Collaborative memory: A selective review

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1 The tug of shared reminiscing

Psychological research posits that people engage in shared reminiscing to regulate emotion and to enhance social bonds (Berger and Milkman, 2012; Luminet et al., 2000; Rimé, 2009). People also intuitively value shared remembering because they believe that it improves memory. Beliefs about the social as well as mnemonic values of shared remembering also account for the popularity of study groups in schools and colleges. In fact, extensive research in educational and social psychology has been directed towards understanding the impact of collaborative learning techniques on social interactions, personality, and student engagement (e.g., Garfield, 1993; Johnson and Johnson, 2009; Keeler and Steinhorst, 1995; Slavin, 1991).

Beliefs about the value of shared remembering are also important to consider in the face of memory decline in normal aging as well as in pathological aging where social support for memory retrieval could confer significant benefits (for reviews, see Blumen et al., 2013a, 2013b). Adults across the lifespan view collaboration as more beneficial for remembering than working alone, especially when the collaborator is someone they know well (Dixon and de Frias, 2007; Dixon et al., 1998; Henkel and Rajaram, 2011).

Zooming out to the impact of joint remembering in small groups and larger communities, growing psychological evidence shows that remembering with others aligns memory of people within groups and communities, giving rise to collective memory (Congleton and Rajaram, 2014; Greeley and Rajaram, 2023; Luhmann and Rajaram, 2015; Hirst and Manier, 2008; Momennejad et al., 2019; Wertsch et al., 2022). The idea of collective memory has long preoccupied social scientists with interest in how unfolding stories that engage public opinion, debates on historic and current events that have social, national, and cultural significance, and memories that underlie group identities, may differentially shape the collective memory of different communities. Psychological research on collective memory has focused more on identifying the role of cognitive mechanisms in producing memory convergence than on the broader questions of identity and socio-cultural influences, an approach we too take in reviewing psychological research.

With the wide range of consequences of social remembering in mind, we review in this chapter a selection of empirical findings from cognitive research that highlight how remembering with others changes memory.

2 A bit of history

Experimental study of collaborative memory represents an important new era for cognitive research in the 21st century. For about 100 years before that, the dominant approach cognitive psychological scientists employed to study the nature of human memory was what we will call "the individual memory paradigm." In this approach, individual participants work in isolation to learn and remember study materials. This widespread practice of isolating participants in order to pinpoint memory function and its underlying mechanisms may be traced back to the recommendations made by Ebbinghaus (1885). This was a carefully devised recommendation, not because Ebbinghaus considered the social context (where much learning and remembering occurs) to be irrelevant, but precisely because he saw the ebb and flow of external influences in an experimental situation to complicate the precise interpretations and conclusions the experimenter could draw from the findings. Ebbinghaus seemed so concerned about the extraneous influences in memory experiments that he even promoted the use of nonsense syllables as study materials since words, events, and narratives can be imbued with idiosyncratic variations in meaning, depending upon the personal and social history of the individual participants.

As far removed as Ebbinghaus might have considered the collaborative memory movement from the pristine experimental study of individual memory he championed, in our work on collaborative memory we have deliberately and systematically leveraged the theories and findings that emerged from this long tradition. In fact, the Ebbinghaus tradition has been a precursor to the study of collaborative remembering in our laboratory as well as in the approach many other scientists have taken, and it has enabled scientists to investigate social memory with the necessary controls Ebbinghaus would have espoused.

Interestingly, this inspiration to systematically investigate the social side of memory with experimental control is not recent. It dates back to Frederic Bartlett who explicitly promoted a study of social influences in understanding the nature of human memory (Bartlett, 1932). In the Preface of his book titled, *Remembering: A Study in Experimental and Social Psychology*, Bartlett (1932) noted that he took inspiration from Ebbinghaus's approach of using strict experimental methods, initially even using nonsense syllables as his material to be recalled later. As Bartlett continued with his quest, he deliberately moved away from nonsense syllables but as he noted, "...I determined to try to retain the advantages of an experimental method of approach, with its relatively controlled situations, and also to keep my study as realistic as possible" (Bartlett, 1932, p. v).

The confluence of these sensibilities—implementing the rigors of experimental methods to study memory while expanding the investigation to include collaboration among several participants to recall the past—gathered momentum in the mid-1990s. This conceptual and methodological progression has since guided cognitive psychological research on collaborative memory, enabling experimentalists to study memory as an emergent social phenomenon.

As we mentioned briefly, outside cognitive psychology, the idea that social context influences memory has had a considerable past in academic investigations. A study of socially situated memory has thrived across disciplines such as anthropology, history, philosophy, and sociology (Bodnar, 1992; Cole, 2001; Durkheim, 1915; Halbwachs, 1980; Vygotsky, 1962, 1978). In these disciplines, the emphasis is on examining these memory phenomena at large scales and concepts such as the group mind, the extended mind, joint remembering, groupthink, cultural memory, and collective memory are expounded upon in depth (Janis, 1972; McDougall, 1920; Wegner, 1987). Social influences on memory have been topics of investigation within other areas of psychology as well. For instance, in developmental psychology and social psychology concepts of memory scaffolding and transactive memory, respectively, have been developed (Fivush and Graci, 2024; Reese and Fivush, 2008; Wang, 2008; Wegner, 1987). Even within cognitive research on memory, several important areas of study, such as eyewitness memory, memory shaped through oral traditions, memory developed for narratives through telling and retelling, and autobiographical memory all inherently incorporate the notion that social interactions influence memory (Alea and Bluck, 2003; Assmann and Czaplicka, 1995; Bernsten and Rubin, 2012; Halbwachs and Coser, 1992; Olick and Robbins, 1998; Marsh and Tversky, 2004; Rubin, 1997).

Against this backdrop, research on collaborative memory makes an important departure. To understand the social side of memory, the collaborative memory approach directly focuses on creating dyadic, triadic, or larger group interactions in the laboratory as group members learn or remember. It seeks to systematically map the consequences of collaborative remembering on the memory of the group and each member, the consequences on individual memory of those who previously interacted in groups, and the collective memories that emerge across group members as a consequence of collaboration. In other words, collaborative memory research takes the most direct approach to date to study group influences on memory within an experimental setting. This chapter provides a selective review of this research to highlight major findings on the nature of collaborative memory. We note at the outset that all memory measures in this chapter will refer to accurate or true memory, that is, memory for information to which subjects were exposed earlier in the course of the experiment. Where we discuss memory errors or false memories, we will specifically note that change in the memory phenomenon of interest. Finally, unless noted otherwise, studies described in this chapter tested groups (pairs, triads, or larger) composed of strangers.

3 A paradigm to study collaborative memory

In Fig. 1, we have presented a schematic representation that captures the widely used paradigm to study collaborative memory. Introduced in the 1990s (Basden et al., 1997a; Basden et al., 1997b; Basden et al., 2000; Finlay et al., 2000; Weldon and Bellinger, 1997; Weldon et al., 2000), this paradigm has galvanized experimental research on this topic.

