Journal of Experimental Psychology: Learning, Memory, and Cognition

How Social Is Social Memory? Isolating the Influences of Social and Nonsocial Cues on Recall

Tori Peña, Nicholas W. Pepe, and Suparna Rajaram

Online First Publication, January 8, 2026. https://dx.doi.org/10.1037/xlm0001557

CITATION

Peña, T., Pepe, N. W., & Rajaram, S. (2026). How social is social memory? Isolating the influences of social and nonsocial cues on recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. Advance online publication. https://dx.doi.org/10.1037/xlm0001557

AMERICAN PSYCHOLOGICAL ASSOCIATION

Journal of Experimental Psychology: Learning, Memory, and Cognition

ISSN: 0278-7393

https://doi.org/10.1037/xlm0001557

How Social Is Social Memory? Isolating the Influences of Social and Nonsocial Cues on Recall

Tori Peña, Nicholas W. Pepe, and Suparna Rajaram
Department of Psychology, Stony Brook University

It is intuitive to think that retrieval cues always aid recall. Surprisingly, cues sometimes hurt recall. This counterintuitive phenomenon occurs regardless of whether the cues come from a social (a person) or a nonsocial (a computer or article) source. However, we do not know whether recall impairment differs depending on the source, raising the question—do social versus nonsocial sources create differential impacts on memory and, if so, what theoretical mechanism underlies this difference? We addressed these questions by directly comparing memory impairment across collaborative recall (cues received from social sources) and part-list cued recall (cues received from nonsocial sources). We aligned the two procedures by taking the recall output of each collaborative group and generating cues for part-list cued participants. This yoked design enabled us to present identical cues and equate their presentation sequence across the two cuing conditions. We also devised a group-level recall index for the part-list cued "groups" yoked to the collaborative groups, thus equating the recall metric between conditions. Across two experiments ($N = 270$), we replicated both the standard collaborative inhibition and part-list cuing impairments. Collaborative groups exhibited more reciprocal influence on one another's recall than part-list cuing participants, producing responses from the same taxonomic category as the cues more often than part-list cuing participants, and exhibiting greater collective memory. These findings provide evidence for the operation of the cross-cuing mechanism in social remembering relative to nonsocial remembering. We discuss these theoretical contributions and implications for education, information transmission, beliefs, and collective narratives.

Keywords: collaborative inhibition, part-list cuing impairment, social memory advantage, cross-cuing, collective memory

Supplemental materials: https://doi.org/10.1037/xlm0001557.supp

For much of the past century, cognitive research on the nature of memory has been directed at the study of the individual (e.g., Crowder, 1976; Ebbinghaus, 1885). Understanding how memory operates when a person works alone is clearly important; however, in many everyday situations people also rely on others to aid their recall. For example, while grocery shopping one might ask an accompanying friend (a social source) for some to-be-remembered items that then helps us remember the full grocery list. Such experiences give us the subjective feeling that collaboration aids remembering, but do such cues we receive from others actually improve our recall? Retrieval cues can come not only from social sources such as family members, friends, or coworkers, but these cues can also come from nonsocial sources; for example, when we jot down a few grocery items to help us remember the full shopping list. Does the impact of this subset of information on our ability to recall the remaining information differ depending on whether it comes from a social source or a nonsocial source? The broader significance of this question pertains to understanding whether the

Evan Frank Risko served as action editor.

Tori Peña https://orcid.org/0000-0003-1812-5138

The processed data and code are available at https://osf.io/hfxtd/?view_only=0e1d409b36f24145832961d666a8783a (Peña et al., 2025). The authors declare no competing interests. Preparation of this article was supported by the National Science Foundation Graduate Research Fellowship (Grant 1839287) awarded to Tori Peña and the National Science Foundation (Grant 1456928) awarded to Suparna Rajaram. The authors thank Jacqueline Bohk, Jenny Chen, Jiajun "Jacob" Li, Kylon Coombs, Lobsang Dolma, Smita Roy, Mili Shah, and Weiye Yuan for their research assistance. The authors thank Melissa Chen for her feedback on this article.

Tori Peña played a lead role in data curation, formal analysis, investigation, project administration, software, validation, visualization, writing–original draft, and writing–review and editing, a supporting role in funding acquisition, and an equal role in conceptualization and methodology. Nicholas W. Pepe played a supporting role in data curation, formal analysis, investigation, project administration, software, validation, writing–original draft, and writing–review and editing and an equal role in conceptualization and methodology. Suparna Rajaram played a lead role in funding acquisition, resources, and supervision, a supporting role in formal analysis, investigation, and project administration, and an equal role in conceptualization, methodology, writing–original draft, and writing–review and editing.

Correspondence concerning this article should be addressed to Tori Peña, Department of Psychology, Stony Brook University, Stony Brook, NY 11794-2500, United States. Email: tori.pena@stonybrook.edu

information we receive from people shapes our memories (and consequently actions) in a different way compared with receiving that same information from books, news, and similar nonsocial sources. In the present study, we addressed this question about the nature of remembering where we conducted laboratory-based experiments to isolate the influences of social versus nonsocial cues on memory and investigate the underlying theoretical mechanisms that can account for potential differences.

A well-known laboratory method to study the impact of social influences on memory consists of the *collaborative recall* paradigm (B. H. Basden et al., 1997; Weldon & Bellinger, 1997). This paradigm reveals a counterintuitive finding about remembering with others: When people work together in collaborative groups to recall materials they earlier studied on their own, they recall less information compared with the pooled recall of an equal number of individuals who recalled working alone, or *nominal groups*. This social memory impairment, known as *collaborative inhibition*, is robust and it occurs even after removing redundant items in the pooled calculation of nominal "groups" (i.e., groups in name only). Social loafing (Latané et al., 1979) or leaving the task to others seems like an intuitive explanation for this impairment, but research suggests that this impairment occurs due to the adverse effects of listening to others' recall while trying to retrieve from one's own memory the remaining studied items (B. H. Basden et al., 1997). In other words, others' recalled items that ought to serve as helpful retrieval cues instead impair recall. We will refer to this type of cues as *social cues*.

An antecedent memory paradigm in the literature, known as the *part-list cuing recall* paradigm, also shows that cues impair recall (Slamecka, 1968, 1969). In this paradigm, cues come from nonsocial instead of social sources. Participants study a list of items and then work alone to recall the studied items. In the part-list cued condition, participants receive a subset of the studied information on article or via computer at the start of their memory task, to serve as cues to "aid" the recall of the remaining studied items. These participants report fewer of the noncued studied items compared with those who receive no cues to assist their recall and instead perform a recall without any assistance from cues (i.e., a free recall task). This finding is known as *part-list cuing impairment* in recall (for a review, see Nickerson, 1984), and it is attributed to the negative effects of processing a subset of the "cue" studied items while trying to retrieve one's own memory for the remaining studied items. We will refer to this subset of items as *nonsocial cues.*

In brief, collaborative recall and part-list cued recall produce strikingly similar results such that both procedures lead to recall impairment due to the presence of "cues." Importantly, however, the sources of cues differ; in the case of collaborative recall, cues come from social sources (studied items recalled by other group members), and in the case of part-list cued recall, cues come from nonsocial sources (studied items provided on article or via computer). As we describe later, the theoretical explanations offered for the recall impairments in the two paradigms are also similar. These intriguing similarities motivate the question whether the impact of cues on remembering can be differentiated depending on whether the cues come from social or nonsocial sources and what theoretical mechanisms could account for this potential difference.

We addressed these theoretical questions by developing a novel methodology that isolates the impact of social influences on memory by comparing the consequences of social versus nonsocial cues in recall. We accomplished this by equating key methodological differences between the collaborative recall and part-list cuing recall paradigms while varying the cue source. We illustrate this approach by first describing the two paradigms and then reviewing the available evidence on their comparisons. Finally, we specify the details of our novel methodology that made it possible to test our key theoretical questions about the differential influence of cue sources and the mechanisms associated with them that guide remembering.

Collaborative Recall Paradigm

Five consequences of recalling in groups are of particular interest here. First collaborative groups reliably recall more information compared with a single person (e.g., Meudell et al., 1992; Weldon & Bellinger, 1997). Second, by contrast, when the recall of collaborative groups is compared with equal-sized nominal "groups," collaborative groups produce significantly lower recall, a phenomenon called *collaborative inhibition* (for reviews, see Marion & Thorley, 2016; Rajaram & Pereira-Pasarin, 2010). These groups are typically composed of three strangers, as was also the case in the present experiments. This impairment in group recall has been replicated with a variety of study materials, including unrelated word lists (e.g., Blumen & Rajaram, 2008), the Deese–Roediger–McDermott lists (e.g., Maswood et al., 2022; Thorley & Dewhurst, 2007), categorized word lists (e.g., B. H. Basden et al., 1997; Henkel & Rajaram, 2011), grocery lists (e.g., Ross et al., 2004), film (e.g., Meudell et al., 1995), and emotional information (e.g., Choi et al., 2017; Yaron-Antar & Nachson, 2006). Collaborative inhibition is also observed across the lifespan (Andersson, 2001; Blumen & Stern, 2011; Henkel & Rajaram, 2011; Leman & Oldham, 2005; Ross et al., 2008). As mentioned earlier, an intuitive explanation for this group memory reduction is *social loafing*, that is, diffusion of responsibility among group members or a lack of motivation that can reduce contribution during collaboration (Latané et al., 1979). However, collaborative inhibition persists even under conditions of increased motivation (e.g., Weldon et al., 2000) or when group members take turns to remember information, a procedure that discourages social loafing as group members are required to contribute at regular intervals (B. H. Basden et al., 1997; Maswood et al., 2022; Thorley & Dewhurst, 2007; Wright & Klumpp, 2004).

A key explanation for collaborative inhibition turns out to be cognitive in nature. According to this explanation known as *retrieval disruption,* when group members encounter items that other group members recall during collaboration, these items (or "cues") disrupt each member's own idiosyncratic strategy for recalling the studied information which lowers their recall performance (B. H. Basden et al., 1997; D. R. Basden et al., 1977). This explanation suggests that once the disruptive cues are removed, such as in a later individual free recall task, people should be able to recover information that was temporarily inaccessible now using their preferred strategy. Evidence supports such a *rebound effect* (Marion & Thorley, 2016; Rajaram & Pereira-Pasarin, 2010) although it is not consistently observed, implicating the role of an additional cognitive mechanism called *retrieval inhibition* (Barber et al., 2015). This mechanism comes into play when the memories for cued items are strengthened and, in turn, weaken the memory representations of noncued items resulting in them being functionally inaccessible (e.g., Anderson et al., 1994).

A third consequence, that is of particular theoretical interest in the current investigation, is one where collaboration can potentially increase group recall. Such an increase is attributed to a mechanism called *cross-cuing* and it can occur despite the detrimental effects of collaboration recall just noted (Meudell et al., 1992). That is, items recalled by some group members help other members access memories during collaboration that would have been otherwise not recalled had they worked alone. One approach to investigating cross-cuing during collaboration involves having participants study some items, recall alone, and then either recall alone again or recall with a partner. The number of *additional* items produced in the second recall session by participants who recalled alone both times is compared with those who worked with a partner in the second recall session (Meudell et al., 1992, 1995). Contrary to what one might expect if cross-cuing operated during collaborative recall, some studies show that participants who collaborated in the second recall produce an equal number of new items compared with those who never collaborated (Harris et al., 2017; Meudell et al., 1992, 1995; Takahashi & Saito, 2004, Experiment 1a).

At the same time, other findings are consistent with the cross-cuing hypothesis. For example, extended time intervals between repeated collaborative recalls preserve memories better compared with repeated individual recalls (Congleton & Rajaram, 2011; Takahashi & Saito, 2004; Experiment 2). Other evidence for cross-cuing comes from instances coded from the collaborative audio files; although small in magnitude, these findings suggested its occurrence when access to study context is impaired (Abel & Bäuml, 2017; Harris et al., 2011). Additional evidence for cross-cuing comes from a study that reported a rare occurrence of collaborative facilitation for expert pilots who recalled flight scenarios they studied earlier (Meade et al., 2009). A coding analysis of recalled narratives revealed that expert pilots working together helped each other access items that were in adjacent positions in the studied narratives. This process improved their group recall performance over and above other groups that consisted of nonexpert pilots or nonpilots, demonstrating cross-cuing benefits for expert pilots. A similar analysis of cross-cuing could be applied to recall of other types of materials as well; for example, to assess whether a group member recalled studied item from a particular taxonomic category in response to their group members' recall of another item from the same taxonomic category. In brief, the operation of cross-cuing during collaborative recall has not been consistently detected in past studies and its potential benefits may also get obscured by collaborative inhibition (B. H. Basden et al., 1997). These inconsistences motivated our probe of this mechanism to understand the potential distinctive benefits of social cues in comparison to nonsocial cues.

