .38$), individual-directed pressure ($M = .44$), and control conditions ($M = .40$) recalling a similar proportion of correct list items. We also investigated whether accurate information suggested by a partner influenced recalls (i.e., correct contagion). Significant differences were observed among the groups, $F(2, 72) = 4.16$, $p = .02$, $\eta_p^2 = .10$. Tukey post-hoc comparisons indicated participants in the individual-directed pressure condition ($M = .63$) recalled more correct suggestions from their partner than did participants in the goal-directed pressure ($M = .53$, $p = .02$, $d = .71$) and control conditions ($M = .55$, $p = .09$, $d = .59$), although the latter difference did not reach significance. Participants in the goal-directed pressure and control conditions recalled a similar proportion of correct items suggested by their partner ($p = .84$, $d = .15$).

### Source Monitoring

Data from the recognition source-monitoring test appear in Table 2. Correct sourcing responses for contagion items were "partner only" as they were produced by the confederate partner but never appeared in the lists. Correct responses for unmentioned control items were "neither" given they were never mentioned by the confederate nor presented in the lists. Source misattributions were operationalized as the proportion of contagion and control items attributed to the lists (i.e., marking "list only" or "both sources"). A 2 (contagion or unmentioned) × 3 (goal-directed pressure, individual-directed pressure, control) repeated measures ANOVA showed a main effect of contagion, $F(1, 72) = 36.69$, $p < .001$, $\eta_p^2 = .34$. Participants made more source misattributions for contagion ($M = .64$) than unmentioned items ($M = .43$). No difference was observed across groups in their source misattributions, $F(2, 72) = 1.04$, $p = .36$, $\eta_p^2 = .03$, although average performance was in the expected direction, with participants in the goal-directed pressure condition making fewer sourcing errors ($M = .49$) than did participants in the individual-directed pressure ($M = .58$) and control conditions ($M = .54$; see Table 2). There were also no group differences for correct sourcing, with all groups recognizing a similar proportion of studied items ($M = .85$ for the goal-directed pressure group; $M = .84$ for the individual-directed pressure group; $M = .90$ for the control group), $F(2, 72) = 2.26$, $p = .11$, $\eta_p^2 = .06$.

**Table 2**
*Mean Proportion of Source Judgments for Contagion and Unmentioned Items for Goal-Directed Pressure, Individual-Directed Pressure, and Control Groups*

| | Contagion items | | | | Unmentioned items | | | |
|---|---|---|---|---|---|---|---|---|
| | Goal | Ind | Cont | *M* | Goal | Ind | Cont | *M* |
| List only | .15 | .22 | .22 | .20 | .36 | .39 | .38 | .38 |
| Both list and partner | .42 | .51 | .40 | .45 | .04 | .06 | .08 | .06 |
| Total false recognition | .57 | .73 | .62 | .65 | .40 | .45 | .46 | .44 |
| Partner only | .27 | .18 | .26 | .23 | .05 | .02 | .01 | .03 |
| Neither list nor partner | .16 | .10 | .12 | .12 | .54 | .53 | .53 | .54 |

*Note.* Goal = goal-directed pressure; Ind = individual-directed pressure; Cont = control.

### Discussion

A social contagion effect was observed for both the individual recall and recognition source-monitoring tests, replicating previous findings. Inaccuracies suggested by a partner influenced subsequent individual recall performance in a detrimental manner, in comparison to when inaccuracies were not mentioned by the partner. Social contagion was also influenced by the expectancy of the studied items, in accord with previous work (e.g., Andrews & Rapp, 2014; Roediger et al., 2001). Items more typical of a list category were more likely to be incorrectly recalled than were less typical items.

The pressure manipulation also yielded results in the predicted directions. Participants in the individual-directed pressure condition recalled more contagion items suggested by their partner than did participants in the goal-directed pressure and control conditions. Individual-directed pressure participants recalled more inaccurate contributions, but also recalled more accurate partner contributions on the final individual recall test than did participants in the other conditions, with the difference from the control condition only trending toward significance. In line with previous accounts, the individual-directed pressure may have co-opted attentional resources needed to process the accuracy of partner suggestions. The need to appear competent may also have motivated participants to rely more liberally on their partner's productions, regardless of the accuracy of those productions and memories.

The goal-directed pressure manipulation was framed to reduce susceptibility to incorrectly mentioned items. It provided an explicit goal connected to specific task-relevant performance criteria (i.e., monitoring and detecting inaccuracies), in contrast to the need for appearing competent generally. This likely focused participants' attentional resources toward task-relevant activities that highlighted avoiding inaccurate contributions. Participants in this condition indeed recalled fewer contagion items, with the social contagion effect substantially reduced. Specifically, goal-directed participants recalled a similar, small number of contagion items regardless of whether they were self-generated or their partner produced them. With this said, both pressure conditions reported equivalent concern with respect to resisting inaccurate information provided by their partners, even though only the goal-directed pressure group received

information regarding social contagion effects in the task instructions. General performance concerns in the individual-directed pressure condition may have invoked feelings of pressure as captured in the manipulation check questions. This, however, does not necessarily mean that these participants adopted the same strategies as did participants in the goal-directed pressure condition. Despite providing similar ratings with respect to feeling pressure, participants in the two pressure conditions indeed differed with respect to their reported beliefs about differences between Northwestern and University of Chicago students. This was consistent with the intended condition manipulations, and most importantly, was accompanied by differential patterns of social contagion between the pressure conditions.