At its bare bones, the typical design and procedure involve three phases common to most memory experiments—an initial study (or encoding) session, a distractor period (retention interval), and a memory (retrieval) test. In the initial study session, participants typically study the materials individually; that is, no collaboration takes place (except in studies that have specifically tested the impact of collaboration at study; for example, Andersson and Rönnberg, 1995, 1997; Barber et al., 2010; Barber et al., 2012a; Barber et al., 2012b; Finlay et al., 2000; Garcia-Marques et al., 2012; Harris et al., 2013). The study materials typically consist of word lists, but a variety of stimuli have been used across studies such as pictures, narratives, movies, and emotionally laden materials. The distractor period can last from several minutes to a week, depending on questions about the time course of memory (for example, Andersson et al., 2007; Andersson and Rönnberg, 1996; Barber et al., 2010; Congleton and Rajaram, 2011; Takahashi and Saito, 2004; Rajaram and Pereira-Pasarin, 2007). The retrieval tasks commonly consist of free recall, but other memory tasks such as recognition memory and cued recall have been occasionally used (for example, Finlay et al., 2000; Experiment 2; Clark et al., 2000).

In this paradigm, the key manipulation consists of comparing a condition where two or more participants collaborate to recall the studied materials with another condition where such collaboration does not take place and participants perform the task alone. In a majority of studies, the collaboration condition has consisted of triads (groups consisting of three members) although dyads and tetrads have been used occasionally. In terms of performance, it is no surprise that a group remembers more than an individual. To understand the role of collaborative processes, a better comparison is one where performance of the collaborative group is compared with the performance of an equal number of individuals who performed the task alone. This is precisely the comparison Basden et al. (1997a) and Weldon and Bellinger (1997) employed in their respective studies, calling this baseline a nominal group or a group in name only. To assess the performance of this same-sized nominal group, all items recalled by the nominal group members are combined in a nonredundant fashion (i.e., including only once the items that are produced by more than one participant). Collaborative group performance is compared to this nominal group performance to assess the impact of collaboration on memory performance.

We focus on the case of free recall, a memory task that has been used widely in collaborative memory studies. In this task, participants recall in any order all the items from the study phase that they can remember. Contrary to intuition, collaborative group

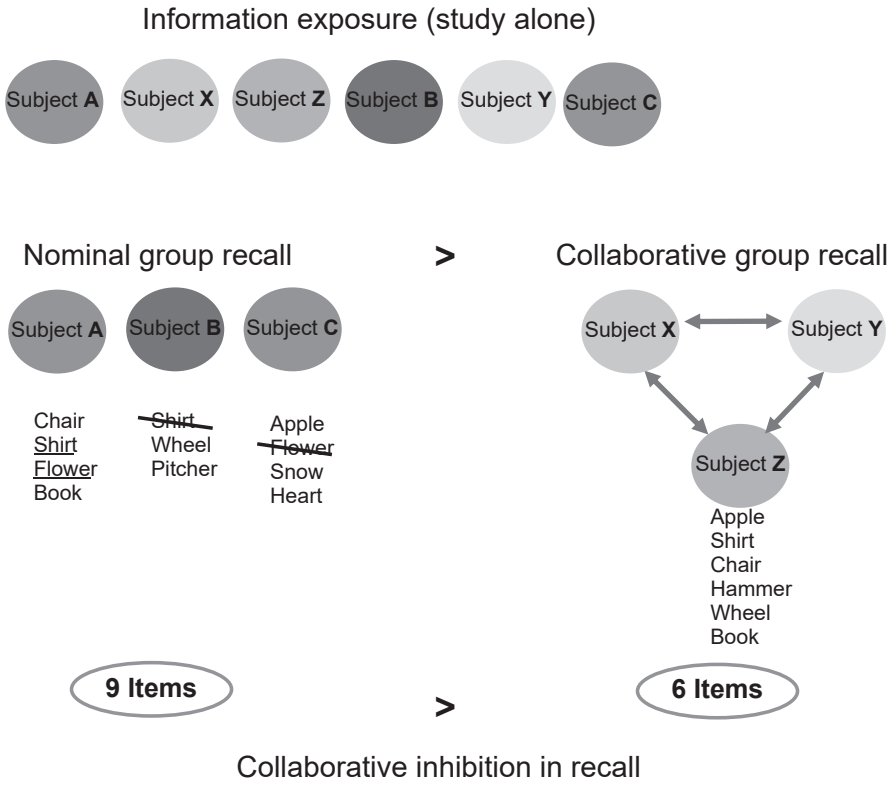


Fig. 1 A schematic illustration of a prototypical collaborative memory procedure. Adapted from Blumen HM, Rajaram S and Henkel L (2013a) The applied value of collaborative memory research in aging: Behavioral and neural considerations. *Journal of Applied Research in Memory and Cognition* 2(2): 107–117. https://doi.org/10.1016/j.jarmac.2013.03.003.

recall produces significantly fewer items than does nominal group recall, a phenomenon Weldon and Bellinger (1997) called *collaborative inhibition* in recall. Since this surprising outcome was initially reported (Basden et al., 1997a; Weldon and Bellinger, 1997), it has been replicated across several laboratories and summarized in a meta-analytic study (Marion and Thorley, 2016). Collaborative inhibition is not limited to word lists; it occurs for a wide variety of materials, such as stories, categorized lists, word pairs, associated word lists such as the DRM lists (Roediger and McDermott, 1995), pictures, emotional stimuli, and film clips (Andersson et al., 2006; Basden et al., 2002; Finlay et al., 2000; Takahashi and Saito, 2004; Weldon and Bellinger, 1997; Yaron-Antar and Nachson, 2006). Collaborative inhibition is also not limited to young adults; older adults show collaborative inhibition in recall that is often comparable to that observed in young adults (e.g., Henkel and Rajaram, 2011; Johansson et al., 2000; Meade and Roediger, 2009; Ross et al., 2008), as do children (Andersson, 2001; Leman and Oldham, 2005). Even friends and couples—who presumably have experience collaborating together to recall past events—exhibit collaborative inhibition, albeit the magnitude of the effect can be reduced (Andersson, 2001; Andersson and Rönnberg, 1995; Harris et al., 2017; Johansson et al., 2000; Johansson et al., 2005). In brief, collaborative inhibition in recall is a robust phenomenon.