Finally, beyond examining the nature of recall in the presence of social cues during collaborative recall, the fourth and fifth consequences of interest here are downstream consequences on later, individual recall where these cues were removed. To assess these effects, we examined two postcollaborative memory phenomena, one related to later individual memory and another to emergence of collective memory. Turning to individual memory first, prior collaboration exerts both benefits and costs in downstream recall. On the one hand, collaborative recall improves later individual memory performance when they are no longer working in groups (Choi et al., 2014; Congleton & Rajaram, 2014). This is proposed to be because items that one group member recalls during collaboration can become reinforced in other group members' memory through a process known as *reexposure benefits* (Blumen & Rajaram, 2008). On the other hand, information that is not mentioned during collaboration may remain forgotten such that participants do not recover these items even after they leave the groups and perform the memory task alone (Barber et al., 2015; Cuc et al., 2006).

At the collective level, former collaborative group members come to have greater overlap in their memories, both in what they later remember and what they forget, compared with those previously assigned to nominal groups and thus possessing no prior shared experience (e.g., Choi et al., 2014). Consequently, people exhibit greater overlap in their postcollaborative, individual memories, a phenomenon known as *collective memory* (Congleton & Rajaram, 2014; Cuc et al., 2006). The emergence of collective memory under these experimental conditions is proposed to be driven by the multifaceted mechanisms that operate during collaboration, including memory impairment, cross-cuing, reexposure, and forgetting we just described (Rajaram & Maswood, 2018).

In brief, working with social cues (i.e., items recalled by other group members) is associated with costs as well as benefits that occur in group memory performance during collaboration as well as in later individual performance after collaboration. Collaborative remembering also aligns memories of former collaborators to give rise to collective memory. How do these phenomena compare in a recall paradigm where the cues and procedures are matched except for the key variable of the sources of the cues—social versus nonsocial? We turn to the nonsocial counterpart that can provide a suitable comparison to test this question.

Part-List Cuing Recall Paradigm

The part-list cuing effect is a nonsocial memory impairment, one that is also counterintuitive (Slamecka, 1968). This impairment occurs when participants who receive a partial list of the studied information to serve as retrieval cues recall significantly fewer of noncued studied items instead of recalling more, compared with participants who receive no cues and who perform a free recall task. As with collaborative inhibition, the part-list cuing impairment is robust (for reviews see Nickerson, 1984; Pepe et al., 2023) and has been replicated for recall of unrelated word lists (e.g., Rhodes & Castel, 2008), Deese–Roediger–McDermott lists (e.g., Kimball & Bjork, 2002), categorized word lists (e.g., Barber & Rajaram, 2011), prose (e.g., Wallner & Bäuml, 2020), grocery lists (Bovee et al., 2009), and semantic categories (e.g., Kelley & Parihar, 2018). The part-list cuing impairment has also been reported in children and older adults (e.g., Foos & Clark, 2000; John & Aslan, 2018; Marsh et al., 2004).

The part-list cues are typically presented at the outset as the recall task begins and impair recall regardless of whether participants read the cues aloud (D. R. Basden et al., 1977; Slamecka, 1968, 1969) or read the cues silently (Barber & Rajaram, 2011). A few studies have also delivered these cues in a gradual manner, and while such intermittent presentation reduces the magnitude of the effect, the part-list cuing impairment nonetheless persists (Andersson et al., 2006; Garrido et al., 2012; Pepe, 2021). Notably, impairment can disappear under conditions in which the cues are presented relatively late during the recall session (Wallner & Bäuml, 2021). Further, like the impact of social cues, the impairing effect of part-list cues reverses, and results in a faciliatory effect when there is a long delay between study and test, suggesting that cues can help reactivate the study context and help performance (i.e., c*ontext reactivation*, Bäuml & Schlichting, 2014; Lehmer & Bäuml, 2018a). In brief, there are notable parallels between collaborative inhibition and the part-list cuing impairment phenomena in recall.

Beyond the parallels in recall impairment, overlapping mechanisms have been proposed to explain the impairing effects of these nonsocial cues. In fact, the theoretical cognitive mechanisms used to explain collaborative inhibition, namely retrieval disruption and retrieval inhibition, have been derived from the part-list cuing recall literature (Barber et al., 2015; B. H. Basden et al., 1997; D. R. Basden et al., 1977; Lehmer & Bäuml, 2018b; Rundus, 1973). Support for the operation of retrieval disruption comes from studies where following part-list cued recall, people show recovery of noncued items on a later individual free recall task (e.g., D. R. Basden & Basden, 1995; B. H. Basden et al., 1991). Support for the operation of retrieval inhibition comes from studies where part-list cuing participants do not recover all the noncued items in a later, free recall task (e.g., Aslan et al., 2007). Emerging evidence suggests a multimechanism account, that incorporates both retrieval disruption and retrieval inhibition to explain the part-list cuing impairment in recall (Barber et al., 2015; Bäuml & Aslan, 2006; Lehmer & Bäuml, 2018a).

Differences Between Collaborative Recall and Part-List Cued Recall

Despite the similarities in recall impairment and the associated cognitive mechanisms between collaborative recall and part-list cuing recall (Lehmer & Bäuml, 2018b), some differences between these two paradigms make the needed direct comparisons difficult. One important aspect of the procedures that differs between the two paradigms is cue presentation—intermittent in collaborative recall versus simultaneously presented at the outset in part-list cuing recall. The second aspect pertains to the processing of the cues. The cues in collaborative recall are typically processed both auditorily and visually, given these items are most often called out by another person, and then written down, whereas the part-list cues are typically presented from a nonsocial source in a visual format (e.g., on the computer screen or article). The third aspect is that the cues presented in the collaborative recall paradigm are dynamic such that one group member can influence another member's response, and this response in turn, can influence the response that others in the group report next. This reciprocal feature is not present in the part-list cuing paradigm where the cues are traditionally fixed and predetermined by the experimenter.

With respect to the cue presentation sequence, some studies have investigated the distinction that collaborative cues typically appear intermittently throughout the recall session whereas part-list cues are typically presented at the outset of the recall session (Andersson et al., 2006; Garrido et al., 2012; Kelley et al., 2014). Andersson et al. (2006) compared two types of cuing, both within the part-list cuing paradigm. In the gradual part-list cued condition, participants received auditory cues that were presented one every 20 s, to mimic the intermittent cues presented in the collaborative memory paradigm. In the standard part-list cuing condition, all cues were presented at the outset of recall, and in the control, free recall condition, no cues were presented during recall. Both gradual and standard cued conditions produced significant part-list cuing impairment relative to free recall, and standard cues produced significantly greater impairment compared with gradual cues. Garrido et al. (2012) also examined gradual cue presentation, again in a part-list cuing paradigm, and in their procedure, participants received intermittent cues such that two cues appeared prior to a participant giving their own response. This cuing arrangement was designed to mimic the turn-taking procedure in collaborative recall where each member in a triad takes turn to recall the studied items (e.g., B. H. Basden et al., 1997). This gradual cuing also produced significant part-list cuing impairment, with cues presented at the outset producing marginally more disruption compared with gradual cuing. Both studies demonstrate that gradually presenting part-list cues impairs recall, with the caveat of this presentation order mitigating the magnitude of the impairment compared with cue presentation at the outset.

Kelley et al. (2014) examined the joint influence of both collaborative recall and part-list cuing. They compared recall performance across free recall, only collaborative recall, only part-list cued recall, and a combined condition that included both collaborative and part-list cuing procedures. The part-list cues were always presented at the outset. The standard part-list cuing impairment and collaborative inhibition in recall were observed in these respective conditions. The combined condition produced the greatest impairment in recall, suggesting that part-list cuing and collaborative recall may have unique influences on recall impairment. These findings were recently replicated with emotional stimuli as well (Nie et al., 2024). In brief, these studies suggest the impact of social cues versus nonsocial cues on memory could differ and may be tied to the procedures used for investigating these effects.

The Present Study

Together, the background outlined above motivates the theoretical questions whether sociality confers a unique impact on memory and what mechanisms may be associated with the unique influence. To address these theoretical questions, it is critical that the methodological differences between tests of social and nonsocial remembering are reduced while preserving the key difference tied to the source of cues. To pursue these questions, we developed a direct comparison of the impact of social versus nonsocial sources of cues while equating three notable procedural differences that also exist between the collaborative and part-list cued conditions. With this approach, we investigated the impact of social cues during the first, collaborative recall phase as well as in the second, individual recall phase where we measured the downstream consequences that the type of cues has on remembering.

The first procedural difference pertains to the specific cues (i.e., studied items serving as retrieval cues) participants receive during collaborative recall and part-list cued recall. In collaborative recall, the cues typically are responses produced by group members and thus the identity of the cues cannot be controlled by the experimenter whereas in part-list cuing paradigm the cues are selected by the experimenter. To equate this substantive difference, we created a yoked procedure to ensure participants received identical cue content in both recall conditions. In the collaborative recall condition, as per the standard procedure, the cues consisted of responses that other group members reported during collaboration. We took the items recalled by one group member and presented these as part-list cues on a computer screen to one participant in the part-list cued condition.

We continued this arrangement with the recall of the other two members of a triadic group and created cue lists for two other part-list cued participants. In other words, each collaborative recall session served to generate three sets of part-list cues. The Method section presents this procedure in greater detail.

A second key difference is the presentation sequence of the cues throughout the recall session. In part-list cuing recall, except for a few studies we described earlier, most studies have presented the cues simultaneously at the start of recall (Pepe et al., 2023). Such onset cuing is the opposite of what happens in collaborative recall where group members respond throughout the recall session and where the temporal appearance of these cues is unpredictable; for example, in the prevalent procedure of free-for-all collaboration that we also used (Weldon & Bellinger, 1997). Therefore, in addition to the identity of cues, we yoked the sequences of cue presentation such that we implemented identical sequences of cues in part-list cued recall to their counterpart in the collaborative condition.

A third key difference that complicates a direct comparison is the unit of measurement. In collaborative recall, performance is measured at the group level whereas in part-list cuing recall it is measured at the individual level. The matching of the study items as well as the identity and sequence of retrieval cues between the collaborative group members and the part-list cued individuals made it possible for us to create a comparable unit of measurement for these recall conditions. We developed a group-level measure in the part-list cuing procedure by aggregating responses in such a way as to match it to the recall units in collaborative recall (further details are in the Method section). These matched recall units made it possible for us to directly compare the magnitude of recall across the three conditions—the collaborative groups, the part-list cued "groups," and the control, nominal "groups."

Turning to the two downstream phenomena in later recall, we investigated the reexposure effect and collective memory that are reported following collaborative recall. As noted earlier, these phenomena are observed in individual recall after the collaborative recall phase. These two postcollaborative effects also provide insights into aspects of cue influences on memory, making them diagnostic phenomena to examine in relation to part-list cuing recall. With respect to the reexposure effect (improved recall following collaboration compared with no collaboration), we asked whether this social advantage would be evident when we compare the consequences of collaborative recall and part-list cued recall in a yoked comparison.

With respect to collective memory, that is, convergence in memory for people who collaborated earlier compared with those who did not, we asked whether collective memory differs between the two paradigms. This question gets at the heart of potential differences in interaction with the cues across these two conditions. Free-flowing collaborative recall entails dynamic exchange of information that allows participants to settle on a single recall product (see Rajaram & Pereira-Pasarin, 2010), whereas in part-list cued recall the influence of collaboration is absent and each person provides an output that is their own.

We conducted two experiments where we modified the part-list cued condition in the manner described above. In Experiment 1, we administered this novel methodology while keeping the properties of the cues as typically found in each paradigm; in the collaborative condition participants received social cues both visually and auditorily whereas in the part-list cues they received the cues only visually. We can hence assess how social cues relative to nonsocial cues may differentially influence memory in the typical formats that have been used. In Experiment 2, we executed a systematic replication of Experiment 1, where we changed one procedural detail. In the part-list cuing condition, we asked participants to read aloud each cue as it was presented (as opposed to covert reading in Experiment 1) which ensures that each cue is processed by each participant in this speak-aloud procedure (e.g., Wallner & Bäuml, 2021). This modification also makes cue properties more similar between the two conditions by adding auditory processing in part-list cued recall and matching it more to collaborative recall that involves listening to others' recall. At the same time, this procedural modification succeeds in isolating, as in Experiment 1, the cue source (social vs. nonsocial) and the conversational exchange that is specific to collaborative recall in comparison to part-list cuing recall, while once again equating the presentation order and the identity of the cues across these two recall conditions. We elaborate further on this procedural detail and the associated predictions in the section on Experiment 2.

In summary, the theoretical aims behind the novel design and procedure we developed in this experiment series were (a) to test whether sociality confers a unique influence on memory and (b) to identify the theoretical mechanisms that may explain the findings if differences were to emerge between social and nonsocial memory. Across experiments, we expected to observe a collaborative inhibition effect given our use of the standard procedures in this condition (Marion & Thorley, 2016). We also expected a part-list cuing impairment in our modified design given the reports of such an impairment in the modified, intermittent cuing procedure (Andersson et al., 2006; Garrido et al., 2012; Kelley et al., 2014). However, in individual recall measures a reduction in the part-list cuing impairment when cues are presented intermittently (Andersson et al., 2006) or its absence when cues are presented late in the recall session (Wallner & Bäuml, 2021) leaves open the possibility that the impairment might be reduced or not appear in our procedure. Critically, the yoked comparison in these experiments allowed a test of whether the collaborative exchanges among group members during collaborative recall would produce differences between recall in the collaboration condition compared with the part-list cued condition in which no participant collaborative occurs. This difference would indicate that the operation of the cross-cuing mechanism differs in social remembering that may offset the severity of recall impairment resulting from the other cognitive mechanisms (i.e., retrieval disruption, retrieval inhibition) at play.