## Experiment 2

In Experiment 1, the individual- and goal-directed pressure manipulations differentially affected participants' reproductions of inaccurate partner contributions. While the individual-directed pressure manipulation increased recall of the partner's inaccurate contributions, the goal-directed pressure manipulation decreased it. However, the reduction in the goal-directed pressure condition may not have been due to the pressure manipulation, but instead of (or complemented by) the warning that participants received about the potential for social contagion. Participants in the other two conditions did not receive that same warning. While warnings can be useful for reducing susceptibility to erroneous information (Brashier et al., 2020; Christiaansen & Ochalek, 1983; Echterhoff et al., 2005; Greene et al., 1982; Meade & Roediger, 2002; Peshkam et al., 2011; Rapp et al., 2014), they often need to be paired with additional instructions to obtain substantial benefits (Brashier et al., 2020; Marsh & Fazio, 2006; Salovich & Rapp, 2020; Sparks & Rapp, 2011). To test whether reductions in social contagion were due to the included warning, Experiment 2 compared goal-directed pressure and control conditions to a condition in which participants were warned, without pressure, about the possibility of a partner providing inaccurate contributions. Explicit warnings that direct participants' attention to definite discrepancies may be effective at reducing social contagion (Echterhoff et al., 2005). Contrasting an explicit warning with a more general warning allowed for determining whether benefits observed in the goal-directed pressure condition were due to the mere mention of social contagion in the instructions. We drew upon the extant literature in designing the general warning used in this experiment (Peshkam et al., 2011), including from previous attempts to reduce the deleterious effects of exposures to inaccurate information by mentioning the possibility of encountering inaccurate content and its potential consequences (Ecker et al., 2010; Jalbert et al., 2019; Marsh & Fazio, 2006; Nadarevic & Aßfalg, 2017). If goal-directed pressure motivates participants to monitor the source and accuracy of partner contributions more than does a general warning alone, participants under goal-directed pressure should make fewer contagion and source monitoring errors than do participants in warning-only and control conditions. If, however, warning-only participants show similar rates of social contagion as in the pressure manipulation, it would suggest warnings are sufficient to remediate contagion. Alongside these considerations, Experiment 2 also afforded the opportunity to replicate the previous findings.

### Method

#### *Participants*

Fifty-six Northwestern University undergraduates (26 female) participated in the experiment for course credit. Data from five participants were discarded, two due to confederate error, two for not following directions, and one because of suspicion about the confederate, leaving 51 participants.

#### *Materials*

The materials were identical to Experiment 1 with the manipulation check questionnaire modified to include different performance and open-ended questions. The potential difficulty of being asked to recall six items from each list may invoke pressure in all participants given they could not skip a response (see Thorley & Dewhurst, 2007 for discussion), but goal-directed pressure participants should experience additional pressure associated with their condition-specific manipulations (e.g., the desire to only recall accurate information; pressure due to the presence of a video camera). The use of open-ended questions allowed for examining whether participants' feelings about pressure were qualitatively different by condition.

#### *Design*

The experiment used a 2 (contagion or unmentioned) × 2 (high expectancy or low expectancy) × 3 (goal-directed pressure, warning-only, control) mixed design, with the first two factors manipulated within subjects and the third factor between subjects. Seventeen participants were randomly assigned to the goal-directed pressure condition, 17 to the control condition, and 17 to the warning-only condition. The dependent variables and analyses were the same as in Experiment 1.

#### *Procedure*

The procedure was identical to Experiment 1 with the following changes. For the collaborative recall, participants in the warning-only condition were told about the social contagion effect but received no information about comparisons between University of Chicago and Northwestern University students, nor about video-recording their performance. For the individual recalls, participants in the warning-only condition were reminded about the social contagion effect with instructions for completing the individual recall. Minor changes were also made to the wording of the instructions to enhance the readability of the information (all instructions are included in Appendix B).

Next, all participants completed the recognition source-monitoring task, followed by a seven-item manipulation check questionnaire modified from Experiment 1. On a 7 point scale, participants were asked to rate (a) how much performance pressure did you feel to resist inaccurate information on the collaborative recall, with 1 representing *very little performance pressure* and 7 representing *extreme performance pressure*; (b) describe the pressure that you experienced during the collaborative recall; (c) how much pressure did you feel to resist inaccurate information during the individual recall, with 1 representing *very little performance pressure* and 7 representing *extreme performance pressure*; (d) describe the pressure that you experienced during the individual recall; (e) in general,

how well do you think Northwestern students resist inaccurate information from a partner, with 1 representing *much worse than University of Chicago students* and 7 representing *much better than University of Chicago students*; (f) how do you think Northwestern students perform on the task you did today, with 1 representing *much worse than University of Chicago students* and 7 representing *much better than University of Chicago students*; and (g) how strongly do you identify with being a Northwestern student, with 1 representing *not strongly at all* and 7 representing *very strongly*.