Despite the robustness of this deficit in group recall, both scientists and the general public remain surprised by this result. As Weldon noted in 2001, "In presenting findings on collaborative inhibition, I am often met with extreme resistance by the audience. The result seems to fly in the face of most peoples' intuitions or assumptions about what should happen, which is that collaboration should be beneficial. As evidence, people often mention the experience of sitting around with friends reminiscing about a shared experience, and how when someone cannot remember a particular detail, everyone joins in the effort to reconstruct the event, offering hints and tip-of-the-tongue information until the desired fact is remembered. This kind of experience certainly gives the impression that collaboration helps retrieval, although in reality it is only demonstrating that a group can remember more than an individual, which many data already show (Weldon, 2001, p. 99). We get this same reaction more than 20 years later. We also agree with Weldon's reflection further on where she notes, "Nevertheless, it does raise questions about how generalizable the phenomenon is for different kinds of retrieval tasks." Later in this chapter, we consider some experiments where, under certain conditions, collaborative inhibition in memory disappears, or even reverses. Furthermore, it is also a matter of perspective whether lowered recall through collaboration necessarily implies negative consequences. Shared forgetting can have functional importance in helping people build an agreed upon account of their memories. We will briefly touch upon the implications of such a reduction in group recall for emergence of collective memory in a later section. For now, we simply conclude that collaborative inhibition in recall constitutes a well-replicated phenomenon.

How persistent is collaborative inhibition? As robust as the phenomenon of collaborative inhibition is in group settings, it is not an inevitable outcome. As we discuss in more detail later, collaborative inhibition reduces or even disappears in some settings because of the way encoding (e.g., Congleton and Rajaram, 2011; Pereira-Pasarin and Rajaram, 2011), delay (e.g., Congleton and Rajaram, 2011; Takahashi and Saito, 2004), or retrieval (e.g., Basden et al., 1997a, Experiment 4) are manipulated in experiments. For instance, in conditions where group members are experts in the studied materials, and if group members use certain collaboration skills, collaborative inhibition can even reverse (Meade et al., 2009). We cover these boundary conditions in more detail throughout the chapter.

4 A framework to study collaborative memory

We now know that collaboration affects memory. It is intuitive to assume that this relationship is influenced by social, cultural, and historic conditions within which collaboration takes place, contexts that have preoccupied sociologists, anthropologists, and historians in their efforts to understand the nature of social memory. Our interest centers on the cognitive underpinning of this relationship. What does collaboration change in the operation of one or more cognitive processes that we know to influence individual memory? This is the place of inquiry where Weldon and Bellinger (1997) began their experiments. What processes are activated uniquely during collaborative remembering that do not come into play during individual remembering? Do the antecedent conditions in the rememberer's cognitive architecture influence collaborative remembering? How does collaborative recall in turn influence the post-collaborative state of each group member's memory? To understand these facets that influence, and are influenced by, collaborative remembering we developed a framework to organize the cognitive flow of the antecedent conditions, the processes that may be activated during collaborative recall, and the post-collaborative consequences of these preceding stages on memory (Rajaram and Pereira-Pasarin, 2010). In Fig. 2, we present a slightly updated version of this framework. As with the previous version, this framework is meant to be descriptive, and it is not exhaustive. It is a work in progress, and it provides a working model for mapping out the concrete steps we can take to incorporate the "social" component in the transmission and reshaping of memory.

We first describe research on the processes that are activated during collaborative recall rather than starting with the antecedent conditions. This approach has a two-fold advantage—it places the focus on the collaboration process first, and it provides a better context for understanding the role of the antecedent conditions that we describe next. Finally, we turn to the post-collaborative consequences on memory.

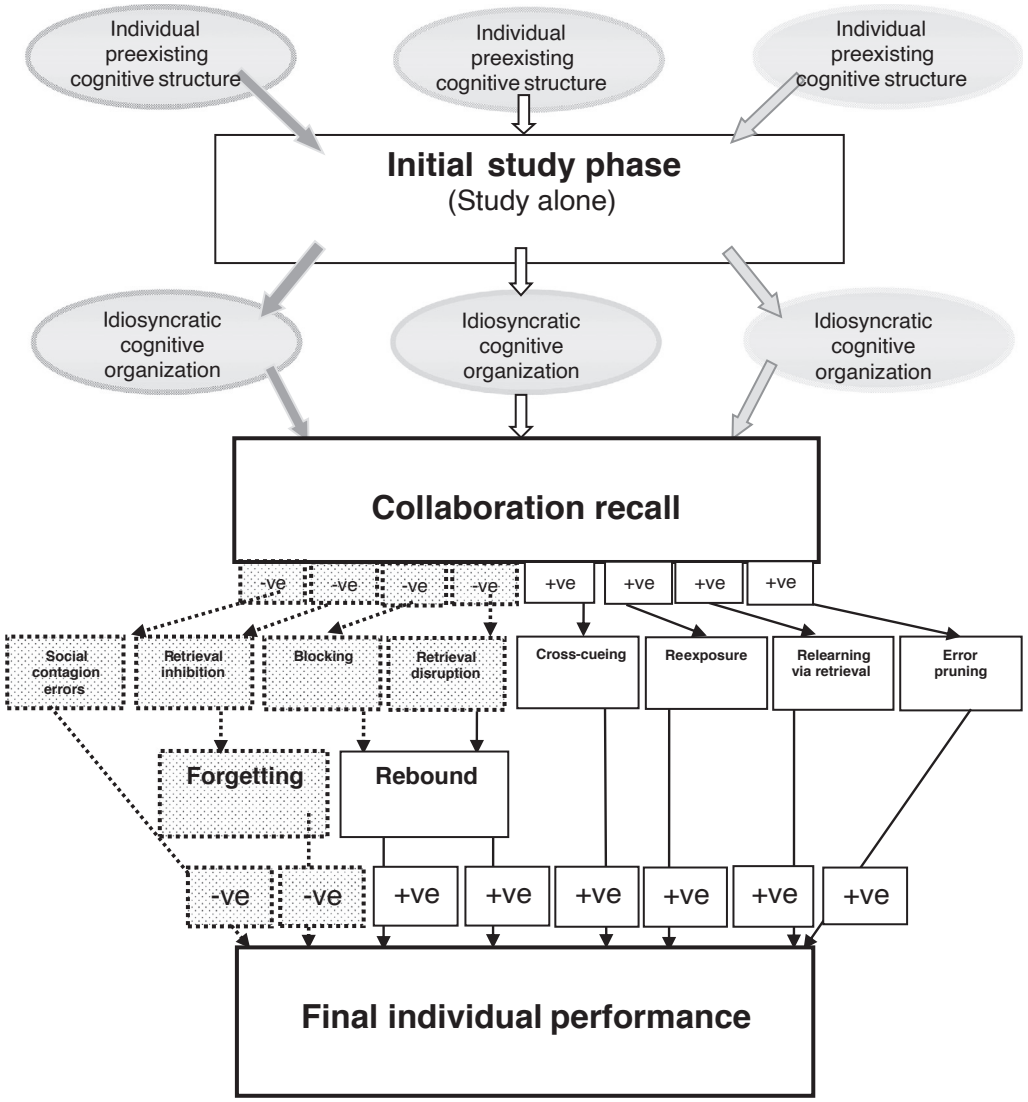


Fig. 2 A descriptive framework to study collaborative memory. Positive and negative notations in the figure represent improvement or impairment in recall. Revised from Rajaram S and Pereira-Pasarin LP (2010) Collaborative memory: Cognitive research and theory. *Perspectives on Psychological Science* 5(6): 649–663. https://doi.org/10.1177/1745691610388763.