Transparency and Openness

For both experiments, we follow the *Journal Article Reporting Standards* guidelines in the current work (Appelbaum et al., 2018) to report our sample size and to describe all data exclusions and manipulations. Analyses were conducted using the *rstatix* package (Kassambara, 2021) in R (R Team, 2020) and graphs were generated with *ggplot2* (Wickham et al., 2016). The study design and analyses were not preregistered. Processed data and code for the analyses are available on the Open Science Framework. Procedures were reviewed and approved by the Stony Brook Institutional Review Board (Cognitive and Social Processes During Collaboration, #95438).

Experiment 1

Method

Participants

We recruited 144 undergraduate volunteers from Stony Brook University who participated for course credit (*M* = 19.3 years, *SD* = 2.22, range = 17–28 years). We selected this sample size to achieve power of .95 based on the part-list cuing impairment in Barber and Rajaram (2011) with an effect size of 0.42 (Cohen's *d*). Our sample comprised 98 (68.06%) women, 45 (31.25%) men, and 1 (0.69%) person not reporting their gender, and included 57 White (39.58%), 55 (38.19%) Asian, 14 (9.72%) multiracial, 13 (9.03%) Black or African American, three (2.08%) Native American or Alaskan Native, and two (1.39%) participants not reporting their race. Of these participants, 22 (15.28%) reported that they were Hispanic/Latino.

Design

The independent variable recall condition was manipulated between subjects at three levels (collaborative, part-list cued, nominal), with 48 participants (i.e., 16 triads) randomly assigned to each condition, and the nominal group condition serving as control. The experiment first included a study phase, a 7-min distractor phase, and the first recall session where the independent variable was manipulated. Participants in the collaborative condition worked together in groups of three to recall the studied items. In the part-list cued and nominal group conditions participants completed Recall 1 alone. In the part-list cued condition, participants were presented with part-list cues on the computer screen gradually throughout the recall session. After the first recall and a 5-min delay, a second recall session took place where participants from all conditions now recalled alone. The experiment was automated using PsychoPy 2.0 (Peirce, 2007, 2009).

Materials

Study Materials. The study list consisted of 90 exemplar words, consisting of 15 categories with six exemplars per category, taken from Congleton and Rajaram (2011) who had drawn the items from Van Overschelde et al. (2004). The exemplar response frequency and word length were matched across categories (see Congleton & Rajaram, 2011 for more details).

Part-List Cue Lists. The part-list cues and their presentation sequence were derived from the responses reported at Recall 1 by collaborative groups. The audio recordings from the collaborative recall sessions were used to determine which group member reported a given word and when in the group's output sequence. Then, three different part-list cue lists were derived from the recall output of one collaborative group. This was done by removing one of the three participants' responses from the group recall output while preserving the recall order of the items (see Figure 1).[1] For example, take a collaborative triad consisting of Participants 1, 2, and 3, where Participant 1 recalls *doctor*, Participant 2 recalls *mountain*, Participant 3 recalls *grape*, and Participant 1 recalls *cherry*, in this order. An equivalent part-list cuing condition group would consist of Participants 4, 5, and 6, with each participant recalling alone. Here, Participant 4 would receive part-list cues consisting of the items Participants 2 and 3 in the collaborative group recall, thus, will

Figure 1
Example of Part-List Cue Selection in the Present Study

Collaborative Recall	Participant 4 (PLC 1)	**Participant 5 (PLC 2)**	*Participant 6 (PLC 3)*
doctor		doctor	doctor
mountain	**mountain**		**mountain**
grape	*grape*	*grape*	
cherry		cherry	cherry

Note. An example of how the part-list cues are derived from collaborative recall output. Each font style (e.g., italic versus bold) represents a participant from a collaborative triad. PLC = part-list cued participant.

have an experience that simulates the experience of Participant 1 in the Collaborative group. Similarly, Participants 5 would receive part-list cues to simulate Participant 2's experience, and finally, Participant 6 would receive part-list cues to simulate Participant 3's experience.

Furthermore, each part-list cuing participant received the cues in the same sequence as experienced by their yoked collaborative participant. In the above example, Participant 4 would see a blank slot in the sequence where Participant 1 recalled an item and thus would see a sequence consisting of a blank slot, items *mountain* and *grape*, and then a blank slot again. In this manner, these three lists allowed for a direct comparison between three individual participants in the part-list cuing condition and three members of a group in the collaborative condition by equating the identity and sequence of cues. Such triads of participants made it possible for us to examine possible differences at the group level, by aggregating the recall performance of the three part-list cuing participants yoked to a particular collaborative group and removing redundancies in the former triads (the way nominal group recall is calculated). Thus, to calculate group recall, we took all the correctly recalled items (i.e., studied items). In this calculation, we included the recalled items if they were later presented as cues but excluded them if they had been presented as cues *prior to* the participant recalling them (similar to another group member in the collaboration condition having already recalled it). We summed these nonredundant items for each group and then calculated the proportion of items remembered as a group. In this way, we equated as closely as possible both the exposure to the cue lists during recall and the calculation of group recall across the two conditions.

[1] Such cue presentation may allow part-list cued participants to recall to-be-remembered items that may later be presented as a cue. Only a few instances of this occurred (E1: *M* = 2.78, E2: *M* = 2.79), and as such we considered any impact of these occurrences negligible. In addition, the same opportunity for a repetition of cues by collaborators does occur, and also at low rates (E1: *M* = 1.10, E2: *M* = 2.40).

Procedure

After providing informed consent, participants sat in front of individual computer monitors. Participants performed all tasks while working alone except in the collaborative condition in Recall 1. At study, in all three conditions, the experimenter read the instructions aloud while the participant read the instructions on the screen. Participants performed a standard study task used in memory experiments to ensure deep encoding, where they were told that they would be presented with a list of words to remember for later, and to rate each word for its pleasantness of meaning (1—*very unpleasant*, 3—*neutral*, 5—*very pleasant*; Craik & Lockhart, 1972). Each study trial began with an asterisk presented for 1 s followed by a study word presented for 5 s. In the distractor phase, participants typed the names of as many U.S. cities as possible within 7 min (Choi et al., 2014).

Next, in the first recall phase, the experimenter read aloud the task instructions presented on the computer monitors. The recall format was the same in all conditions except for the noted modifications. Participants were instructed to recall as many words from the earlier study list as possible and in any order (Barber et al., 2015; Congleton & Rajaram, 2011, 2014; Kelley et al., 2014). Based on pilot work and past studies, they were given 7 min to perform the recall task. Participants typed their responses into a box at the center of the screen. The word then moved to the left-hand corner of the screen where it remained in view along with all their previously recalled words throughout Recall 1. Participants were not provided with any visual identifiers separating the cues from the recalled words in the collaborative or part-list cuing conditions.

Collaborative participants worked together as a group to complete the first recall task. Before beginning the task, each collaborator was asked to say their participant number and the day of the week aloud into a tape recorder. This information enabled us to anonymously map the items recalled by each group member. Participants were given the commonly used, free-flowing collaboration instructions such that they were not provided with directions on how to recall together and were not required to reach a consensus (e.g., Weldon & Bellinger, 1997). The participant sitting directly in front of the computer was asked to type the group's responses throughout the recall session.

Part-list cued participants worked alone to recall the studied items. As in the standard part-list cuing instructions, they were told that they would receive a subset of items they previously studied to aid their recall of the remaining noncued studied items. They were further informed that these cues would appear intermittently throughout the task and to view the cue word when it appeared in the box. They were also told that if the box was blank, their task was to enter a study item that they could recall that was not already present on their list. Last, in the nominal (control) condition, participants were given standard instructions to type as many words as possible in any order that they could remember from the study list. The recall conditions were implemented in an interleaving manner, and the cues for the part-list cued sessions were derived from the collaborative sessions.

During the 5-min break between Recalls 1 and 2 (e.g., Choi et al., 2014), participants in the Collaborative condition returned to their original individual computer stations and were instructed not to talk to one another. In Recall 2 session, participants from all three conditions now worked alone and performed a free recall task (i.e., recalling without any cues). They had 7 min to type as many studied items as possible and in any order. Participants were informed they should also include any study words that were recalled during the first memory task by them or their group members (in the collaborative condition) or any words that may have been provided to them as cues in the Recall 1 task (in the part-list cuing condition). As in Recall 1, the words participants typed once again remained in full view throughout the recall period. After completing the second recall task, participants completed a short demographic survey and were debriefed. The entire experimental session took approximately 45 min.

Results

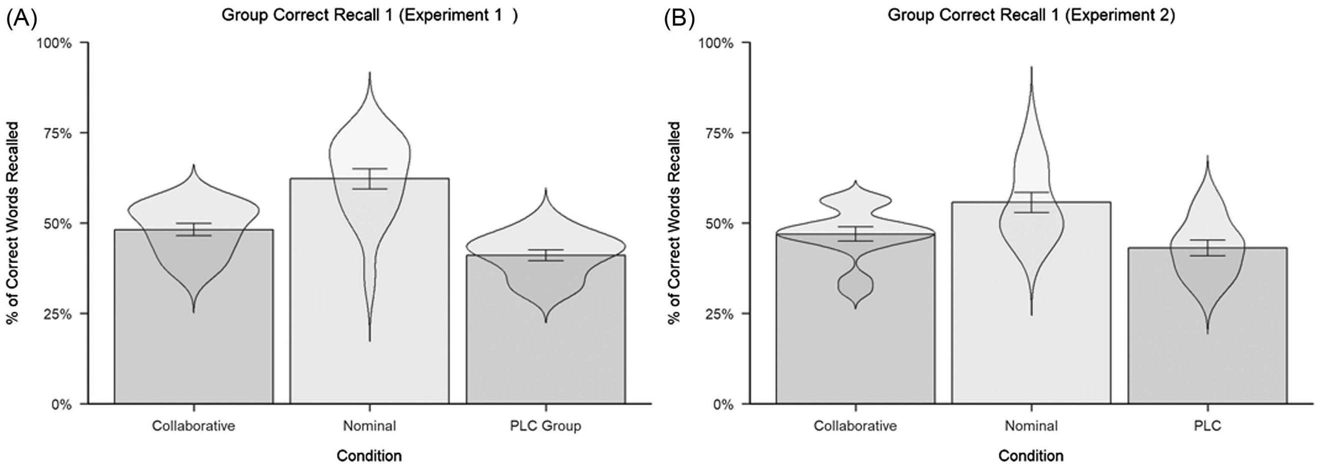
We assessed the influence of social versus nonsocial cues on memory performance. Intrusions (items not studied earlier) were low in Recall 1 in all conditions (collaborative: $M = 0.05$, $SD = 0.80$; nominal: $M = 0.98$, $SD = 1.18$; part-list cued: $M = 1.38$, $SD = 1.38$), and will thus not be considered further. All comparisons were two-tailed, and the α level was set at .05 a priori. All effect sizes were calculated with eta-squared (Cohen, 1973) and Cohen's *d* (Cohen, 1988). Across all results, we removed outliers that were above or below 2.5 standard deviations from the mean (Finlay et al., 2000).

Recall 1

Individual-Level Memory Performance in Part-List Cuing Recall. As a manipulation check, we first examined whether there was an individual-level, part-list cuing impairment. This individual-level measurement provides a comparison to the standard test of the part-list cuing impairment reported in the individual recall tasks in the literature. As a reminder, the number of maximum items a given participant could recall varied from person to person because of our yoked design as the cues were drawn from the recall of each member from a collaborative group. Therefore, we calculated the proportion of noncued studied items each participant recalled relative to the maximum number of potential items they could have recalled (Marsh et al., 2004) and removed two outliers. An independent samples *t* test comparing the nominal (control) individuals ($M = 0.29$, $SD = 0.09$) to part-list cued individuals ($M = 0.26$, $SD = 0.08$) showed that the part-list cuing impairment did not reach significance, $t(92) = 1.89$, $p = .062$, $d = 0.39$, 95% CI [−0.001, 0.07], an outcome similar to the absence of this impairment when the part-list cues appear later in the recall phase (Wallner & Bäuml, 2021) and a reduction when the cues appear intermittently every 20 s (Andersson et al., 2006) in individual recall measures of part-list cuing.

Group-Level Memory Performance. To test our key question, we examined group-level memory performance across all three conditions. A one-way, between subjects analysis of variance on the proportion of unique, noncued studied items revealed a significant main effect of recall condition, $F(2, 45) = 27.11$, $p < .001$, $\eta^2 = .55$ (see Figure 2, Panel A). Follow-up contrasts showed that collaborative groups ($M = 0.48$, $SD = 0.07$) recalled a significantly smaller proportion of words than the nominal groups ($M = 0.62$, $SD = 0.11$), $t(30) = -4.31$, $p < .001$, $d = -1.52$, 95% CI [−0.21, −0.74], demonstrating a robust collaborative inhibition in Recall 1. The part-list cued groups also showed significantly reduced recall for the proportion of noncued items ($M = 0.41$, $SD = 0.06$) compared with the

Figure 2
Group-Level Recall 1 Across Experiments 1 and 2



Note. Error bars represent the standard error. PLC = part-list cued condition.

nominal groups, $t(30) = 6.71$, $p < .001$, $d = 2.37$, 95% CI [0.15, 0.28], demonstrating that the part-list cuing impairment occurred at the group level. Thus, we replicated the collaborative inhibition effect and found a part-list cuing impairment in pooled group recall.