## Results and Discussion

### Manipulation Check Questions

Group differences were not observed when all Likert-scale pressure question scores were combined (collaborative recall: $F(2,48) = 1.98$, $p = .15$, $\eta_p^2 = .08$; individual recall: $F(2,48) = 1.55$, $p = .22$, $\eta_p^2 = .06$). Importantly though, while participants in the goal-directed pressure ($M = 4.71$), warning-only ($M = 4.41$), and control ($M = 5.29$) conditions reported similar feelings of pressure during the collaborative recall, for the individual recall, feelings of pressure remained elevated in the goal-directed pressure condition ($M = 4.29$), $t(16) = 1.39$, $p = .20$, $d = .27$, but were reduced in the warning-only ($M = 3.47$), $t(16) = 2.09$, $p = .05$, $d = .57$ and control conditions ($M = 3.24$), $t(16) = 4.76$, $p < .001$, $d = 1.29$. To determine whether open-ended responses revealed qualitative differences between the groups, two raters coded whether the responses reflected feelings of pressure associated with the collaborative task (e.g., fear of judgment due to the presence of others and/or pressure to generate items during recall) or the pressure manipulation (e.g., desire to perform well or better than other students and/or pressure due to the presence of a camera). They each coded all responses. For the collaborative recall, again, the three groups showed no differences in responses associated with the collaborative task or the pressure manipulation, $\chi^2(2, N = 51) = 0.16$, $p = .92$ ($\kappa = 0.84$ indicating good agreement; Landis & Koch, 1977). For individual recalls, a significant association between the pressure condition and response type was observed, $\chi^2(2, N = 51) = 6.31$, $p = .04$: Participants in the goal-directed pressure condition provided fewer responses associated with the collaborative task (20%) than did participants in the warning-only (43%) and control conditions (37%). Participants in the goal-directed pressure condition instead provided more responses associated with the pressure manipulation (52%) than did participants in the warning-only (19%) and control conditions (29%, $\kappa = 0.84$). These results suggest the pressure manipulations exerted their intended effects, particularly on the individual recall task.

Group differences also emerged for the two questions regarding beliefs about the performance of Northwestern and University of Chicago students with respect to resisting inaccurate information in general, $F(2,48) = 5.31$, $p = .008$, $\eta_p^2 = .18$, and on the specific task, $F(2,48) = 4.08$, $p = .02$, $\eta_p^2 = .15$. For both questions, goal-directed pressure participants (tasks in general: $M = 3.76$, specific task: $M = 3.94$) reported lower performance for Northwestern students in comparison to University of Chicago students than did participants from the warning-only group (tasks in general: $M = 4.82$, specific task: $M = 4.76$). No differences emerged for ratings between the control (tasks in general: $M = 4.29$, specific task: $M = 4.41$) and goal-directed pressure and warning groups on those questions, though the means are in line with expected patterns. In sum, participants under goal-directed pressure perceived Northwestern students to be significantly worse than University of Chicago students, in contrast to the perceptions of participants who received a warning only. Participants reported similar levels of identifying as a Northwestern student in the goal-directed pressure ($M = 5.12$), warning ($M = 5.41$), and control ($M = 5.94$) conditions, $F(2,48) = 1.80$, $p = .18$, $\eta_p^2 = .07$.

### False Recall

The results for false recall appear in Table 3, replicating Experiment 1. A 2 (contagion or unmentioned) × 2 (high or low expectancy) × 3 (goal-directed pressure, warning, control) repeated measures ANOVA revealed a main effect of contagion, $F(1,48) = 49.43$, $p < .001$, $\eta_p^2 = .51$. Overall, participants recalled more contagion ($M = .34$) than unmentioned items ($M = .14$). There was also a main effect of expectancy, $F(1,48) = 67.32$, $p < .001$, $\eta_p^2 = .58$, as participants recalled more high-expectancy ($M = .37$) than low-expectancy items ($M = .11$).

The main effect of group was also significant, $F(2,48) = 10.18$, $p < .001$, $\eta_p^2 = .30$. Tukey posthoc comparisons revealed that participants in the goal-directed pressure condition ($M = .11$) recalled fewer contagion items than did participants in the warning-only ($M = .28$, $p = .005$, $d = .65$) and control conditions ($M = .33$, $p < .001$, $d = .78$). Recall of contagion items did not differ between participants in the warning-only and control conditions ($p = .56$, $d = .15$). The contagion by group interaction trended toward significance, $F(2, 48) = 2.54$, $p = .09$, $\eta_p^2 = .10$. Interestingly, participants under goal-directed pressure produced fewer contagion items than did the warning-only participants, both when the contagion items had been mentioned by the confederate, $F(2, 48) = 8.22$, $p = .001$, $\eta_p^2 = .26$, and when they were unmentioned, $F(2, 48) = 5.92$, $p = .01$, $\eta_p^2 = .20$. This suggests goal-directed pressure reduced contagion errors as well as spontaneous productions of the contagion items. Goal-directed pressure participants ($M = .17$) recalled fewer contagion contributions from their partner than did participants in the warning-only ($M = .39$, $p = .02$, $d = 1.12$) and control conditions ($M = .47$, $p = .001$, $d = 1.27$), with no difference emerging between the warning-only and control conditions ($p = .56$). Similarly, goal-directed pressure participants ($M = .05$) spontaneously recalled very few unmentioned contagion items in comparison to participants in the warning-only ($M = .17$, $p = .03$,

**Table 3**
*Mean Proportion of False Recall of High- and Low-Expectancy Items for Goal-Directed Pressure, Warning, and Control Groups*

| Condition | High expectancy | Low expectancy | *M* |
|---|---|---|---|
| | Goal-directed pressure | | |
| Contagion | .27 | .06 | .17 |
| Unmentioned | .10 | .00 | .05 |
| | Warning | | |
| Contagion | .61 | .18 | .40 |
| Unmentioned | .31 | .02 | .17 |
| | Control | | |
| Contagion | .59 | .35 | .47 |
| Unmentioned | .35 | .04 | .20 |

$d = 1.11$) and control conditions ($M = .20$, $p = .01$, $d = 1.13$), with no difference between the warning-only and control conditions ($p = .79$). No other interactions were significant, all $p$s $> .05$.