5 Cognitive processes activated during collaborative recall

When two or more people recall past information together, they are likely to influence one another's memories (Fig. 2, Collaborative recall stage). In the case of collaborative inhibition, this influence lowers memory performance. Collaboration can also reduce memory accuracy in another way. Collaborators can become susceptible to social contagion of false information, that is, when people pass along inaccurate or false memories during collaboration. This false information gets incorporated in the reports of group members who are exposed to it, and thereby impairs memory performance.

But the news is not all bad. Collaborative recall can also improve the quantity and accuracy of recall through at least four processes that empirical studies have considered. One such process is error pruning where collaborating partners correct one another's memory errors during recall (Rajaram and Pereira-Pasarin, 2010). Another way collaboration improves recall is by re-exposure (Blumen and Rajaram, 2008). Listening to a collaborating partner recall an item, particularly one that might have otherwise not been recalled, provides a second exposure to a studied item much like a second study opportunity. Although re-exposure is experienced during collaboration, its benefit on memory becomes evident during post-collaborative recall where an increase in the recipient's memory product can be observed. A third process is one we call relearning via retrieval where the act of recalling an item serves as a second learning opportunity (Rajaram and Pereira-Pasarin, 2010). The reader will correctly surmise that collaboration, that is, the presence of another person during recall, is not necessary for this process to play out and that recalling individually also amounts to the same benefit where recalled items would be strengthened in memory. We include this process here

because it nevertheless occurs when one group member recalls a memory to contribute to the group product. Readers who are familiar with the landmark findings in a related area of memory research—effects of repeated study versus repeated testing on learning (e.g., Roediger and Karpicke, 2006a, 2006b; Zaromb and Roediger III, 2010)—will notice that the processes of re-exposure and relearning via retrieval are similar in effect to repeated study versus repeated testing, respectively, and are likely produce similar beneficial consequences on later memory.

A fourth process in this framework that assumed to operate during collaborative recall and with potential to improve memory performance is known as cross-cueing (Congleton and Rajaram, 2011; Meudell et al., 1995; Meudell et al., 1992; Takahashi and Saito, 2004). Cross-cueing refers to the idea that a memory recalled by one group member serves as a retrieval cue to trigger a different memory for another group member who might not have otherwise recalled it. Cross-cueing is particularly relevant in a collaborative recall situation as opposed to individual recall. This process is also intuitive and appealing and is tied to the idea that collaborative recall ought to increase recall. As we will review later, a test of cross-cueing has been rather difficult in experiments and the evidence for it has been elusive, although some evidence of this process during collaboration is emerging.

Further, recent proposals about the operation of a related facilitatory mechanism called context re-activation during collaborative recall may provide additional avenues to explore cross-cueing effects of collaborative recall (Abel and Bäuml, 2017; also see Lehmer and Bäuml, 2018a). Context reactivation refers to the facilitatory effects of collaborative group members when they do not have access to the study context (Abel and Bäuml, 2017; e.g., there is a long temporal delay between study and test [see also Congleton and Rajaram, 2011; Takahashi and Saito, 2004]). Under these conditions of impaired access to the study context, collaborative group members may do better with cross-cueing one another to recall more studied items, and, in turn, reduce or eliminate impairing effects of collaborative recall.

This collection of cognitive processes shows how a single change during retrieval, that is, adding one or two recalling partners, can trigger a cascade of impairments or enhancements in memory. Two points are worth noting in this context. One, not all of these processes need be activated simultaneously every time collaborative recall takes place; the conditions of learning and remembering can determine the particular processes that become activated, and the consequences on memory would depend on the combination of processes that become activated during a given session of collaboration. Two, the notion of memory impairment or enhancement refers to the prevalent interpretation in the individual memory research, which refers to a decrease or increase in accurate recall. When it comes to collaborative recall an often-desired goal for the collaborating partners is to come to an agreed upon account of the past. This goal can make accuracy secondary to quantity and consensus in recall. As such, "improvement" in collaborative recall can serve as an ambiguous measure of what improved—accuracy or quantity of recall, or consensus among those who recalled the information. Consistent with the prevalent practice in individual memory research, in this chapter we will use the term memory improvement or memory decrement to refer to accuracy of recall. However, we recognize the importance of shared agreement about the past as the key index of memory in some contexts. We now turn to elaborating on the specific cognitive processes activated by collaborative recall that we outlined above.

6 Collaborative inhibition in recall: The mechanism of retrieval disruption

When people working together produce less, it is reasonable to explain this outcome as social loafing (Latané et al., 1979). This behavioral phenomenon is defined as a diffusion of responsibility among group members, where each member ends up giving less of their effort in comparison to a situation where they are fully accountable for their individual output. Weldon et al. (2000) tested this possibility by manipulating several factors that were social in nature. The authors provided group members with monetary incentives to increase their recall performance. In other experiments, they used test instructions to reduce apprehensions about being evaluated on a task in a social setting, to increase personal accountability, or to increase group cohesion, and assessed whether group members would show increased recall as a function of these manipulations. Collaborative inhibition nonetheless persisted in group recall, making social loafing an unlikely explanation of collaborative inhibition.

Why, then, does collaborative inhibition occur? Basden et al. (1997a) proposed a retrieval disruption account where recall deficit is presumed to occur because listening to others' output during recall disrupts the ability to recall one's own remembered items. It has been known since Tulving (1962; also Sternberg and Tulving, 1977) that when individuals recall studied information, they organize their recall output in a subjectively preferred sequence. Past work has shown that when participants are given some items from the study list as retrieval cues, called part-list cues, their individual recall of the remaining set of studied items is worse than their recall of the same item set if they were not given any retrieval cues (i.e., in a free recall task). This is because the presence of the part-list cues disrupts the preferred way in which the participant would sequence their recall output, and thereby lowers recall (Bäuml, 2008; Rundus, 1973; Basden and Basden, 1995; Basden et al., 1977). The retrieval disruption account in collaborative recall parallels part-list cuing deficits observed in individual recall. We describe this parallel below.

During collaborative recall, each group member brings their own preferred retrieval organization as they approach the task. Whereas certain elements of this organization overlap across individuals (for example, taxonomic categories—such as fruits, vehicles, etc., cluster together), other elements differ because each person brings a unique cognitive history to the learning situation and thus organizes the study information, and consequently the retrieval output, in an idiosyncratic sequence. According to the retrieval disruption account, when group members listen to one another recall the studied information in a group setting their own recall organization is disrupted by the idiosyncratic sequence of others' recall output that differs from their own. This mutual disruption during collaboration lowers the amount each member recalls during collaboration compared to their potential, or the

amount that they would produce in individual recall. As a result of this process, collaborative group recall is lower than the nominal pooling of individual recall.