Crucial to the novel theoretical question in this study, we found that collaborative groups recalled a significantly greater proportion of noncued items compared with the part-list cued groups, $t(30) = 3.14$, $p = .004$, $d = 1.11$, 95% CI [0.02, 0.12]. In other words, while collaboration inhibition occurred, this recall impairment in response to social cues was significantly smaller compared with nonsocial cues.

Category Matches. We described in the Introduction a mechanism known as cross-cuing that offers a potential theoretical explanation for less recall impairment for collaborative groups compared with part-list cuing groups. As a reminder, cross-cuing is when group members help each other access study items that have yet to be recalled during collaboration, with one person's recalled item enabling another member to access other studied information (Meudell et al., 1992, 1995). Such an increase in recall may partially offset the recall reduction that occurs due to retrieval impairment during collaboration. If cross-cuing occurs during collaborative recall, related items are more likely to appear in adjacent output positions in group recall compared with part-list cued recall since group members who collaborate are likely to cross-cue items from the same categories more so than the participants in the part-list cuing condition who cannot influence the future cues. This idea draws on Meade et al.'s (2009) observation that significantly greater sequences of related items appear together in the recall of group members who exhibited collaborative facilitation compared with participants who did not.

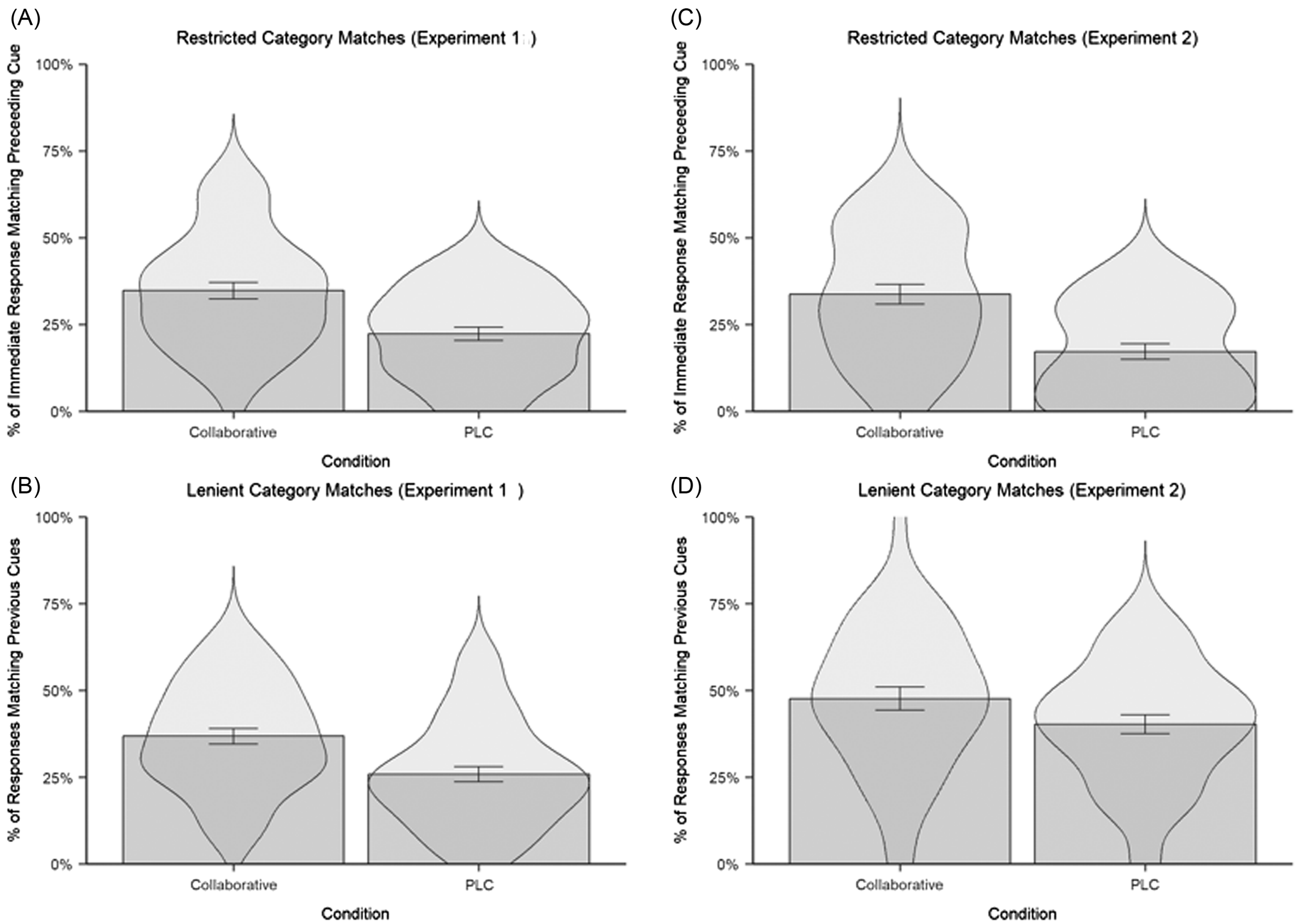
To test this possibility, we examined the proportion of accurately recalled items that matched the taxonomic category of the preceding cues as a metric to assess whether cross-cuing was more prevalent among collaborative participants compared with part-list cued participants in Recall 1. In other words, the crux of this comparison was to test, with the same cues and presentation sequence across recall conditions, whether these cues would influence recall in different ways between the social and nonsocial conditions.

To examine the evidence for cross-cuing, we scored category matches in two ways, restricted and lenient. For the restricted scoring, we examined responses that immediately followed a cue and examined how many of those immediate responses in succession matched the category of the previous cue. For the lenient scoring, after the occurrence of a cue or a succession of cues (a group member's recalled item or a part-list cue) we examined all the responses that followed to calculate how many of the ensuing responses matched the category of the preceding cue(s). Both types of scoring revealed similar patterns, and each had one outlier removed. In the restricted scoring, collaborative participants provided a significantly higher proportion of responses that matched the preceding cues ($M = 0.35$, $SD = 0.16$) than did the part-list cuing participants ($M = 0.22$, $SD = 0.13$), $t(93) = 4.09$, $p < .001$, $d = 0.84$, 95% CI [0.06, 0.18]. Similarly, the lenient analysis revealed significantly more related responses produced by collaborative than part-list cuing participants (collaborative: $M = 0.37$, $SD = 0.15$; part-list cuing: $M = 0.26$, $SD = 0.15$), $t(93) = 3.50$, $p < .001$, $d = 0.72$, 95% CI [0.05, 0.17]. Findings from the restricted and lenient analyses are displayed in Figure 3, Panel A and Figure 3, Panel B, respectively. These findings for the collaborative recall and part-list cued recall conditions indicate that cross-cuing during collaboration helps reduce the cues' detrimental effects relative to the effects observed in part-list cued recall.

Recall 2

Reexposure Benefits. Next, we assessed whether participants benefited more from social cues versus nonsocial cues in their later individual free recall. As a reminder, in the collaborative condition, cues refer to those studied items that other group members recalled during Recall 1, and in the part-list cued condition, cues are these same items provided as retrieval aids during Recall 1. We computed the proportion of cues that participants reported in final individual free recall relative to the number of cues they received during

Figure 3
Category Matches in Recall 1 Across Experiments 1 and 2



Note. Error bars represent the standard error. PLC = part-list cued condition.

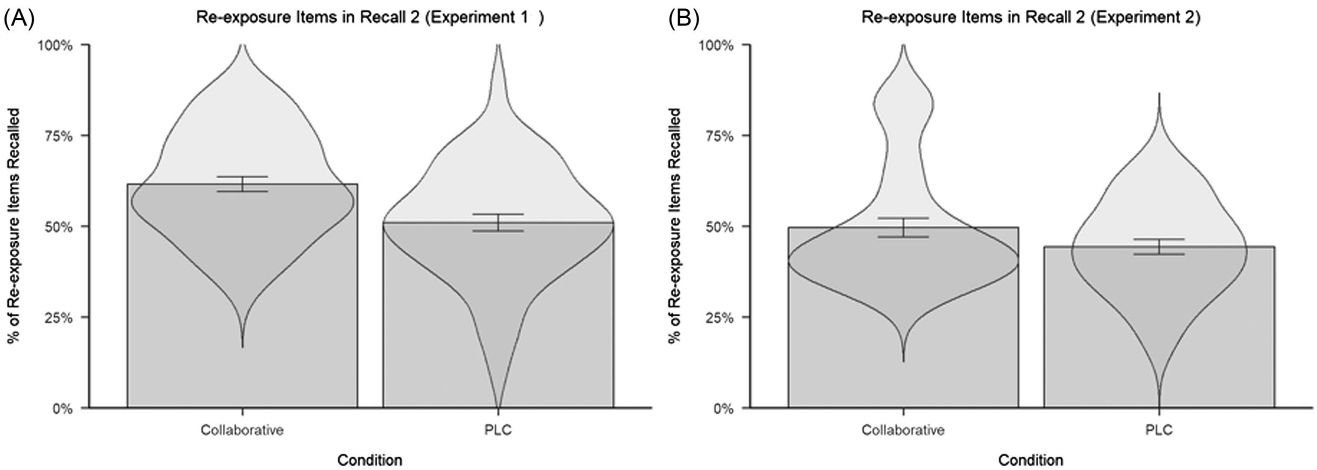
Recall 1, with one outlier removed. Collaborative participants ($M = 0.62$, $SD = 0.14$) recalled a greater proportion of cues than their part-list cued counterparts ($M = 0.51$, $SD = 0.16$), $t(93) = 3.43$, $p < .001$, $d = 0.70$, 95% CI [0.04, 0.17] (see Figure 4, Panel A), showing a social advantage in postcollaborative recall as well.

We also conducted exploratory analyses to examine noncued items, rather than cued responses, which were reported in Recall 2. For the sake of brevity and to focus on our main theoretical questions, we have reported this information in the Supplemental Materials.

Collective Memory. Finally, we examined the formation of collective memory. An item recalled by all group members during Recall 2 was counted toward *Collective Remembering* while an item forgotten by all members in Recall 2 was counted toward *Collective Forgetting*. The sum of collective remembering and collective forgetting scores constituted *Collective Memory* (Choi et al., 2014; Stone et al., 2010).

A one-way between subjects analysis of variance comparing collective memory scores across the three conditions was significant, $F(2, 45) = 23.36$, $p < .001$, $\eta^2 = .509$ (see Figure 5, Panel A). No outliers were present in this or the follow-up analyses. Follow-up contrasts showed that collective memory was greater in the collaborative condition ($M = 56$, $SD = 7.81$) compared with the Nominal condition ($M = 38.75$, $SD = 9.50$), replicating past reports, $t(30) = 5.61$, $p < .001$, $d = 1.98$, 95% CI [10.97, 23.53]. With respect to the novel goals of this study, collective memory in the collaborative condition was also greater compared with the part-list cued condition ($M = 40.63$, $SD = 5.73$), $t(30) = 6.35$, $p < .001$, $d = 2.24$, 95% CI [10.43, 20.32]. Finally, collective memory scores did not differ between part-list cued and nominal conditions, $t(30) = -0.68$, $p = .50$, $d = -0.24$, 95% CI [−7.54, 3.79]. Thus, collective memory was greater following collaboration compared with the other two conditions, with comparison to the part-list cuing condition underscoring how the source of cues can differentially influence this performance. We also conducted exploratory analyses to examine collective memory organization. In this analysis, beyond the overlap in the contents of recall that constituted collective memory, we examined the sequence in which items were recalled and how it aligned across participants who were formerly collaborators (Congleton & Rajaram, 2014; Greeley et al., 2024). We observed similar patterns in collective memory organization as well (see Supplemental Material for this information).

Figure 4
Reexposure Benefits in Recall 2 Across Experiments 1 and 2



Note. Error bars represent the standard error. PLC = part-list cued condition.