### Correct Recall

A one-way ANOVA showed no group differences in overall recall accuracy, $F(2, 48) = 0.06$, $p = .94$, $\eta^2 = .003$, with participants in the goal-directed pressure ($M = .39$), warning-only ($M = .41$), and control conditions ($M = .40$) recalling a similar proportion of correct list items. Recalls of accurate partner productions were also similar across goal-directed pressure ($M = .47$), warning-only ($M = .55$), and control conditions ($M = .52$), $F(2, 48) = 1.37$, $p = .26$, $\eta^2 = .05$.

### Source Monitoring

Data from the recognition source-monitoring test appear in Table 4. A 2 (contagion or unmentioned) × 3 (goal-directed pressure, control, warning) repeated measures ANOVA revealed a main effect of contagion, $F(1, 48) = 22.72$, $p < .001$, $\eta_p^2 = .32$. Participants made more sourcing errors for contagion ($M = .65$) than unmentioned items ($M = .46$), as in Experiment 1. There was also a main effect of group, $F(2, 48) = 3.66$, $p = .03$, $\eta_p^2 = .13$. Tukey posthoc comparisons indicated that participants in the goal-directed pressure condition ($M = .45$) made fewer source misattributions than did participants in the control condition ($M = .65$, $p = .03$, $d = .72$). Source misattribution errors did not differ between the warning-only ($M = .57$) and goal-directed pressure or control conditions ($p = .24$, $d = .47$; $p = .55$, $d = .28$, respectively). The contagion by group interaction was not significant [$F(2, 48) = 1.91$, $p = .16$, $\eta_p^2 = .07$]. Analyses of correct sourcing for list items indicated no group differences, $F(2, 48) = 1.49$, $p = .24$, $\eta^2 = .05$, as participants in the goal-directed pressure ($M = .81$), warning-only ($M = .84$), and control groups ($M = .88$), correctly recognized a similar proportion of studied items.

### Discussion

Social contagion was again observed for individual recall and source recognition judgments. Participants were more likely to falsely recall incorrect contributions provided by a partner than when those items were never mentioned. Additionally, inaccurate contributions that were highly typical members of a category were more likely to be incorrectly recalled than were inaccurate contributions that were less typical category members.

Most importantly, goal-directed pressure again reduced participants' susceptibility to inaccurate information. Participants in this condition recalled fewer inaccurate partner contributions and made fewer spontaneous recall errors in comparison to participants in the control and warning conditions. This aligns with the findings in Experiment 1, in which goal-directed pressure participants recalled a similar, small proportion of contagion items regardless of whether those items were suggested by their partner or not. The pressure manipulation was designed to make salient a specific, task-relevant performance goal that motivated participants to direct attention toward evaluating partner contributions, thereby improving performance as reported in other work (e.g., Locke & Latham, 1990; Nokes-Malach et al., 2015). Participants in the goal-directed pressure condition also made fewer source misattribution errors than did control participants. While this was not significant in Experiment 1, the average performance in both experiments was in the expected direction, with goal-directed pressure participants showing fewer sourcing errors than control participants. While these results suggest that the benefits observed in the goal-directed pressure condition may be partly attributed to differences in source monitoring behaviors, future work is needed to corroborate this possibility.

Participants in the warning condition did not show similar reductions in social contagion, suggesting that the benefits observed in the pressure condition cannot be explained solely by warnings about the potential for social contagion. Warnings, at times, have proven insufficient for reducing reliance on inaccurate information (Edelson et al., 2011; Gabbert et al., 2012; Monds et al., 2013; Paterson et al., 2011). They are more often useful when paired with additional instructions, such as explicit cues or metacognitive prompts to critically evaluate information (Brashier et al., 2020; Marsh & Fazio, 2006; Salovich & Rapp, 2020; Sparks & Rapp, 2011). While the pressure manipulation motivated participants to direct resources toward the goal of resisting inaccurate information, the brief warnings on their own were insufficient to remediate social contagion. However, warnings did appear somewhat successful in motivating source monitoring behavior. Participants in the pressure and warning conditions showed similar reductions in sourcing errors as compared to participants in the control condition. So warnings did appear to reveal benefits, but those benefits did not extend to actual recall performance.