7 Forgetting due to collaborative recall: The mechanism of retrieval inhibition

The role of retrieval disruption brings to light an important point about the use of the term inhibition in describing the recall deficit of collaborating groups. When retrieval disruption occurs during collaboration, the process of disruption implies that items not recalled will *rebound* in memory when the disruptive forces of collaboration are removed. As a result, if group members later recall the study information, but do so individually by themselves, items not recalled during collaboration ought to appear in post-collaborative individual recall. Studies have frequently reported this outcome (e.g., Basden et al., 2000; Congleton and Rajaram, 2011; Henkel and Rajaram, 2011; Meudell et al., 1992; Reysen, 2005). The question then is whether the deficit in group recall is limited to the collaboration session or whether some information not recalled during collaboration is indeed functionally lost even afterwards. Some evidence suggests that such forgetting occurs, and that retrieval inhibition observed in individual memory performance (Aslan and Bäuml, 2009; Bäuml, 2008; Bäuml and Aslan, 2006) is also associated with collaborative recall settings.

To elaborate, retrieval disruption and retrieval inhibition differ in the following way. When a participant's recall is disrupted due to part-list cues or listening to other's output, it is assumed that items this participant failed to recall during collaboration will bounce back, and appear, if this participant gets another opportunity to recall the study information alone. In other words, retrieval disruption implies that unrecalled items are not forgotten, and once the disrupting conditions are removed these items will be recalled. Interestingly, as just noted, several items not reported during collaboration appear in post-collaborative recall where former group members work alone. But other items are forgotten. This outcome suggests that collaboration can also result in inhibition in memory for at least some studied items.

Initial evidence for such extended forgetting came from a study where the collaborative inhibition effect was found to be larger in groups consisting of four members compared to dyads (Basden et al., 2000). This outcome is completely consistent with the retrieval disruption account due to the expectation that larger groups would create greater disruption during collaboration than smaller groups. At the same time, members from larger groups also showed less reminiscence on a later individual recall than did members from dyads. Reminiscence refers to an outcome where items not recalled previously are recalled later and is a component of hypermnesia (the net gain in memory that is summed across what is additionally remembered versus what is forgotten across repeated recalls, despite only one study exposure; Payne, 1987). Reduced reminiscence in larger groups implies that collaborative recall in larger groups not only caused more disruption but also more inhibition in memory than in smaller groups, leading to extended forgetting (also see, Meudell et al., 1992).

Moreover, evidence from a collaborative study suggests that forgetting occurs in both young and older adults (Henkel and Rajaram, 2011). In a sequential procedure of three recalls, the initial and final recalls consisted of individual recall and the middle recall consisted of collaborative recall by triads. Although both young and older adults showed some item gains from Recall 1 to Recall 3, indicating the effects of re-exposure benefits, we also observed that in Recall 3 both young and older adults forgot some items they had recalled in Recall 1. These studies together suggest that some forgetting occurs as a result of collaborative recall although these studies were not designed to directly test a role of retrieval inhibition associated with such forgetting.

We directly tested the possibility that retrieval inhibition can result from collaborative recall (Barber et al., 2015). We presented three different study lists to three subjects who were to later become a triad and engage in collaborative recall. After collaborative recall, subjects either performed a free recall test alone (Experiment 1) or a recognition test alone (Experiment 2). In the control condition, subjects performed both recall attempts alone. Because subjects in this control (nominal group) condition together recalled non-overlapping memories, the possibility of re-exposure to studied information was eliminated and could not account for post-collaborative rebound of studied information that subjects did not recall during collaboration. In the collaborative recall condition, any rebound, on a later individual test, of studied information that was not recalled during collaboration would provide evidence for retrieval disruption whereas forgetting of these items on a later individual test would provide evidence of forgetting. This test would be most diagnostic if the second test were a recognition task where all the studied items were presented to the subjects for recognition, and thus failure to correctly recognize studied information, compared to the control condition, would indicate retrieval inhibition (Bäuml, 2008). The detrimental effects of collaboration on memory persisted on the second individual recognition test, showing that, in addition to retrieval disruption, retrieval inhibition also contributes to collaborative inhibition in memory.

While a role of retrieval inhibition in collaborative memory is emerging, much work is needed to understand a fuller scope of its influence, and two additional points are worth bearing in mind. One, just as retrieval disruption influences both individual and group recall, the operation of the retrieval inhibition mechanism also has parallels in theories of individual recall (Anderson and Bjork, 1994; Bäuml and Aslan, 2004; Nickerson, 1984; Tulving and Psotka, 1971), and as just described, in collaborative recall. Two, in theories of individual recall, retrieval disruption and retrieval inhibition are proposed as two of three mechanisms in a cluster that lead to forgetting, with the third mechanism being retrieval blocking. We briefly consider this process next.

8 Retrieval blocking and collaborative recall: An untested relationship

A third mechanism of forgetting proposed in individual recall concerns blocking (see Bäuml, 2008), and this process differs from retrieval disruption and retrieval inhibition. When an item is blocked in memory, unlike for the process of retrieval disruption, the blocked item is not produced on a later recall task. However, memory for that item can be detected on a recognition task where the item is presented for accepting or rejecting it as previously seen. This is unlike the process of retrieval inhibition where people fail to even recognize the item later. In collaborative recall studies, the post-collaborative memory is often measured using a recall task, as can be seen in the studies we summarized above, and therefore an absence of rebound for studied items can result from either inhibition or blocking. In the Barber et al. (2015) study where participants were impaired at recognition in the post-collaborative phase, we saw evidence for inhibition. However, this evidence does not preclude the possibility that in other situations items that were not recalled would be nonetheless recognized in a post-collaborative test. Whether blocking operates in collaborative recall remains an empirical question.[1] Nevertheless, a broader point to note is that there is not likely just one mechanism to explain collaborative inhibition. Emerging evidence for both retrieval disruption and retrieval inhibition points to multiple mechanisms being associated with collaborative inhibition (Barber et al., 2015; Barber et al., 2017). In this context, a multi-mechanism account proposed for individual memory impairment from part-list cueing has also been hypothesized for collaborative inhibition (Lehmer and Bäuml, 2018a).

9 Error production versus error pruning during collaborative recall

Social psychologist Asch (1951) reported the classic finding of the power of social pressure on performance inaccuracies. Under social pressure from a confederate (i.e., an actor in the experiment), participants made flagrant errors in reporting the length of a line even though they could clearly see and compare it to a target. The potential of social forces to introduce false memories has been a topic of great interest to memory scientists as well. A well-known example of this interest in the social genesis of false memories is research on eyewitness memory and eyewitness identification procedures. Although these procedures frequently employ individual responses from participants rather than group responses, memory errors are often assessed in the context of exposure to misinformation from social sources. Even the goals of memory narration can change memories, where retelling a story to entertain others can lead to exaggerations compared retelling for accuracy (Marsh and Tversky, 2004). A few studies investigating false memory phenomena have included social exchange in the procedures by including dyads who discussed a video shown before (e.g., Gabbert et al., 2003; Gabbert et al., 2004), and other studies have reported transmission of memory distortion in procedures where a confederate systematically introduces memory errors (e.g., Roediger et al., 2001).