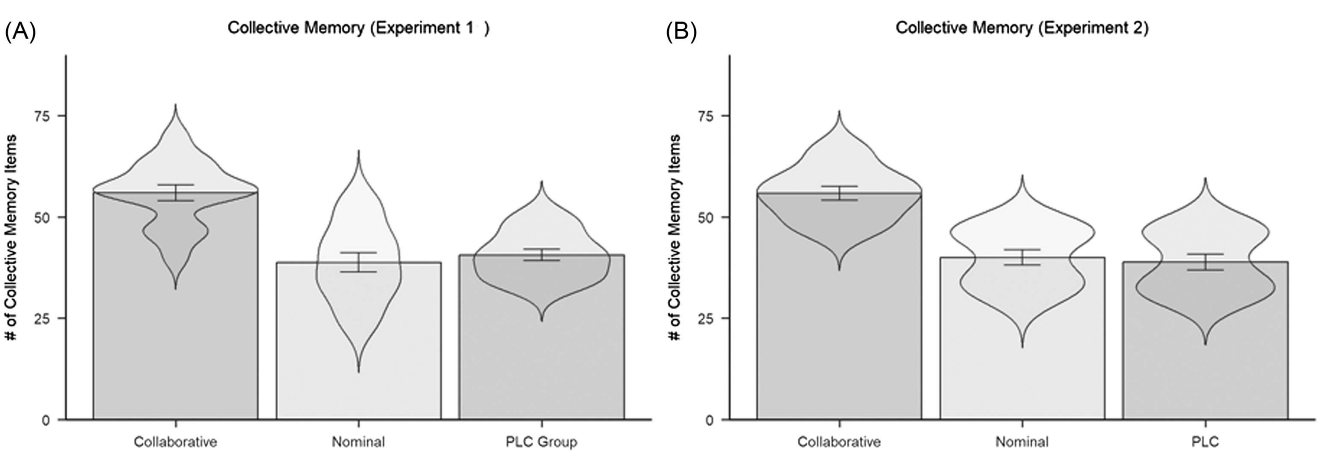
The novel finding of a difference in collective memory between collaborative and part-list cued conditions is particularly noteworthy since the cues and their presentation sequence were equated between the collaborative and part-list cued conditions during Recall 1 and speaks to the role of the cross-cuing mechanism and thus the influence of sociality in facilitating the formation of collective memory. We return to an elaboration on this new evidence in the General Discussion.

Discussion

In Experiment 1, we investigated whether social versus nonsocial cues differentially influence memory. We tested this question by setting up a direct comparison where we equated the identity and the presentation sequence of cues across collaborative and part-list cued recall. In this novel methodology where part-list cues were presented intermittently, we observed a group-level part-list cuing impairment effect, but it was not statistically significant at the individual level. As noted in the Introduction, previous work has observed a reduction in part-list cuing impairment when cues are presented intermittently (e.g., Andersson et al., 2006) and an absence of this impairment when cues are presented late in the recall session (e.g., Wallner & Bäuml, 2021) at the individual level. Finally, we replicated the standard collaborative inhibition effect in group recall (Marion & Thorley, 2016).

Our key question focused on whether social versus nonsocial cues differ in their impact on recall, to identify the potential influence of cue source on memory. Collaborative groups recalled a higher proportion of unique items than the part-list cued groups, and this advantage in collaborative recall occurred under conditions

Figure 5
Collective Memory Across Experiments 1 and 2



Note. Error bars represent the standard error. PLC = part-list cued condition.

where participants received the same cues and in the same order during collaborative recall and part-list cued recall. This difference provides critical evidence for the theoretical idea that social remembering differs from individual remembering. Moreover, the evidence for cross-cuing during collaborative recall provides a theoretical explanation for the social memory advantage we observed in this experiment. Specifically, category match analyses provided support for cross-cuing and revealed interesting nuances in how participants remember differently in social settings. That is, people responded to cues with items within the same taxonomic categories more often when the cues were from a social source versus a nonsocial source.

Another consideration for why there was a mnemonic advantage among collaborative groups compared with part-list cuing groups is the dynamic exchange that occurs during collaboration. A collaborative group member, in addition to matching their group members' responses, can also influence the responses of other group members. In other words, a collaborative participant recall can be influenced by their social cues (i.e., items recalled by their group members) and at the same time, produce a response that can influence other group members' upcoming recall. For example, during collaborative recall, a participant can respond to a social cue (i.e., a group member's recall output) "shark" by producing their own response from the same category, for example, "guppy." This response, in turn, can influence another group member's upcoming response by conforming to the same category, for example, "trout." Using this same example for the part-list cuing recall condition, if a participant here receives a nonsocial cue "shark," they can also respond with an aligning item like "guppy." However, their response cannot influence the upcoming cue that is predetermined by the nature of this task. The distinct, reciprocal aspect of social remembering contributes to the cross-cuing benefits that we observed in our categorical matching analysis. Together, our patterns reveal the differences in retrieval dynamics that unfold during social versus nonsocial remembering and how this may consequently influence memory performance.

In addition to the benefits in categorical matching that occurred during collaboration at Recall 1, findings from Recall 2 suggest downstream influences of social cues that were not present with nonsocial cues. One, the reexposure mechanism (Blumen & Rajaram, 2008; Weldon & Bellinger, 1997) was more effective in the collaboration condition compared with the part-list cuing condition such that participants who collaborated also remembered later in Recall 2 more of the cue items from Recall 1 compared with part-list cued participants. By directly comparing social remembering to individual remembering for which identical cues were available, these reexposure findings suggest that social sources exert a differential influence on later memory than nonsocial sources (e.g., Reysen & Adair, 2008).

Two, the emergence of collective memory occurred only following social remembering, that is, following collaborative recall and not following part-list cuing recall. As reported in previous studies using similar studied information as our study, collaborative participants had higher collective memory scores compared with the nominal participants (Congleton & Rajaram, 2011, 2014). Novel to our study, collaborative participants also had higher levels of collective memory compared with their part-list cued counterparts who had received the same cues in the same sequence. In fact, the collective memory scores did not differ between the part-list cued and nominal participants, indicating a potential influence of social interaction given the greater emergence of collective memory following collaborative remembering. In other words, our findings on collective memory support the hypothesis that the process of collaboration heavily drives the formation of collective memory (Rajaram, 2022). Collaboration can lead to both higher collective memory hypothesized to be due to cross-cuing benefits, reexposure gains, and collective forgetting (due to recall impairment) through listening to what other group members recall during Recall 1 and influencing their recall in turn (Rajaram, 2017; Stone et al., 2012). We observed the operations of these mechanisms associated with collaborative recall in our Recalls 1 and 2 findings. By contrast, part-list cued participants did not have the opportunity to engage with other group members which, in turn, likely prevented them from developing collective memory with their respective "group" members.

In summary, Experiment 1 findings revealed that social cues provided by group members during collaboration (a) simultaneously impair and facilitate memory performance; (b) encourage more reciprocity; (c) reinforce memory more effectively than cues from nonsocial sources; and (d) homogenize memory representations more effectively than cues from nonsocial sources. These findings show that the mechanisms engaged during collaboration can be more powerful in influencing memory than processing the same information in the same order when received from a computer screen. Taken together, Experiment 1 provided a test of the key theoretical questions regarding the unique contribution of social influences on remembering, and the mechanisms that selectively operate in social remembering exerting contrasting influences (i.e., impairment, cross-cuing, reexposure), produce an overall memory advantage. In light of these novel findings about the nature of social memory, Experiment 2 was designed to systematically replicate and extend Experiment 1.

Experiment 2

Two aims guided Experiment 2. The first aim was to conduct a systematic replication of Experiment 1 further examining how the source of a cue can moderate recall impairment. The second aim was to modify the procedure in the part-list cuing recall to ensure that participants processed each presented cue during Recall 1. This was done by requiring the participants to read aloud into a microphone each cue as it was presented (e.g., Wallner & Bäuml, 2021). This modification also increased the similarities in the properties of cues in the collaborative and part-list cued recall conditions such that cues in both conditions were visual and included an auditory element. At the same time, as intended, Experiment 2's procedure maintained the important distinction between the source of the cues—whether the cues came from a social or a nonsocial source—hence maintaining the potential for conversational exchange during collaborative recall and a test of the mechanisms that may be influenced by this distinction in the procedure.

Past research has reported a part-list cuing impairment for the part-list cues with an auditory component (e.g., Andersson et al., 2006; Bäuml & Aslan, 2006), suggesting that this impairment would replicate in the group recall measure as observed in Experiment 1. With regard to the comparison of the part-list cuing impairment to collaborative inhibition in Experiment 2, no such comparison between social versus nonsocial cues has been reported with the current procedure to our knowledge, precluding clear predictions based on past work. However, past findings of a reduction in the part-list cuing impairment when participants write down cues presented auditorily and gradually across the recall period (Andersson et al., 2006), suggests that in our read-aloud procedure the part-list cuing impairment, while present, may not be greater than collaborative inhibition in our group recall measure, contrary to Experiment 1. Alternately, if the processing of both the visual and auditory aspects of the cue items reduces access to the to-be-recalled items, we may observe the Experiment 1 pattern of better performance in the collaborative condition compared with the part-list cued condition. Regardless of either of these outcomes in Experiment 2, the question of interest continued to be whether the cross-cuing mechanism will operate to a greater extent in the collaborative condition than the part-list cuing condition at Recall 1 in Experiment 2, pointing to a test of the theoretical mechanism that may differ between social versus nonsocial remembering in these paradigms.

In Recall 2, the questions were whether the postcollaborative recall advantage observed in Experiment 1 would remain, thus replicating the reexposure benefit of collaboration, or whether the part-list cued condition would lead to better memory for the cued items given participants would both see and read aloud the items during the first recall thereby improving the recall for the cue items in this condition. Finally, we assessed whether social remembering through collaborative recall, involving collaborative exchange and cross-cuing during collaboration, would continue to exert greater memory convergence than nonsocial remembering in part-list cuing recall, and lead to greater collective memory compared with the part-list cuing condition.

Method

Participants

We recruited 126 volunteers from Stony Brook University who participated for course credit ($M = 19.25$ years, $SD = 3.36$, range = 17–49 years). This sample size was selected to achieve power of .80 based on the difference observed in Experiment 1 between collaborative and part-list cuing "group" conditions in Recall 1 ($d = 1.11$). We replaced 18 participants for the following reasons: 10 part-list cuing participants who did not read all the cues aloud into the microphone as required, three collaborative participants (i.e., one triad) as we could not confirm which group member generated which item (to generated their cue list), two control participants who did not following instructions during the recall session such that they did not press enter after each recalled item, two control participants who did not report any correct items in Recall 1, and one part-list cuing participant who did not report any noncued items during Recall 1.

The participants in our final sample comprised 91 (72.22%) women, 33 (26.19%) men, and 2 (1.59%) people who did not report their gender, and included 48 (38.10%) Asian, 46 (36.51%) White, 17 (13.49%) Black or African American, 12 (9.52%) multiracial, two (1.59%) Native American or Alaskan Native, and one (0.79%) participant did not report their race. Of these participants, 21 (16.67%) reported that they were Hispanic/Latino.

Design and Materials

Experiment 2 was identical to Experiment 1 with respect to the design and materials such that participants studied the same categorized words, and all participants completed the experiment in-person. We once again derived new part-list cues from the collaborative recall lists collected in this experiment in the same fashion as Experiment 1.

Procedure

The procedure was the same as in Experiment 1, with the following modification to the part-list cuing condition—at Recall 1, part-list cuing participants were required to wear a microphone and read aloud into the microphone each cue as it appeared on the computer screen throughout the recall session.

Results

We once again focus on accurate recall data from Recalls 1 and 2. Intrusions were low in this experiment as well and were not analyzed further (collaborative: $M = 1.69$, $SD = 1.73$; nominal: $M = 1.76$, $SD = 1.87$; part-list cued: $M = 1.40$, $SD = 1.82$). We followed the same analytic approach as the previous experiment.

Recall 1

Individual-Level Memory Performance in Part-List Cuing Recall. The proportion of noncued items in Recall 1 was compared between the nominal individuals ($M = 0.27$, $SD = 0.10$) and part-list cued individuals ($M = 0.32$, $SD = 0.14$), with one outlier removed. As in Experiment 1, the numerical pattern of part-listing cuing recall impairment did not reach significance, $t(81) = -1.80$, $p = .076$, $d = 0.40$, 95% CI [−0.099, 0.005].

Group-Level Memory Performance. As in Experiment 1, the group recall measure that equated the two conditions of interest revealed significant differences in performance in Recall 1 across the three conditions, $F(2, 39) = 7.80$, $p = .001$, $\eta^2 = .286$ (Figure 2, Panel B). Planned comparisons revealed collaborative inhibition once again, with nominal groups ($M = 0.56$, $SD = 0.10$) recalling significantly greater proportion of study items than collaborative groups ($M = 0.47$, $SD = 0.07$), $t(26) = -2.57$, $p = .016$, $d = -0.97$, 95% CI [−0.16, −0.02]. Similarly, part-list cuing impairment was observed again, with part-list cuing groups ($M = 0.43$, $SD = 0.08$) reporting fewer items than nominal groups, $t(26) = 3.60$, $p = .001$, $d = 1.36$, 95% CI [0.05, 0.20]. Contrasting Experiment 1, we did not observe a difference between collaborative groups and part-list cuing groups, $t(26) = 1.35$, $p = .188$, $d = 0.51$, 95% CI [−0.02, 0.10]. No outliers were identified in these analyses. This finding is discussed later.

Category Matches. As in Experiment 1, collaborative participants provided significantly more immediate responses related to the same taxonomic category ($M = 0.34$, $SD = 0.18$) than part-list cued participants ($M = 0.17$, $SD = 0.14$) in the restricted analysis, $t(81) = 4.54$, $p < .001$, $d = 1.00$, 95% CI [0.09, 0.24] (Figure 3, Panel C). One outlier was removed. In the lenient metric, the numerical difference between the collaborative participants ($M = 0.48$, $SD = 0.21$) and the part-list cued participants ($M = 0.40$, $SD = 0.18$) was not statistically significant, $t(82) = 4.54$, $p = .08$, $d = 0.38$, 95% CI [−0.01, 0.16]. No outliers were identified in this analysis (Figure 3, Panel D).