**Table 4**
*Mean Proportion of Source Judgments for Contagion and Unmentioned Items for Goal-Directed Pressure, Control, and Warning Groups*

| | Contagion items | | | | Unmentioned items | | | |
|---|---|---|---|---|---|---|---|---|
| | Goal | Cont | Warn | *M* | Goal | Cont | Warn | *M* |
| List only | .14 | .23 | .18 | .18 | .35 | .43 | .33 | .37 |
| Both list and partner | .35 | .52 | .53 | .47 | .05 | .12 | .10 | .09 |
| Total false recognition | .49 | .75 | .71 | .65 | .40 | .55 | .43 | .46 |
| Partner only | .32 | .21 | .20 | .24 | .01 | .00 | .05 | .02 |
| Neither list nor partner | .19 | .05 | .10 | .11 | .58 | .45 | .52 | .52 |

*Note.* Goal = goal-directed pressure; Cont = control; Warn = warning.

## General Discussion

People's use of others' contributions can benefit performance when those contributions are accurate. However, when partner contributions are inaccurate, the use of that information can be problematic. Social contagion involves people's potentially problematic use of others' contributions, exemplified by recalls of a partner's inaccurate productions alongside beliefs that the information was personally experienced. Past research has demonstrated that social pressure can hurt performance on collaborative memory tasks (Basden et al., 1997; Reysen, 2003, 2007; Thorley & Dewhurst, 2007). Linking these topics, the current study investigated how different kinds of pressure can influence a person's use and attributions of partner contributions.

In Experiment 1, we examined whether individual-directed pressure affects social contagion differently than does goal-directed pressure. To instantiate pressure, participants in both conditions were offered evidence that students at their university performed poorly on a task relative to students at a nearby, rival institution. Individual-directed pressure was additionally induced by including instructions that motivated collaborative pairs to "appear competent" while completing collaborative and individual recall tasks. We expected that this goal would elicit concerns about performance and self-efficacy, directing resources away from task-relevant activities such as evaluation and source monitoring. Goal-directed pressure, in contrast, involved instructing pairs to avoid the inaccurate information provided to them by their partners. This condition provided participants with an explicitly stated, task-relevant goal to avoid social contagion by monitoring the source and accuracy of information. As predicted, participants experiencing individual-directed pressure problematically recalled more partner-generated inaccuracies on a final individual recall test than did participants experiencing goal-directed pressure or participants receiving no pressure. Participants under goal-directed pressure were more successful at the recall task, in that they recalled fewer of their partner's inaccurate productions and on average made fewer source misattribution errors than did participants under individual-directed pressure or in the control condition. These findings suggest that pressure can differentially influence social contagion, increasing or decreasing people's recalls of a partner's inaccurate contributions depending on task goals.

The benefits associated with the goal-directed pressure manipulation could have been a function of participants receiving a warning about the potential for exposure to inaccurate partner contributions, rather than or in addition to the pressure instantiated in the task. We tested this possibility in Experiment 2 by comparing goal-directed pressure to a warning-only condition in which participants were informed about the possibility of receiving inaccurate information without an additional pressure manipulation. Goal-directed pressure again reduced the effects of social contagion and improved source monitoring in comparison to the control condition. Participants under goal-directed pressure also produced fewer contagion errors than did participants in the warning-only condition. That similar recall benefits as observed in the goal-directed pressure condition were not obtained when participants received a general warning indicates that, on its own, a warning is insufficient as an explanation of those benefits. The warning, however, was useful with respect to source monitoring, as participants who received warnings performed as well as participants in the goal-directed pressure manipulation at identifying the source of their recall productions. The benefits of that monitoring, however, did not necessarily contribute to the enhanced evaluation of those monitored contributions, as reflected in recall differences between the goal-directed pressure and warning-only conditions. In sum, the two conditions had observable and separable consequences for memory performance following group collaboration.

While participants in the individual-directed pressure condition showed increased recalls for inaccurate contributions, they also generally relied more on partner-generated accurate contributions than did participants in other conditions. This represents a challenge for explanations that focus solely on the idea that pressure reduces a person's mental resources. If attentional resources were taken up with worries about performance and/or ability, it would likely reduce a participant's use of both the incorrect *and* correct contributions of their partner. While that was not observed, the pattern obtained in the individual-directed pressure condition generally accords with behaviors associated with performance pressure: Participants often attempt to work harder, though not necessarily better, as a means of displaying competence (Gardner, 2012; Inzlicht & Kang, 2010; Roberson & Kulik, 2007). An important consideration for these results is that individual- and goal-directed pressure groups may have adopted different attentional strategies. In the individual-directed pressure condition, without a clear and specific task goal, participants may have tried to appear competent by generating as many list items as possible during recall. In the goal-directed pressure condition, in contrast, participants may have favored "quality" over "quantity," leading to an overall more conservative approach to contributions. These differential strategies, as enacted by the pressure manipulations, could account for differential performance on the memory tasks.

Both of these possibilities, operating simultaneously, may be responsible for the current findings. For example, task-irrelevant thoughts produced in the individual-directed pressure condition could have distracted participants and/or consumed the resources needed to evaluate the accuracy of any generated items. Thus, while feelings of pressure may have motivated participants to offer more contributions, difficulty associated with discerning which productions were correct or incorrect could underlie their overall increased recall (Baumeister, 1984; Hyman et al., 2014; Kanfer & Ackerman, 1989; Wood et al., 2016). In line with this view, the recall and source monitoring patterns, accompanied by the manipulation check, indicate that individual-directed pressure may have created challenges for discerning accurate from inaccurate information, allowing partner contributions to inform recall performance. Additional work is needed to better understand the nuances of how these different attentional strategies may operate. For example, future research could directly test attentional contributions to differentiate between the effects of focus versus the availability of resources, perhaps by assessing rumination and/or mind-wandering (Shrimpton et al., 2017; Smallwood et al., 2008) or by measuring cognitive load during the task (e.g., Mousavi et al., 1995; Sweller, 2011).