9.1 Error production

Despite a long-standing interest in social influences on memory errors, researchers have not typically involved actual social presence of others in experimental procedures designed to study memory errors. In contrast, inclusion of others during encoding or retrieval has been prevalent in collaborative memory designs except a few experiments reporting techniques of that involve only perceived social presence (e.g., information presented via computers is attributed to other members who are connected via the computers) or confederates to create social presence (Basden et al., 2002). Collaborative memory experiments have largely examined how group remembering among strangers gives rise to false recollections. This section provides an overview of findings from studies using the collaborative memory paradigm (Fig. 1) to investigate the transmission of false memory in groups.

Research on collaborative memory explores two different possibilities about the influence of others on memory errors we make—how group members potentially contribute false information during collaboration and thereby promoting false memory, and, conversely, how group members help evaluate and exclude one another's errors, thereby protecting against acquiring false information. We consider each in turn.

Early study of false memory using the collaborative memory paradigm was motivated by the finding that while collaboration reduced recall of studied information, it increased false recall compared to the nominal recall condition (Basden et al., 1997b). Here, an increase in false recall was observed in the form of increased intrusions, that is, reporting more nonstudied items during recall in the collaboration condition compared to the nominal condition. Subsequent studies over the years show that the susceptibility of groups to recall nonstudied information depends on many factors such as the material a group studies for later recall, the method collaboration that a group uses to recall the studied information and the associated group pressure, and the size of collaborating group (for a review, see Maswood and Rajaram, 2019).

With regard to the impact of study materials, the Deese-Roediger-McDermott (DRM) paradigm (Deese, 1959; Roediger and McDermott, 1995) has also been frequently employed to investigate false memory in groups and has generated a wealth of data in individual memory research. In this paradigm, individuals study DRM lists that consist of words that are semantically associated

[1]As a clarification, retrieval blocking is different from the notion of production blocking in a subtle but important way. Retrieval blocking refers to the level of activation associated with a studied word as a consequence of collaboration whereas production blocking refers to the phenomenon associated with collaboration procedure where waiting to produce a response while other group members report theirs is assumed to block one's ability to recover and report one's own items from recall. Evidence for production blocking is also not yet convincing (Andersson et al., 2006; Finlay et al., 2000; Wright and Klumpp, 2004).

with one another, e.g., *bed, rest, awake, tired, snooze,* and *blanket*. The false memory finding in this paradigm shows that on a later memory test, participants typically produce a critical 'lure', a word highly associated with the presented words, but one that was not included in the original list, e.g., *sleep*. In an early study, Basden et al. (1997b) used the DRM lists that contain associatively related words such as in the example above (Experiment 1) and categorized lists (e.g., *desk, ottoman, bed, chair*—all exemplars of the category *furniture*) that contain superordinate-to-item associations (Experiment 2). Interestingly, collaborative groups were more likely to falsely recall critical lures from categorized lists than from associatively related DRM lists. This finding seems surprising given the robustness of false recall reported for the associatively related, DRM lists in individual memory experiments. Basden et al. (1997b) proposed that intrusions are greater for collaborative groups when study lists provide strong retrieval cues, as they argued was the case with categorized lists. A possible alternate explanation might come from a different aspect of their findings where collaborative inhibition in recall was observed in the experiment using the DRM lists (Experiment 1) but not in the experiment using the categorized words (Experiment 2). This pattern raises the possibility that the adjustments needed in the procedure where the categorized lists were used might have generally increased collaborative recall, both for true and false items, although this possibility is speculative. Moreover, in later studies, increased false recall by collaborating groups was observed for the DRM lists, where collaborating groups falsely recalled or recognized the critical lures more than the nominal groups (Thorley and Dewhurst, 2007, 2009).

Another way in which researchers have examined the error production during collaboration is by distributing studied information. Specifically, researchers will present some unique information to the participants that their group members did not study (Meade and Gigone, 2011). Naturally, participants will report some of their unique information during collaborative recall that is considered nonstudied or "false" to their group members (Choi et al., 2017; Saraiva and Garrido, 2024). Much like studied items, these nonstudied items were also subject to collaborative inhibition (Meade and Gigone, 2011) which is consistent with some studies that have observed collaborative inhibition of critical lures produced after studying DRM lists (Maswood et al., 2021 Nie et al., 2023; Rossi-Arnaud et al., 2024; but also see Thorley and Dewhurst, 2007).

In addition to the type of study material, the method of collaboration and the group pressure associated with the method can also be a source for false recall in collaborating groups. The collaborative recall procedure most commonly involves two methods of group recall—*turn-taking* and *free-for-all*. In the turn-taking method, as the name implies group members take turns, recalling one after another in a sequence the units of studied information. This procedure reliably produces collaborative inhibition in recall (Basden et al., 1997a; Meade and Roediger, 2009; Wright and Klumpp, 2004). It also guards against social loafing because each group member gets their turn and is expected to contribute during their turn (e.g., Basden et al., 1997a). But because of the sequential nature of this procedure where group members do not typically go back and forth in their discussion, they fail to eliminate information that others recall erroneously. Once a memory error is introduced in this way, it essentially gets 'exposure' just like studied information that is recalled would get, and this error can subsequently get incorporated into the memory of the listener. As a result, such an error can propagate and appear in subsequent recalls of both the member who first introduced the error and the listener who did not make or hear a correction. This has been empirically supported in the literature such that turn-taking groups have been found to report more errors than nominal groups (Basden et al., 1997a; Basden et al., 2002; Thorley and Dewhurst, 2007; but also see Maswood et al., 2021; Peker and Tekcan, 2009).

In contrast, in the *free-for-all* method participants freely interact, discuss, and recall with one another, with minimal instructions given to them to coordinate recall. In this procedure, there is less pressure among group members to produce something, and there are also more opportunities for catching errors and making corrections that can prevent false recall. Along the lines just discussed, whether groups falsely remember has been found to be associated with which of the methods were used for collaborative recall, turn-taking or free-for-all. Studies that have implemented a turn-taking strategy have found increased false recall in collaborative groups relative to individuals and nominal groups (Basden et al., 1997a; Basden et al., 2002), whereas studies where group members freely discussed recall with one another have not observed increased false recall for collaborative groups (Blumen and Rajaram, 2008, 2009; Finlay et al., 2000; Maki et al., 2008; Pereira-Pasarin and Rajaram, 2011; Takahashi and Saito, 2004; Weldon and Bellinger, 1997; Yaron-Antar and Nachson, 2006). Thorley and Dewhurst (2007) demonstrated these patterns of differences in a direct comparison between the two types of collaboration procedures. A study by Maswood et al. (2021) further demonstrated that free-for-all collaboration actually reduced false memories relative to both turn-taking groups and nominal groups, whereas the turn-taking groups and nominal groups did not significantly differ for false memory production.