Recall 2

Reexposure Benefits. In Recall 2, the proportion of cues reported by collaborative participants (M = 0.50, SD = 0.17) compared with the part-list cued participants (M = 0.44, SD = 0.13) was not statistically significant unlike in Experiment 1, $t(82) = 1.60$, $p = .11$, $d = 0.35$, 95% CI [−0.1, 0.12] (Figure 4, Panel B). No outliers were removed from this analysis. Additional, exploratory analyses conducted to examine noncued items in Recall 2 are once again reported in the Supplement Material.

Collective Memory. As in Experiment 1, we observed significant differences across conditions in collective memory, $F(2, 39) = 26.20$, $p < .001$, $\eta^2 = .573$ (Figure 5, Panel C). Collaborative participants (M = 55.86, SD = 6.42) exhibited higher collective memory scores than nominal participants (M = 40.00, SD = 7.10), $t(26) = 6.20$, $p < .001$, $d = 2.34$, 95% CI [10.60, 21.12], and once again also compared with the part-list cued participants (M = 38.86, SD = 7.28), $t(26) = 6.55$, $p < .001$, $d = 2.48$, 95% CI [11.67, 22.33]. The part-list cued and nominal participants once again did not differ in their collective memory scores, $t(26) = 0.42$, $p = .67$, $d = 0.16$, 95% CI [−4.45, 6.73]. As in Experiment 1, the exploratory analyses on collective memory organization can be found in the Supplemental Material.

Discussion

We tested two aims in Experiment 2—(a) a systematic replication of Experiment 1 for the differential contributions of social remembering and the cognitive mechanisms associated with it and (b) ensuring the processing of cues in the part-list cuing condition by asking participants to read aloud the visually presented cues during Recall 1, making it similar to hearing these cue items produced by other group members during collaborative recall. This modification in the part-list cuing condition increased the match of visual and auditory cue properties between social and nonsocial cues, while continuing to keep distinct the source of information—social versus nonsocial—to examine the process of recall that is tied to this distinction.

We replicated three key findings from Experiment 1. One, we observed collaborative inhibition in group recall as well as a group-level part-list cuing impairment compared with the nominal groups at Recall 1. Two, collective memory once again emerged in the collaborative condition in Recall 2. This outcome occurred in the standard comparison to the nominal condition as reported in past research and, critically, also in comparison to the part-list cuing condition as observed in Experiment 1. This consistent pattern of collective memory following only collaborative remembering underscores the unique contributions of the collaboration process to memory convergence (Rajaram et al., 2022). The collaborative interactions with other group members likely allowed participants to experience the cues provided by other group members or withheld or disrupted by them, and, in turn, influencing the recall of others with their own recalled items (serving as "cues") leading to memory convergence. Three, the operation of the cross-cuing mechanism was once again greater in the collaborative condition compared with the part-listing cuing condition as statistically evident in the restricted analysis. Specifically, this analysis showed that collaborative participants in their recall matched their cues subsequently with an item from the same category more often than part-list cued participants. These three findings show that during collaboration some aspects of the recall process differs such that people engage with social versus nonsocial cues in different ways.

Three findings diverged in Experiment 2 relative to Experiment 1 such that the part-list cuing recall condition in Experiment 2 had comparable recall performance in some respects to the collaborative recall condition. First, at Recall 1, while both collaborative inhibition and part-list cuing recall impairment were replicated, the magnitude of the impairment did not differ between the two conditions in Experiment 2 ($d = .51$). Second, in Recall 1, evidence for cross-cuing was observed in the strict analysis in both experiments but was not reliable in the lenient analysis in Experiment 2 ($d = .38$). Finally, in Recall 2, collaborative and part-list cued participants recalled similar proportion of cues, showing comparable recall benefits of having been exposed to cues at Recall 1 ($d = .35$), whereas this reexposure benefit was greater for collaborative participants in Experiment 1. The sample size in Experiment 2 was slightly smaller compared with Experiment 1. This calculation was based on replicating the large effect size of key interest from Experiment 1, namely the difference between the collaborative versus part-list cued "group" recall levels ($d = 1.11$). It is possible that the true effect size is smaller than the observed effect size in Experiment 1 and, therefore, Experiment 2 was underpowered to detect it. Alternatively, these patterns might have resulted because of the procedural change we purposely made in Experiment 2 that increased the similarities in cue processing between the two cuing conditions. Finally, the outcomes might also be the result of a combination of these factors. We revisit these points in the General Discussion.

Despite these differences, Experiments 1 and 2 revealed three key replications—the occurrence of both collaborative inhibition and part-list cuing impairment, and in the context of this pattern, greater cross-cuing in three of four measures, and greater collective memory in collaborative recall compared with part-list cued recall. Together, these findings reveal theoretically important nuances between social and nonsocial remembering regarding retrieval cues.

General Discussion

It is intuitive to think that retrieval cues improve recall. However, a substantial body of research shows that such cues have the capacity to impair recall instead. Not only do cues often lower recall in certain situations, but this striking phenomenon occurs regardless of whether these cues come from social sources or nonsocial sources. These parallel patterns have been reported in collaborative recall that involves group remembering where cues come from social sources, and in part-list cued recall that involves individual remembering where cues come from nonsocial sources (e.g., presented on the computer screen). Similar theoretical explanations have also been proposed to account for the recall impairments across these social versus nonsocial recall paradigms. These parallels motivated the theoretical questions of interest as to whether social context differentially influences memory and what underlying process might be associated with this outcome. To address these questions, we conducted two experiments to test the consequences of remembering with social versus nonsocial cues. A consistent finding across these experiments was the reciprocal nature of collaboration such that collaborative participants were more likely to respond to the cues with an item from the same category compared with their part-list cuing counterparts. These findings indicate that the retrieval dynamics during social versus nonsocial remembering differ despite these sources having other similar consequences on memory.

Impact of Social Cues on Group Recall Compared With Nonsocial Cues

We addressed key theoretical questions about the selective impact of social context on remembering. To this end, using a novel methodology we directly compared the collaborative recall paradigm with the part-list cuing paradigm. In collaborative group recall, the recall outputs of some members serve as social cues for other members. We created a yoked design where each part-list cued participant received the same items in the same order as one member of a collaborative group, and in this manner, three individual participants received part-list cues derived from each of the three members of a collaborative group, that served as nonsocial cues. If social sources (in this case, the output of other members in a collaborative group) and nonsocial sources (in this case, the yoked part-list cues) have similar cuing influences on memory, recall outcomes between these conditions would not differ. However, we found notable differences in remembering between cue sources.

With respect to collaborative recall, we observed both detrimental and facilitatory effects associated with collaboration. In line with previous research, we found detrimental effects where collaborative groups recalled a significantly smaller proportion of unique information than nominal groups, demonstrating a collaborative inhibition effect (B. H. Basden et al., 1997; Weldon & Bellinger, 1997). Novel to the present study, in Experiment 1, this decrement in collaborative group recall was significantly less compared with the decrement observed in the counterpart group measure in part-list cued recall, thus revealing an advantage. Interestingly, in Experiment 2, this advantage did not occur.

As noted in the discussion of Experiment 2, three possibilities may account for this discrepancy between Experiments 1 and 2. First, an intentional procedural change we made in Experiment 2 might have helped improve recall among the part-list cuing participants. We asked participants to read aloud the visually presented, part-list cues, similar to the procedure in the collaborative condition where social cues (items recalled by other group members) were both heard and written down. While cross-cuing likely still occurred in the collaborative groups, as evidenced by significant cross-cuing in the strict analysis in Experiment 2, the addition of the auditory component during cue processing in the part-list cuing condition might have increased the degree to which part-list cuing participants benefitted from cue processing that was now more similar to processing social cues as in the collaborative condition. Second, the sample size in Experiment 2 was slightly smaller compared with Experiment 1, based on the large effect size for a key effect from Experiment 1, namely the observed difference between the collaborative and part-list cued "group" conditions in Recall 1. But it might not have had the statistical power necessary to capture the moderate effects size we observed in Experiment 2. Finally, the discrepancy in the findings between Experiments 1 and 2 might have resulted from a combination of the first two possibilities, that is, a larger sample size and thus more statistical power may be needed to detect reliable differences between the two conditions when the cue processing modalities in the part-list cuing condition become more similar to the collaborative recall condition. These three possibilities may also account for two other findings, related to phenomena we discuss in sections below, where the moderate effect sizes were not statistically reliable between the collaborative and part-list cuing conditions in Experiment 2, namely, the lenient analysis comparing cross-cuing and the analysis comparing downstream reexposure effects.

Yet, as we describe below, across both experiments the collaborative recall condition nonetheless produced advantages from cross-cuing (in three out of four comparisons), as well as significantly greater collective memory, compared with the part-list cuing condition, suggesting that conversational exchange in collaborative recall makes its own contributions to memory.

Cross-Cuing and a Social Memory Advantage

The detrimental effects of social cues on memory performance, that is, collaborative inhibition in recall, have been well-explained in terms of retrieval disruption and retrieval inhibition as likely mechanisms that drive this memory impairment (Barber et al., 2015; B. H. Basden et al., 1997; Marion & Thorley, 2016; Rajaram & Pereira-Pasarin, 2010), and the same mechanisms are also implicated in the detrimental effects of nonsocial cues on memory (Barber et al., 2015; Bäuml & Aslan, 2006; Lehmer & Bäuml, 2018a). However, less is known about whether and how social cues can simultaneously facilitate group recall performance (see Harris et al., 2017). We investigated this question by focusing on the explanation proposed for such facilitation known as cross-cuing or the ability for group members to help each other access memories that would have otherwise been inaccessible (Meudell et al., 1992). Specifically, when one group member recalls a studied item, it can trigger the recall of a related item for another group member who might have otherwise not accessed and reported that item. Evidence for cross-cuing remains sparse, but some studies have reported findings that are consistent with cross-cuing as the basis for sustained levels of performance in collaborative recall over time (Congleton & Rajaram, 2011; Takahashi & Saito, 2004), or where group collaboration facilitated recall (Meade et al., 2009).

The yoked design of our study enabled a direct, quantitative test of the ways in which collaborative recall differs from part-list cued recall. This test revealed cross-cuing as a candidate explanation for the social facilitation we observed in our study. Specifically, collaborative participants provided responses related to their group members' responses more often than part-list cued participants. This pattern was statistically significant in both experiments for the restricted analysis and in Experiment 1 for the lenient analysis as well. These results align with previous studies that have found better memory performance among groups who recall studied items that were close to each other in the study list order (e.g., recall reported by groups of experts in Meade et al., 2009). In our study, collaborative participants all studied the items in a different order than their group members but frequently followed up on their group members' recalled items with an item from the same taxonomic category. This finding indicates that the exchange during collaboration allowed a more reciprocal process across group members compared with participants who worked alone with a nonsocial source which can in some cases improve group recall performance (e.g., Experiment 1).

Downstream Effects of Social Remembering on Individual Recall

In Experiment 1, collaborative participants benefitted from reexposure over and above part-list cued participants such that in their final individual recall participants from the collaborative recall condition recalled more of the items that served as cues during Recall 1 than did participants from the part-list cued condition. This finding of reexposure benefits from collaboration in our direct comparison adds to previous literature reporting postcollaborative boosts due to reexposure benefits during collaboration (Blumen & Rajaram, 2008). Greater reexposure benefits from social cues (compared with nonsocial cues) can occur for several reasons. There is evidence that information when provided by a social source is remembered better than when coming from a nonsocial source (e.g., a computer; Reysen & Adair, 2008). When we ensured cue processing in the part-list cuing condition by asking participants to read aloud the cues, there was an increase in match of visual and auditory properties of the cues across the collaborative and part-list cued conditions during Recall 1 (Experiment 2). Under these conditions, we observed comparable performance for the cue words in Recall 2.

In brief, the levels of memory performance in group-level recall and downstream individual recall can become comparable between the two recall conditions depending on the richness of cue processing, or as discussed earlier, may require more statistical power to detect potential differences under these cue processing conditions. At the same time, as we discuss next, key distinctions persist between social and nonsocial cuing conditions even under these conditions and reveal the selective impact of social cues on memory.

Social Remembering and Collective Memory

Finally, novel to research in this area, we compared the emergence of collective memory between collaborative and part-list cued groups, allowing an examination of collective memory emergence in yoked social and nonsocial recall settings. Across both experiments, collaborative groups exhibited greater collective memory compared with both their part-list cued counterparts and the nominal groups. It is also noteworthy that collective memory scores did not differ between part-list cued and nominal conditions even though part-list cued participants viewed the same cues as the participants in the collaborative condition. These findings converge on prior research demonstrating the importance of collaborative processes for giving rise to collective memory (Choi et al., 2014; Congleton & Rajaram, 2014). That is, these results underscore how conversational exchange of information, with the multiple consequences of collaborating with others—for example, disruption during recall, cross-cuing, reexposure, and error pruning—engender a reconstructive memory process. This process of joint reconstruction, in turn, homogenizes group members' memories (Bartlett, 1932; Rajaram, 2017; Wertsch & Roediger, 2008). The importance of conversational exchange and the processes of joint reconstruction in shaping collective memory are underscored further by the findings that even when the level of attention to the cues was increased in the part-list cuing condition (by asking participants to read aloud the cues, thus also matching the visual and auditory properties of the cues more closely across collaborative and part-list cuing conditions; Experiment 2), collective memory emerged only following collaborative recall.