Despite reporting similar levels of pressure, participants in the goal-directed pressure condition reproduced significantly fewer contagion items than did participants in the control group, and *less than half* as many contagion items as participants in the individual-directed pressure condition. In fact, individuals in the goal-directed pressure condition produced the same amount of contagion items during individual recall regardless of whether their partner produced them or not. But while goal-directed pressure reduced participants' recalls of their partner's inaccurate contributions, it did not seem to influence their use of correct partner responses. Analogous patterns have been reported in previous work. Thomas and Dubois (2011), for example, found that reducing elderly adults' concerns about their declining memory decreased source memory and contagion errors. Those benefits did not similarly reduce recalls of correct responses. These and other findings point to the possibility that goals can positively influence task performance even in difficult, high-pressure situations (Hofmann, 1993; Locke & Latham, 1990; Mento et al., 1987). The specific goal of avoiding contagion could encourage participants to direct resources toward monitoring the accuracy and source of information,

reducing the influence of inaccurate contributions without affecting people's correct responses.

An additional set of considerations, particularly relevant in contemplating the design of activities intended to support memory, might examine features of task instructions underlying differences in participants' reactions and perceptions. For example, the instructions in these experiments informed participants about potential social group differences (i.e., Northwestern vs. University of Chicago students) as being derived from evidence from multiple experiments (as in the individual-directed pressure condition), or as observed in a single demonstration (as in the goal-directed pressure condition). The latter may imply a more tentative finding that could impact students' perceptions as to the likelihood their performance could differ from the reported norm. Follow-up investigations could also examine the effectiveness of different kinds of warnings for reducing social contagion effects. This would clarify the circumstances under which warnings encourage evaluative processing, and how they might be more effectively implemented to motivate particular task behaviors. For instance, warnings that highlight definite concerns (e.g., informing participants that their partner *will* provide inaccurate information) may be more effective than a general or speculative warning for reducing contagion effects (Echterhoff et al., 2005).

The current findings are informative given the regularity with which we engage in discussions and recalls in group settings, and given recent calls for examination of how social factors and group interactions influence memory processes and products (Andrews & Rapp, 2014; Barber et al., 2012; Maswood & Rajaram, 2019; Park et al., 2016; Rajaram, 2011). When people are sufficiently motivated to engage in careful evaluation, they more successfully apply strategies and behaviors intended to detect and discount inaccurate information (Ecker et al., 2011; Hinze et al., 2014; Lewandowsky et al., 2012; Rapp, 2016; Rapp & Braasch, 2014; Salovich & Rapp, 2020). For example, when individuals are made aware that a collaborator might not be a credible source of information, social contagion effects are reduced, as compared to when a partner is believed to be credible, or even when little information about that partner is available (Andrews & Rapp, 2014). It is entirely possible that awareness of a partner's credibility might enact particular goal orientations (e.g., to ignore things a partner says) that could support evaluating, encoding, and/or ignoring information. For example, if a partner is perceived to be a threat to group performance, we may be more inclined to evaluate and reject their contributions (Andrews & Rapp, 2014; French et al., 2011). Recent work in our lab has shown that beliefs about what partners know, and the degree to which partner mistakes are detected as tasks unfold, have clear consequences on the likelihood people will use information communicated in a collaborative task (Andrews & Rapp, 2015; Andrews-Todd & Rapp, 2020). The current results amplify that the pragmatic and routine factors that constitute our discourse experiences, including knowledge about our collaborators, motivations and intentions for our task goals, and the materials the group is contemplating, influences social contagion and the consequences of exposures to inaccuracies.

Pressure is often conceptualized as a general negative influence on cognition and behavior. A variety of studies have demonstrated that pressure leads to memory failures (Baumeister, 1984; Beilock & Carr, 2001) including false recalls (Alper et al., 1976; Basden et al., 1997; Reysen, 2003; Thomas & Dubois, 2011; Thorley & Dewhurst, 2007). For example, participants experiencing pressure to output items in a group memory task produce a greater number of errors than do participants experiencing less pressure (Thorley & Dewhurst, 2007). Other detrimental consequences of pressure have been identified in projects detailing the negative effects of pressure for minority or traditionally stigmatized groups (e.g., women, older adults, Black/African Americans individuals). The threat of potentially confirming a stereotype can impinge on performance in a variety of contexts (e.g., Aronson, 2002; Barber et al., 2015; Davies et al., 2002; Steele & Aronson, 1995). Future work could examine whether attentional strategies elicited by goal-directed pressure can also potentially be leveraged to support positive effects, specifically for circumstances involving individuals from stigmatized groups or members of diverse collectives experiencing performance pressure or stereotype threat (see Choi et al., 2014; Pepe et al., 2020 for investigations with different group configurations and diverse groups, respectively, on aspects of collaborative memory). Experiments could also position different achievement goals with respect to pressure as a means of determining performance benefits or challenges. For example, various pressure conditions might differentially elicit mastery (task) relative to performance (ego) goals (Darnon et al., 2006; Dweck, 1986; Nicholls, 1984), affecting motivations to continue working on a task as well as the behavioral products that result from enacting or even abandoning those goals. Investigations along these lines can help interrogate the conditions and contexts in which pressure has direct effects on performance outcomes.