Why does the free-for-all interaction protect against false remembering in groups? There has been much interest in how group conversations impact group memory (Pritchard and Keenan, 2002; Harris et al., 2011; Ross et al., 2008; Meade and Gigone, 2011; Hirst and Echterhoff, 2012), and there have been suggestions that group discussion allows the rejection of errors in the studies on false remembering using free recall. Weigold et al. (2014) used the collaborative memory paradigm to specifically examine how groups filter out false information. Similar to other studies (e.g., Basden et al., 1997b; Thorley and Dewhurst, 2007), Weigold et al. (2014) used the DRM lists and groups engaged in free-for-all recall. Group discussions were coded and analyzed, and the evidence suggested that group filtering curtails false recall in the free-for-all recall procedure. Group discussions were examined for evaluation, acceptance/rejection and level of confidence. Weigold et al. (2014) found that when nonstudied words were brought up in the discussion, groups filtered out more than half of these errors. Errors were also typically brought up with low confidence. Ultimately, these words were rejected, and this contributed to the low recall of false memory in the groups.

Yet another factor that can influence false remembering is the size of the collaborating groups. Thorley and Dewhurst (2007) systematically examined false remembering and levels of group pressure for free-for-all and turn-taking dyads, triads, and quartets. As we would predict from the logic about an increase in false remembering for groups using the turn-taking method of

collaboration, these groups reported more nonstudied words than the free-for-all and nominal control groups during group recall. Further, false remembering increased with group size, with the most errors being from the largest turn-taking quartets. This increase can arise due to an increase in the number of intrusions of false information with more group members being engaged in recall and an increase in the pressure people feel to accept intrusions recalled by others.

9.2 Error pruning

Turning now to the process of error pruning during collaborative recall, as the term implies this process is the opposite of the error production process where group members transmit memory errors from one to another. As noted earlier, collaborating members can, and often do, correct erroneous recall by other group members as the group discusses the items each member produces during collaboration.

In a free-for-all method of collaborative recall, the evidence is consistent across studies in showing error pruning effects (Blumen and Rajaram, 2008, 2009; Finlay et al., 2000, Experiments 2 and 3; Harris et al., 2012; Hyman Jr et al., 2013; Johansson et al., 2000; Johansson et al., 2005; Pereira-Pasarin and Rajaram, 2011; Takahashi and Saito, 2004; Weldon and Bellinger, 1997; Yaron-Antar and Nachson, 2006; Wessel et al., 2015). A related collaboration procedure of consensus, where group members are instructed to reach agree on each item to be included in recall (Meudell et al., 1995; Ross et al., 2004), similarly reduces errors (Harris et al., 2012; Thorley and Dewhurst, 2007). As improving memory accuracy is an important goal in many contexts, it is useful to investigate further the error pruning function of collaboration and the procedures that enable error pruning (i.e., free-for-all or consensus collaboration).

Here one might ask whether changes in the intrusion rates in collaborative recall can change the collaborative inhibition effect. Past work has not consistently reported the effects of intrusion correction on collaborative inhibition. It is usually the case that collaborative inhibition is larger than the differences observed for intrusions across collaborative and nominal group recalls, and consistent with this observation, when we corrected nominal and collaborative recall for intrusions, we found that collaborative inhibition persisted (Congleton and Rajaram, 2011). It is worth bearing in mind that the benefits of error pruning on memory are relevant not only for the impact on collaborative inhibition but also on post-collaborative processes. That is, correction during collaboration has the potential to improve the accuracy of members' later individual memory, a point to which we return later.

10 Cross-cueing during collaborative recall

Retrieval cues have a powerful effect on recall. A straightforward example is a comparison between a free recall task and a cued recall task, where retrieval cues in the latter task greatly improve recall of studied information. For instance, if participants study paired associates such as "tiger-stripes" and are later asked to recall the second item of each pair (stripes), receiving no cues (i.e., a free recall task) leads to far fewer items recalled than receiving the first word (tiger) as a retrieval cue (i.e., a cued recall task) (e.g., Thomson and Tulving, 1970). Similarly, if participants study a list of exemplars (strawberry, sweater, desk), they are likely to recall more of these items if provided with category names as cues (fruit, article of clothing, furniture) than if they tried to recall the studied items without any cues (e.g., Hamilton and Rajaram, 2003). In other words, both intra-list cues (as in the first example) and extra-list cues (as in the second example) can be effective for increasing recall. It is therefore reasonable to expect that when people work together to recall past information, an item recalled by one member of the group can serve as an effective retrieval cue for another member to recall a related item that the latter member might have otherwise not remembered. Such a process is what people likely have in mind when they say that two heads are better than one, and that joint remembering helps jog memory.

Despite such strong intuitive appeal, and strong evidence for the power of retrieval cues in individual memory performance, benefits of cross-cueing in collaborative recall have not been easy to detect (Harris et al., 2017; Meudell et al., 1992; Meudell et al., 1995; Takahashi and Saito, 2004). For example, some researchers have experimentally tested for evidence of cross-cueing by having all participants initially work alone, then in a second recall phase either work alone again or with a partner to remember the same information (e.g., Meudell et al., 1992; Meudell et al., 1995). In this design, researchers can quantify the amount of new information remembered in Recall 2 by each participant (i.e., that they did not mention in Recall 1) and compare the new information generated between people who always worked alone to those who worked in a group at Recall 2. If participants in the collaborative recall condition produce more items in Recall 2 (relative to their own Recall 1) compared to participants in individual recall condition, this increase would index the impact of cross-cueing. Although such cross-cueing is intuitive, it has not been detectable reliably in such studies (e.g., Harris et al., 2017; Takahashi and Saito, 2004, Experiment 1).

Why have cross-cueing benefits been so elusive? Let us consider the complicated ways in which members within a collaborative group may influence each other's memory. As we described earlier, the detrimental effects of listening to others' recalled items are pervasive under many testing conditions and produce collaborative inhibition. Considering that the group members' recalled items during collaborative recall can potentially produce both retrieval impairment and cross-cueing benefits, this could mask the benefits of cross-cueing. This raises the question that if it is difficult to isolate the contributions of cross-cueing during collaboration, could the consequences of cross-cueing be detected when the impairing influence of retrieval cues lessens? Here, it is useful to consider a few studies where collaborative inhibition was reduced or reversed. Takahashi and Saito (2004) reported a standard collaborative inhibition effect for collaborating dyads compared to nominal dyads when the study-test delay was short (Experiment 1). But at a study-test delay of 1 week (Experiment 2), collaborative inhibition in group recall disappeared.