Broader Implications

Our findings about the distinct ways in which people engage with social sources of information compared with nonsocial sources during recall (i.e., cross-cuing) and the way social cuing during recall homogenizes memories across people to a greater extent (i.e., collective memory), have important implications in many domains for the influence of others in shaping our memory and cognition. Starting with the formative stages in life, the role social interaction and information transmission through social agents in shaping cognition has played a central role in Vygotsky's (1978) influential theory of child development. Similarly, the important role of parent–child narratives in the development of autobiographical memories in children (Nelson & Fivush, 2004) and role of early narrative practices for developing self-knowledge (Wang, 2006) have been well-documented. There is also accumulating evidence that we draw upon other community members' knowledge to advance our own understanding (Rabb et al., 2021; Sloman & Rabb, 2016). Our findings resonate with these lines of work and suggest that person-to-person interactions may exert greater influence than if the same information were communicated via books and other nonsocial sources. Access to memories has been also considered an important factor in belief formation and development of attitudes (Wyer & Albarracin, 2005). To the extent that social sources influence retrieval dynamics differently than nonsocial sources, our findings suggest a distinct role of social interactions in downstream cognitive changes.

Together, these lines of research lead to a consideration of implications for education. Group learning activities in the classroom have been the focus of a thriving area of research in educational and social psychology, and collaborative learning is seen as a success story for improving student self-esteem, persistence, attitudes toward learning, and higher achievement (Johnson & Johnson, 2009). At the same time, evidence also suggests that group learning compared with individual learning may not always bring about better outcomes and can even lower performance (e.g., Crook & Beier, 2010; Gadgil & Nokes-Malach, 2012; Tudge, 1989). Myriad factors including group composition, size, task complexity, learning styles, to name a few, may shape the direction of these outcomes, as noted in Pociask and Rajaram (2014). These mixed patterns are not surprising given the complex but systematic consequences of collaboration on memory delineated in the experimental memory literature and the findings of the present study. In this context, our findings motivate considerations of when and to what extent learning may differ through social engagement than through engaging with the same information using nonsocial sources (such as asynchronous remote learning settings), advancing the conversation about the distinctions that focus on group versus individual learning.

Our findings are also particularly relevant for the recent surge of interest in the role of social transmission of memory and memory errors (e.g., Maswood et al., 2022; see Maswood & Rajaram, 2019, for a review) and suggest that social sources may be more influential than nonsocial sources for how information spreads in communities. In fact, the spread of information has taken on a particularly forceful form in today's digital age, and our findings speak to how communication with others on social media versus information acquisition from written digital articles and sources may shape our memories (e.g., Marsh & Rajaram, 2019; Storm & Soares, 2023). In this context, it would be interesting to explore in future research whether computer-mediated virtual environments (e.g., Greeley et al., 2022; Guazzini et al., 2020) may have different consequences on reexposure benefits, retrieval dynamics and memory consequences in general that we report in the present study.

The collective memory findings in our study suggest that social sources transmitting the same information as nonsocial sources can exert greater influences on schema-consistent memory errors through formation of greater shared memories (Betts & Hinsz, 2013). Social sharing of information has broader implications still, where our findings that information from social sources shapes collective memory more than information from nonsocial sources have intriguing implications for the power of social dialogs and voices (compared with written treatises) in shaping how a people build their collective narrative (Wertsch & Roediger, 2008). In brief, our findings, drawn from basic laboratory experimentation, open conversations about the implications of social remembering on wide ranging topics in psychological science and for real-life experiences.

References

Abel, M., & Bäuml, K. H. T. (2017). Testing the context-change account of list-method directed forgetting: The role of retention interval. *Journal of Memory and Language*, *92*, 170–182. https://doi.org/10.1016/j.jml.2016.06.009

Anderson, M. C., Bjork, R. A., & Bjork, E. L. (1994). Remembering can cause forgetting: Retrieval dynamics in long-term memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *20*(5), 1063–1087. https://doi.org/10.1037/0278-7393.20.5.1063

Andersson, J. (2001). Net effect of memory collaboration: How is collaboration affected by factors such as friendship, gender and age? *Scandinavian Journal of Psychology*, *42*(4), 367–375. https://doi.org/10.1111/1467-9450.00248

Andersson, J., Hitch, G., & Meudell, P. (2006). Effects of the timing and identity of retrieval cues in individual recall: An attempt to mimic cross-cueing in collaborative recall. *Memory*, *14*(1), 94–103. https://doi.org/10.1080/09658210444000557

Appelbaum, M., Cooper, H., Kline, R. B., Mayo-Wilson, E., Nezu, A. M., & Rao, S. M. (2018). Journal article reporting standards for quantitative research in psychology: The APA Publications and Communications Board Task Force Report. *American Psychologist*, *73*(1), 3–25. https://doi.org/10.1037/amp0000191

Aslan, A., Bäuml, K. H. T., & Grundgeiger, T. (2007). The role of inhibitory processes in part-list cuing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*(2), 335–341. https://doi.org/10.1037/0278-7393.33.2.335

Barber, S. J., Harris, C. B., & Rajaram, S. (2015). Why two heads apart are better than two heads together: Multiple mechanisms underlie the collaborative inhibition effect in memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *41*(2), 559–566. https://doi.org/10.1037/xlm0000037

Barber, S. J., & Rajaram, S. (2011). Collaborative memory and part-set cueing impairments: The role of executive depletion in modulating retrieval disruption. *Memory*, *19*(4), 378–397. https://doi.org/10.1080/09658211.2011.575787

Bartlett, F. C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge University Press.

Basden, B. H., Basden, D. R., Bryner, S., & Thomas, R. L., III. (1997). A comparison of group and individual remembering: Does collaboration disrupt retrieval strategies? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *23*(5), 1176–1189. https://doi.org/10.1037/0278-7393.23.5.1176

Basden, B. H., Basden, D. R., Church, B. A., & Beaupre, P. (1991). Setting boundary conditions on the part-set cuing effect. *Bulletin of the Psychonomic Society*, *29*(2), 213–216. https://doi.org/10.3758/BF03335238

Basden, D. R., & Basden, B. H. (1995). Some tests of the strategy disruption interpretation of part-list cuing inhibition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *21*(6), 1656–1669. https://doi.org/10.1037/0278-7393.21.6.1656

Basden, D. R., Basden, B. H., & Galloway, B. C. (1977). Inhibition with part-list cuing: Some tests of the item strength hypothesis. *Journal of Experimental Psychology: Human Learning and Memory*, *3*(1), 100–108. https://doi.org/10.1037/0278-7393.3.1.100

Bäuml, K.-H. T., & Aslan, A. (2006). Part-list cuing can be transient and lasting: The role of encoding. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *32*(1), 33–43. https://doi.org/10.1037/0278-7393.32.1.33

Bäuml, K.-H. T., & Schlichting, A. (2014). Memory retrieval as a self-propagating process. *Cognition*, *132*(1), 16–21. https://doi.org/10.1016/j.cognition.2014.03.007

Betts, K. R., & Hinsz, V. B. (2013). Strong shared representations promote schema-consistent memory errors in groups. *Group Processes & Intergroup Relations*, *16*(6), 734–751. https://doi.org/10.1177/1368430213486206

Blumen, H. M., & Rajaram, S. (2008). Influence of re-exposure and retrieval disruption during group collaboration on later individual recall. *Memory*, *16*(3), 231–244. https://doi.org/10.1080/09658210701804495

Blumen, H. M., & Stern, Y. (2011). Short-term and long-term collaboration benefits on individual recall in younger and older adults. *Memory & Cognition*, *39*(1), 147–154. https://doi.org/10.3758/s13421-010-0023-6

Bovee, J. C., Fitz, C., Yehl, G., Parrott, S., & Kelley, M. R. (2009). Applied part-set cuing. In M. R. Kelley (Ed.), *Applied memory* (pp. 73–87). Nova Science Publishers.

Choi, H.-Y., Blumen, H. M., Congleton, A. R., & Rajaram, S. (2014). The role of group configuration in the social transmission of memory: Evidence from identical and reconfigured groups. *Journal of Cognitive Psychology*, *26*(1), 65–80. https://doi.org/10.1080/20445911.2013.862536

Choi, H.-Y., Kensinger, E. A., & Rajaram, S. (2017). Mnemonic transmission, social contagion, and emergence of collective memory: Influence of emotional valence, group structure, and information distribution. *Journal of Experimental Psychology: General*, *146*(9), 1247–1265. https://doi.org/10.1037/xge0000327

Cohen, J. (1973). Eta-squared and partial eta-squared in fixed factor ANOVA designs. *Educational and Psychological Measurement*, *33*(1), 107–112. https://doi.org/10.1177/001316447303300111

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum.

Congleton, A. R., & Rajaram, S. (2011). The influence of learning methods on collaboration: Prior repeated retrieval enhances retrieval organization, abolishes collaborative inhibition, and promotes post-collaborative memory. *Journal of Experimental Psychology: General*, *140*(4), 535–551. https://doi.org/10.1037/a0024308

Congleton, A. R., & Rajaram, S. (2014). Collaboration changes both the content and the structure of memory: Building the architecture of shared representations. *Journal of Experimental Psychology: General*, *143*(4), 1570–1584. https://doi.org/10.1037/a0035974

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, *11*(6), 671–684. https://doi.org/10.1016/S0022-5371(72)80001-X

Crook, A. E., & Beier, M. E. (2010). When training with a partner is inferior to training alone: The importance of dyad type and interaction quality. *Journal of Experimental Psychology: Applied*, *16*(4), 335–348. https://doi.org/10.1037/a0021913

Crowder, R. G. (1976). *Principles of learning and memory*. Erlbaum.

Cuc, A., Ozuru, Y., Manier, D., & Hirst, W. (2006). On the formation of collective memories: The role of a dominant narrator. *Memory & Cognition*, *34*(4), 752–762. https://doi.org/10.3758/BF03193423

Ebbinghaus, H. (1885). *Uber das gedachinis: Untersuchungen zur experimentellen psychologie* [Memory: A contribution to experimental psychology]. Dunker & Humblot.

Finlay, F., Hitch, G. J., & Meudell, P. R. (2000). Mutual inhibition in collaborative recall: Evidence for a retrieval-based account. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*(6), 1556–1567. https://doi.org/10.1037/0278-7393.26.6.1556

Foos, C., & Clark, P. (2000). Old age, inhibition, and the part-set cuing effect. *Educational Gerontology*, *26*(2), 155–160. https://doi.org/10.1080/036012700267303

Gadgil, S., & Nokes-Malach, T. J. (2012). Overcoming collaborative inhibition through error correction: A classroom experiment. *Applied Cognitive Psychology*, *26*(3), 410–420. https://doi.org/10.1002/acp.1843

Garrido, M. V., Garcia-Marques, L., & Hamilton, D. L. (2012). Enhancing the comparability between part-list cueing and collaborative recall: A gradual part-list cueing paradigm. *Experimental Psychology*, *59*(4), 199–205. https://doi.org/10.1027/1618-3169/a000144

Greeley, G. D., Chan, V., Choi, H. Y., & Rajaram, S. (2024). Collaborative recall and the construction of collective memory organization: The impact of group structure. *Topics in Cognitive Science*, *16*(2), 282–301. https://doi.org/10.1111/tops.12639

Greeley, G. D., Peña, T., & Rajaram, S. (2022). Social remembering in the digital age: Implications for virtual study, work, and social engagement. *Memory, Mind & Media*, *1*, Article e13. https://doi.org/10.1017/mem.2022.3

Guazzini, A., Guidi, E., Cecchini, C., & Yoneki, E. (2020). Collaborative facilitation and collaborative inhibition in virtual environments. *Future Internet*, *12*(7), Article 118. https://doi.org/10.3390/fi12070118

Harris, C. B., Barnier, A. J., Sutton, J., Keil, P. G., & Dixon, R. A. (2017). “Going episodic”: Collaborative inhibition and facilitation when long-married couples remember together. *Memory*, *25*(8), 1148–1159. https://doi.org/10.1080/09658211.2016.1274405

Harris, C. B., Keil, P. G., Sutton, J., Barnier, A. J., & McIlwain, D. J. (2011). We remember, we forget: Collaborative remembering in older couples. *Discourse Processes*, *48*(4), 267–303. https://doi.org/10.1080/0163853X.2010.541854

Henkel, L. A., & Rajaram, S. (2011). Collaborative remembering in older adults: Age-invariant outcomes in the context of episodic recall deficits. *Psychology and Aging*, *26*(3), 532–545. https://doi.org/10.1037/a0023106

John, T., & Aslan, A. (2018). Part-list cuing effects in children: A developmental dissociation between the detrimental and beneficial effect. *Journal of Experimental Child Psychology*, *166*, 705–712. https://doi.org/10.1016/j.jecp.2017.08.013

Johnson, D. W., & Johnson, R. T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher*, *38*(5), 365–379. https://doi.org/10.3102/0013189X09339057

Kassambara, A. (2021). *rstatix: Pipe-friendly framework for basic statistical tests* (R package, Version 0.7.0) [Computer software]. https://CRAN.R-project.org/package=rstatix