In the current study, we replicated the finding that pressure can increase inaccurate recalls and confuse source monitoring, as observed in the individual-directed pressure condition. Clearly, many kinds of pressure situations prove problematic for clear thinking and effective behaviors. The current project demonstrated one such case, as participants encouraged to worry about their competency produced inaccurate recalls and source memory errors. But the current results also indicate that, under particular circumstances, pressure can prove beneficial. Providing individuals with explicit and specific task goals can motivate attention and resources toward manageable, task-relevant activities rather than concerns about self-efficacy. In the best of situations, this can enhance performance rather than harm it as routinely occurs in situations and contexts in which pressure is distracting and unavoidable, and when the choice and implementation of effective processing strategies may be unclear.

These results necessitate a more nuanced account of how pressure can direct attention and performance. Revisiting Attentional Control Theory (Eysenck et al., 2007), source and accuracy monitoring are goal-directed processes that require sufficient resources and motivation to enact. Pressure has the potential to disrupt these activities, which in the case of social contagion, can result in less attention devoted toward monitoring partner responses. Yet pressure can also sometimes lead to beneficial increases in the motivation to accomplish a goal (Aronson, 2002; Gardner, 2012). When pressure-filled situations are accompanied by specific, task-relevant instructions for successful performance, it can support the allocation of attention toward relevant processes and practices (Coull et al., 2001; Fisher & Ford, 1998; Hofmann, 1993; Kanfer, 1996). The concrete objectives associated with goal-directed manipulations may also help drive focus on the task at hand, making it seem more achievable (e.g., Gollwitzer & Sheeran, 2006). In some cases, goal-directed pressure

may even motivate individuals to engage in behaviors that they may not have attempted otherwise. Thus, emerging accounts should not ignore the potential benefits that can be observed in stressful environments.

Further, emerging understandings of the factors that benefit and impair collaborative activities can inform the development of interventions intended to combat the detrimental effects of performance pressure. In many pressure situations, individuals are motivated to do well, but resulting performance still tends to suffer (Gardner, 2012; Roberson & Kulik, 2007). Interventions intended to support performance should include instructions and procedures that direct attention toward specific task-relevant activities associated with optimal performance. In the current study, this was accomplished by motivating individuals to explicitly avoid inaccurate information. Prior work has shown that instructions encouraging individuals to pay attention to the accuracy of information can be useful for reducing or even eliminating the influence of false ideas (e.g., Andrews & Rapp, 2014; Echterhoff et al., 2005; Ecker et al., 2010). This aligns with recent projects that reveal people are capable but often unmotivated to engage in evaluative activities (e.g., Pennycook et al., 2019; Vraga et al., 2019). Salovich and Rapp (2020) relatedly demonstrated that interventions targeting people's confidence appraisals about what they know, and their beliefs about their ability to resist inaccurate information, can be leveraged to reduce the negative effects of exposures to inaccuracies (see also Salovich et al., 2020). These cases direct focus, both for participants in the tasks and for researchers in the field, on how specific task elements and task-relevant behaviors can support effective memory performance. Relevant group contexts include but are not limited to students studying together, brainstorming working teams, and jury experiences, all of which involve the presentation of information, useful and distracting, from multiple sources. Successful performance in all of these contexts involves navigating a multitude of contributions in efforts to judge the most effective, valid, and relevant information to remember so it can be applied to make decisions and solve problems. The current project demonstrates the ways in which a targeted pressure intervention can support collaborative memory. Pressure may be a useful tool when applied with carefully considered, designed, and implemented manipulations that motivate and direct focused attention to both group and individual task goals.

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# Appendix A

## Instructions from Experiment 1

### Individual-Directed Pressure, Collaborative Recall Instructions

Lately, there has been some controversy about whether students at Northwestern and the University of Chicago show differences in higher-order cognition. A group of researchers in the psychology department at the University of Chicago have completed experiments that directly assess higher-order cognition. Higher-order cognition includes the ability to reason, think clearly, and effectively solve problems. When the same experiments have been conducted here at Northwestern, the students here tend to perform worse than University of Chicago students. We are trying to understand why this difference might be occurring. We are going to have you work together with your partner to recall the items you studied, and most people find this challenging. This task will directly assess your higher-order cognition. Again, when Northwestern and University of Chicago students do this task, Northwestern students have consistently performed worse than University of Chicago students. For this recall task, I will call out a list name and you two will take turns recalling items from that list. You will each recall six items from each list. We want you to do your best on this task. Also, your performance will be videotaped so that psychology researchers and university faculty can examine your performance to figure out why Northwestern students do poorly on this task.