Kelley, M. R., & Parihar, S. A. (2018). Part-set cueing impairment & facilitation in semantic memory. *Memory*, *26*(7), 1008–1018. https://doi.org/10.1080/09658211.2018.1428993

Kelley, M. R., Pentz, C., & Reysen, M. B. (2014). The joint influence of collaboration and part-set cueing. *Quarterly Journal of Experimental Psychology*, *67*(10), 1977–1985. https://doi.org/10.1080/17470218.2014.881405

Kimball, D. R., & Bjork, R. A. (2002). Influences of intentional and unintentional forgetting on false memories. *Journal of Experimental Psychology: General*, *131*(1), 116–130. https://doi.org/10.1037/0096-3445.131.1.116

Latané, B., Williams, K., & Harkins, S. (1979). Many hands make light the work: The causes and consequences of social loafing. *Journal of Personality and Social Psychology*, *37*(6), 822–832. https://doi.org/10.1037/0022-3514.37.6.822

Lehmer, E. M., & Bäuml, K. T. (2018a). Part-list cuing can impair, improve, or not influence recall performance: The critical roles of encoding and access to study context at test. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *44*(8), 1186–1200. https://doi.org/10.1037/xlm0000517

Lehmer, E. M., & Bäuml, K. T. (2018b). The many faces of part-list cuing-evidence for the interplay between detrimental and beneficial mechanisms. *Frontiers in Psychology*, *9*, Article 701. https://doi.org/10.3389/fpsyg.2018.00701

Leman, P. J., & Oldham, Z. (2005). Do children need to learn to collaborate? *Cognitive Development*, *20*(1), 33–48. https://doi.org/10.1016/j.cogdev.2004.07.002

Marion, S. B., & Thorley, C. (2016). A meta-analytic review of collaborative inhibition and postcollaborative memory: Testing the predictions of the retrieval strategy disruption hypothesis. *Psychological Bulletin*, *142*(11), 1141–1164. https://doi.org/10.1037/bul0000071

Marsh, E. J., Dolan, P. O., Balota, D. A., & Roediger, H. L., III. (2004). Part-set cuing effects in younger and older adults. *Psychology and Aging*, *19*(1), 134–144. https://doi.org/10.1037/0882-7974.19.1.134

Marsh, E. J., & Rajaram, S. (2019). The digital expansion of the mind: Implications of internet usage for memory and cognition. *Journal of Applied Research in Memory and Cognition*, *8*(1), 1–14. https://doi.org/10.1016/j.jarmac.2018.11.001

Maswood, R., Luhmann, C. C., & Rajaram, S. (2022). Persistence of false memories and emergence of collective false memory: Collaborative recall of DRM word lists. *Memory*, *30*(4), 465–479. https://doi.org/10.1080/09658211.2021.1928222

Maswood, R., & Rajaram, S. (2019). Social transmission of false memory in small groups and large networks. *Topics in Cognitive Science*, *11*(4), 687–709. https://doi.org/10.1111/tops.12348

Meade, M. L., Nokes, T. J., & Morrow, D. G. (2009). Expertise promotes facilitation on a collaborative memory task. *Memory*, *17*(1), 39–48. https://doi.org/10.1080/09658210802524240

Meudell, P. R., Hitch, G. J., & Boyle, M. M. (1995). Collaboration in recall: Do pairs of people cross-cue each other to produce new memories? *Quarterly Journal of Experimental Psychology A*, *48*(1), 141–152. https://doi.org/10.1080/14640749508401381

Meudell, P. R., Hitch, G. J., & Kirby, P. (1992). Are two heads better than one? Experimental investigations of the social facilitation of memory. *Applied Cognitive Psychology*, *6*(6), 525–543. https://doi.org/10.1002/acp.2350060606

Nelson, K., & Fivush, R. (2004). The emergence of autobiographical memory: A social cultural developmental theory. *Psychological Review*, *111*(2), 486–511. https://doi.org/10.1037/0033-295X.111.2.486

Nickerson, R. S. (1984). Retrieval inhibition from part-set cuing: A persisting enigma in memory research. *Memory & Cognition*, *12*(6), 531–552. https://doi.org/10.3758/BF03213342

Nie, A., Li, M., Wang, Q., & Zhang, C. (2024). The isolation between part-set cues and social collaboration in episodic memory is dependent: Insight from ongoing and post-collaboration. *Scandinavian Journal of Psychology*, *65*(6), 981–999. https://doi.org/10.1111/sjop.13042

Peirce, J. W. (2007). PsychoPy—Psychophysics software in python. *Journal of Neuroscience Methods*, *162*(1–2), 8–13. https://doi.org/10.1016/j.jneumeth.2006.11.017

Peirce, J. W. (2009). Generating stimuli for neuroscience using PsychoPy. *Frontiers in Neuroinformatics*, *2*, Article 10. https://doi.org/10.3389/neuro.11.010.2008

Peña, T., Pepe, N. W., & Rajaram, S. (2025, February 28). *How social is social memory? Isolating the influences of social and nonsocial cues on recall*. https://osf.io/hfxtd

Pepe, N. W. (2021). *Bridging the disruptive memory paradigms of part-list cuing and collaborative recall: The impact of cue modality and cue presentation order* (Order No.2592908688) [Doctoral dissertation, State University of New York at Stony Brook]. ProQuest Dissertations and Theses Global.

Pepe, N. W., Moyer, A., Peña, T., & Rajaram, S. (2023). Deceitful hints: A meta-analytic review of the part-list cuing impairment in recall. *Psychonomic Bulletin & Review*, *30*(4), 1243–1272. https://doi.org/10.3758/s13423-023-02263-9

Pociask, S., & Rajaram, S. (2014). The effects of collaborative practice on statistical problem solving: Benefits and boundaries. *Journal of Applied Research in Memory and Cognition*, *3*(4), 252–260. https://doi.org/10.1016/j.jarmac.2014.06.005

R Team. (2020). *RStudio: Integrated development for R*. RStudio. https://www.rstudio.com

Rabb, N., Han, J. J., & Sloman, S. A. (2021). How others drive our sense of understanding of policies. *Behavioural Public Policy*, *5*(4), 454–479. https://doi.org/10.1017/bpp.2020.40

Rajaram, S. (2017). Collaborative inhibition in group recall: Cognitive principles and implications. In M. Meade, A. Barnier, P. Van Bergen, C. Harris, & J. Sutton (Eds.), *Collaborative remembering: How remembering with others influences memory* (pp. 55–75). Oxford University Press.

Rajaram, S. (2022). Collective memory and the individual mind. *Trends in Cognitive Sciences*, *26*(12), 1056–1058. https://doi.org/10.1016/j.tics.2022.09.014

Rajaram, S., & Maswood, R. (2018). Collaborative memory: A selective review of data and theory. In J. H. Byrne (Ed.), *Learning and memory: A comprehensive reference* (pp. 53–70). Academic Press. https://doi.org/10.1016/B978-0-12-809324-5.21050-X

Rajaram, S., Peña, T., & Greeley, G. D. (2022). How collective memories emerge. In H. L. Roediger, III. & J. V. Wertsch (Eds.), *National memories: Constructing identity in populist times* (pp. 409–433). Oxford University Press. https://doi.org/10.1093/oso/9780197568675.003.0020

Rajaram, S., & Pereira-Pasarin, L. P. (2010). Collaborative memory: Cognitive research and theory. *Perspectives on Psychological Science*, *5*(6), 649–663. https://doi.org/10.1177/1745691610388763

Reysen, M. B., & Adair, S. A. (2008). Social processing improves recall performance. *Psychonomic Bulletin & Review*, *15*(1), 197–201. https://doi.org/10.3758/PBR.15.1.197

Rhodes, M. G., & Castel, A. D. (2008). Metacognition and part-set cuing: Can interference be predicted at retrieval? *Memory & Cognition*, *36*(8), 1429–1438. https://doi.org/10.3758/MC.36.8.1429

Ross, M., Spencer, S. J., Blatz, C. W., & Restorick, E. (2008). Collaboration reduces the frequency of false memories in older and younger adults. *Psychology and Aging*, *23*(1), 85–92. https://doi.org/10.1037/0882-7974.23.1.85

Ross, M., Spencer, S. J., Linardatos, L., Lam, K. C. H., & Perunovic, M. (2004). Going shopping and identifying landmarks: Does collaboration improve older people's memory? *Applied Cognitive Psychology*, *18*(6), 683–696. https://doi.org/10.1002/acp.1023

Rundus, D. (1973). Negative effects of using list items as recall cues. *Journal of Verbal Learning and Verbal Behavior*, *12*(1), 43–50. https://doi.org/10.1016/S0022-5371(73)80059-3

Slamecka, N. J. (1968). An examination of trace storage in free recall. *Journal of Experimental Psychology*, *76*(4), 504–513. https://doi.org/10.1037/h0025695

Slamecka, N. J. (1969). Testing for associative storage in multitrial free recall. *Journal of Experimental Psychology*, *81*(3), 557–560. https://doi.org/10.1037/h0027909

Sloman, S. A., & Rabb, N. (2016). Your understanding is my understanding: Evidence for a community of knowledge. *Psychological Science*, *27*(11), 1451–1460. https://doi.org/10.1177/0956797616662271

Stone, C. B., Barnier, A. J., Sutton, J., & Hirst, W. (2010). Building consensus about the past: Schema consistency and convergence in socially shared retrieval-induced forgetting. *Memory*, *18*(2), 170–184. https://doi.org/10.1080/09658210903159003

Stone, C. B., Coman, A., Brown, A. D., Koppel, J., & Hirst, W. (2012). Toward a science of silence: The consequences of leaving a memory unsaid. *Perspectives on Psychological Science*, *7*(1), 39–53. https://doi.org/10.1177/1745691611427303

Storm, B. C., & Soares, J. S. (2023). Memory in the digital age. In M. J. Kahana & A. D. Wagner (Eds.), *Handbook of human memory: Foundations and applications, volume II: Applications* (pp. 2351–2375). Oxford University Press.

Takahashi, M., & Saito, S. (2004). Does test delay eliminate collaborative inhibition? *Memory*, *12*(6), 722–731. https://doi.org/10.1080/09658210344000521

Thorley, C., & Dewhurst, S. A. (2007). Collaborative false recall in the DRM procedure: Effects of group size and group pressure. *European Journal of Cognitive Psychology*, *19*(6), 867–881. https://doi.org/10.1080/09541440600872068

Tudge, J. (1989). When collaboration leads to regression: Some negative consequences of socio-cognitive conflict. *European Journal of Social Psychology*, *19*(2), 123–138. https://doi.org/10.1002/ejsp.2420190204

Van Overschelde, J. P., Rawson, K. A., & Dunlosky, J. (2004). Category norms: An updated and expanded version of the norms. *Journal of Memory and Language*, *50*(3), 289–335. https://doi.org/10.1016/j.jml.2003.10.003

Vygotsky, L. S. (1978). *Mind in society*. Harvard University Press.

Wallner, L., & Bäuml, K. T. (2020). Part-list cuing with prose material: When cuing is detrimental and when it is not. *Cognition*, *205*, Article 104427. https://doi.org/10.1016/j.cognition.2020.104427

Wallner, L., & Bäuml, K. T. (2021). Self-paced part-list cuing. *Psychonomic Bulletin & Review*, *28*(6), 2012–2018. https://doi.org/10.3758/s13423-021-01910-3

Wang, Q. (2006). Culture and the development of self-knowledge. *Current Directions in Psychological Science*, *15*(4), 182–187. https://doi.org/10.1111/j.1467-8721.2006.00432.x

Weldon, M. S., & Bellinger, K. D. (1997). Collective memory: Collaborative and individual processes in remembering. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *23*(5), 1160–1175. https://doi.org/10.1037/0278-7393.23.5.1160

Weldon, M. S., Blair, C., & Huebsch, P. D. (2000). Group remembering: Does social loafing underlie collaborative inhibition? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*(6), 1568–1577. https://doi.org/10.1037/0278-7393.26.6.1568

Wertsch, J. V., & Roediger, H. L., III. (2008). Collective memory: Conceptual foundations and theoretical approaches. *Memory*, *16*(3), 318–326. https://doi.org/10.1080/09658210701801434

Wickham, H., Chang, W., & Wickham, M. H. (2016). *Package 'ggplot2'*. Create elegant data visualisations using the grammar of graphics. Version 2. https://github.com/hadley/ggplot2

Wright, D. B., & Klumpp, A. (2004). Collaborative inhibition is due to the product, not the process, of recalling in groups. *Psychonomic Bulletin & Review*, *11*(6), 1080–1083. https://doi.org/10.3758/BF03196740

Wyer, R. S., Jr., & Albarracin, D. (2005). Belief formation, organization, and change: Cognitive and motivational influences. In D. Albarracin, B. T. Johnson, & M. P. Zanna (Eds.), *The handbook of attitudes* (pp. 273–322). Lawrence Erlbaum Associates.

Yaron-Antar, A., & Nachson, I. (2006). Collaborative remembering of emotional events: The case of Rabin's assassination. *Memory*, *14*(1), 46–56. https://doi.org/10.1080/09658210444000502

Received February 17, 2023
Revision received September 29, 2025
Accepted October 2, 2025 ■