### Goal-Directed Pressure, Collaborative Recall Instructions

Research has shown that when people collaborate to recall information, they can be influenced by the inaccurate information that is recalled by their partner, so much so that they will reproduce this inaccurate information later, thinking that it is true. To

(*Appendices continue*)

determine ways to reduce this effect, a study was conducted in which students at the University of Chicago were told about this effect before collaborating with a partner to recall information. Results showed that when they were made aware of this effect before collaboration, they were able to overcome it and not be influenced by the inaccurate information provided by their partner. Recently, this same study has been completed here at Northwestern University and Northwestern students have consistently not been able to overcome this effect and were influenced by the inaccurate information provided by their partner. We are interested in determining why these differences are occurring. We are going to have you do the exact same task that has been completed across the two universities in order to see how well you can resist inaccurate information that might be provided by your partner. For this task, we will have you both work together to recall the information you studied earlier. I will call out a list name and you two will take turns recalling items from that list. You will each recall six items from each list. We want you to do your best on this task. Also, your performance will be videotaped so that psychology researchers and university faculty can examine your performance to figure out why Northwestern students do poorly on this task.

### Control, Collaborative Recall Instructions

We are going to have you recall the items you studied with a partner. For this task, I will call out the list name and you will take turns recalling items from that list. You will each recall six items from each list.

### Individual-Directed Pressure, Individual Recall Instructions

Now we would like you to recall items from the lists on your own. This is also a way of testing higher-order cognition. And again, when Northwestern and University of Chicago students do this particular task, Northwestern students consistently do worse than University of Chicago students. You will have 2 min to write down as many items from the list as you can remember without guessing. After 2 min, you will move on to the next list and do the same until you have completed all of the lists. Your performance will be videotaped during this task as well so that psychology researchers and university faculty can examine your performance on this type of task in order to figure out why Northwestern students do so poorly.

### Goal-Directed Pressure, Individual Recall Instructions

Now we would like you to recall items from the lists on your own. This is also one of the tasks done in the experiments completed here and at the University of Chicago. And again, when Northwestern and University of Chicago students do this particular task, Northwestern students consistently reported the inaccurate information that was provided by their partner in comparison to University of Chicago students who rarely reported the inaccurate information. You will have 2 min to write down as many items from the list as you can remember without guessing. After 2 min, you will move on to the next list and do the same until you have completed all of the lists. Your performance will be videotaped during this task as well so that psychology researchers and university faculty can examine your performance on this type of task in order to figure out why Northwestern students do so poorly.

### Control, Individual Recall Instructions

Now we would like you to recall items from the lists on your own. You will have 2 min to write down as many items from the list as you can remember without guessing. After 2 min, you will move on to the next list and do the same until you have completed all of the lists.

## Appendix B

## Instructions from Experiment 2

### Goal-Directed Pressure, Collaborative Recall Instructions

Research has shown that when people collaborate to recall information, they can be influenced by the inaccurate information that is recalled by their partner, so much so that they will reproduce this inaccurate information later, thinking that it is true. To determine ways to reduce this effect, a study was conducted in which students at the University of Chicago were told about this effect before collaborating with a partner to recall information. Results showed that when they were made aware of this effect before collaboration, they were able to overcome it and not be influenced by the inaccurate information provided by their partner. Recently, this same study has been completed here at Northwestern University and Northwestern students have consistently not been able to overcome this effect and were influenced by the inaccurate information provided by their partner. We are interested in determining why these differences are occurring. We are going to have you do the exact same task that has been completed across the two universities in order to see how well you can resist inaccurate information that might be provided by your partner. For this task, we will have you both work together to recall the information you studied earlier. I will call out a list name and you two will take turns recalling items from that list. You will each recall six items from each list. We want you to do your best on this task. Also, your performance will be videotaped so that psychology researchers and university faculty can examine your performance to figure out why Northwestern students do poorly on this task.

### Warning-Only, Collaborative Recall Instructions

Research has shown that when people collaborate to recall information, they can be influenced by the inaccurate information that is recalled by their partner, so much so that they will reproduce this inaccurate information later, thinking that it is true. To better understand this effect, we are going to have you both work together to recall the information you studied earlier. I will call out a list name

(*Appendices continue*)

and you two will take turns recalling items from that list. You will each recall 6 items from each list.

### Control, Collaborative Recall Instructions

We are going to have you recall the items you studied with a partner. For this task, I will call out the list name and you will take turns recalling items from that list. You will each recall 6 items from each list.

### Goal-Directed Pressure, Individual Recall Instructions

Now we would like you to recall items from the lists on your own. This is also one of the tasks done in the experiments completed here and at the University of Chicago. And again, when Northwestern and University of Chicago students do this particular task, Northwestern students consistently reported the inaccurate information that was provided by their partner in comparison to University of Chicago students who rarely reported the inaccurate information. You will have 2 min to write down as many items from the list as you can remember without guessing. After 2 min, you will move on to the next list and do the same until you have completed all of the lists. Your performance will be videotaped during this task as well so that psychology researchers and university faculty can examine your performance on this type of task in order to figure out why Northwestern students do so poorly.

### Warning-Only, Individual Recall Instructions

Now we would like you to recall items from the lists on your own. And again, please keep in mind that people can be influenced by the inaccurate information that was previously recalled by group members. We want you to report items you remember from the list without guessing. You will have 2 min to write down as many items from the list as you can remember. After 2 min, you will move on to the next list and do the same until you have completed all of the lists.

### Control, Individual Recall Instructions

Now we would like you to recall items from the lists on your own. You will have 2 min to write down as many items from the list as you can remember without guessing. After 2 min, you will move on to the next list and do the same until you have completed all of the lists.

Received March 20, 2017
Revision received October 13, 2020
Accepted November 15, 2020 ■