Other studies have similarly shown elimination of collaborative inhibition where there was a delay between study and test (e.g., Abel and Bäuml, 2017; Congleton and Rajaram, 2011). Abel and Bäuml (2017) qualitatively calculated the degree to which participants successfully cued each other when there was a short delay (5 minutes) versus a long delay (24 hours) between study and collaborative recall and found more successful cueing in the long delay groups than short delay. Consistent with this pattern, we have also found that collaborative recall remains stable after a 2-hour delay between study and test, whereas nominal recall diminishes (Congleton and Rajaram, 2011, Repeated Study conditions), suggesting that maintenance of collaborative recall levels reflects benefits of cross-cueing after increased delay between study and test phases. Such findings point to conditions where we can detect benefits of cross-cueing in collaborative recall experiments. In brief, although still scarce, some experimental evidence for cross-cueing benefits supports the subjective experience of memory benefits from collaboration people report on surveys (Dixon and de Frias, 2007; Dixon et al., 1998; Henkel and Rajaram, 2011). Future work with richer stimuli (stories, films, narratives) could offer stronger tests of cross-cueing benefits during collaborative recall (see also Weldon, 2001).

More recently, another facilitatory mechanism we noted earlier, namely context reactivation, has been proposed for collaborative remembering (Abel and Bäuml, 2017; Lehmer and Bäuml, 2018a). Like the impairing mechanisms of retrieval disruption and retrieval inhibition, the notion of context reactivation is also drawn from the literature on part-list cueing recall (Lehmer and Bäuml, 2018b). Context reactivation refers to situations where the original study context is reinstated at the time of retrieval. On this account, when the connection between the study and test phases is reduced or eliminated, retrieval disruption and retrieval inhibition mechanisms are less likely to operate, for example, when participants are instructed to forget the study phase or a long delay between study and test phases is inserted (Abel and Bäuml, 2017; Congleton and Rajaram, 2011; Takahashi and Saito, 2004). Under these conditions, impaired access to the study context is assumed to reduce or eliminate collaborative inhibition in group recall, possibilities that have been proposed for testing in future research.

11 Re-exposure during collaborative recall

During collaborative recall, the act of listening to another group member's recalled information serves as a second study opportunity. The benefits of repeated study on recall and recognition memory are well known (e.g., Cepeda et al., 2008; Crowder, 1976; Glenberg, 1979; Greene, 1989). In the context of collaboration, the memory benefits of re-exposure, unlike those from cross-cueing or error pruning, can be detected only on a subsequent memory task and not during collaboration. These re-exposure benefits occur when items that a particular group member failed to recall either prior to or during collaboration are recalled on a post-collaborative task. This memory improvement is assessed using successive recall opportunities consisting of individual versus collaborative recall attempts where a greater gain in eventual recall in the collaborative recall condition than the individual recall condition. Such successive recall arrangement can help determine whether post-collaborative improvements come from re-exposure during collaborative recall or from simple reminiscence, that is, an increase in individual recall simply by attempting to recall multiple times (Payne, 1987). By tracking who-recalled-what across successive recall attempts, researchers can isolate whether re-exposure benefits occurred during collaboration and were carried over to post-collaborative recall. In a later section on *Post-Collaborative Consequences of Collaborative Recall*, we summarize relevant findings from studies where such mapping across recalls has been reported to capture the re-exposure process during collaborative recall and its cascading effects on memory.

12 Relearning via retrieval during collaborative recall

The act of recalling information provides an opportunity to rehearse information and make it more memorable. Further, a somewhat counterintuitive yet robust finding shows that in the long run repeated recall improves memory more than additional opportunities to simply study it again, a phenomenon known as the testing effect (Karpicke and Roediger, 2007, 2008; Roediger and Karpicke, 2006a, 2006b). In a collaboration setting, when group members recall information during collaboration, not only do they provide re-exposure to others, but they also strengthen their own memory for that information, a process we have named relearning via retrieval (Rajaram and Pereira-Pasarin, 2010). This process is not so much a collaborative process but an individual retrieval process that operates during collaborative recall. The operation of relearning via retrieval during collaborative recall receives support from findings from a study where participants monitored a speaker's recall of Swahili-English vocabulary word pairs they studied earlier (Abel and Roediger III, 2018). After 2 days, participants showed better retention for word pairs if in the earlier session they had recalled the word pairs than if they have listened to others' recall. In this vein, such relearning benefits can also be accrued from collaboration if an item is retrieved in response to cross-cueing through another item provided by a group member, then such relearning is activated through collaboration.

An interesting consideration here is that if items are strengthened in memory because they were recalled and the likelihood of recalling them again consequently increases, it also implies that items not recalled become weaker in memory and are less likely to be recalled later. That is, just as in individual recall, where study items with strong representations are assumed to be recalled first (Rundus, 1973; Raaijmakers and Shiffrin, 1981; Wixted et al., 1997), stronger items are likely to be recalled first during collaborative recall as well, and here, too, the stronger items can block and damage memory for the weaker to-be-recalled items. As a result, these mechanisms can then not only induce disruption but also forgetting, a process similar to retrieval induced forgetting in individual recall (Anderson and Bjork, 1994; Bäuml and Aslan, 2004; Bäuml and Kliegl, 2024; Nickerson, 1984). In this way, the process of

relearning via retrieval in collaborative recall situations, through one's self-initiated recall or through cross-cueing during collaboration, can be both a way to enhance the memory for recalled items, and ironically, also be a source of forgetting for items that were not recalled. These possibilities await future research.

As we turn to a discussion of the other stages shown in the framework in Fig. 2, we note that the utility of the collaborative memory paradigm lies not only in the direct and controlled ways in which it enables a comparison of collaborative memory with non-collaborative memory performance, but also in the ways it enables systematic expansions to examine memory processes both before and after the collaborative retrieval phase. With such expansions, researchers can measure as well as manipulate the antecedent conditions that shape collaborative memory. Similarly, they can map the downstream effects in the post-collaborative stages that are shaped by collaborative memory. In this way, it becomes possible to examine the sequential as well as iterative interactions between individual and group memory processes and their mutual influences. Creative extensions of the collaborative memory paradigm make such assessments possible, retaining tight experimental control while integrating elements of the more dynamic sequences of interactions we see in everyday life. We turn to a selection of these findings next.

13 Stages preceding collaborative recall: Antecedent conditions, pre-existing cognitive structures, and collaborative encoding

In the preceding sections, we have discussed a collection of processes that can become active during group collaboration and shape memory. It is also essential to recognize that the collaborative process itself is affected by the unique perspectives people bring to group conversations, perspectives that arise from the pre-existing cognitive histories that participants have developed through life. Pre-existing, idiosyncratic cognitive frameworks (see the topmost part of Fig. 2) develop from people's exposure to diverse life and educational experiences. To take a simple example, people in western cultures share the category structures that different types of fruits belong together, different pieces of furniture belong together, but the two categories are different from each other. Within the category fruit however, one individual might have stronger associations between mango and pineapple because of their frequent vacations in the Caribbean whereas another individual might have stronger associations between mangoes and peaches because they like the color butterscotch that these fruits share. Extrapolating from this example, one can imagine the great spans of overlap in our cognitive structures as well as the variations for all sorts of information. This consideration of pre-existing cognitive structures relates back to the role of retrieval organization in collaborative recall that Basden et al. (1997a) proposed originally.

Retrieval organization refers to how an individual has organized the to-be remembered information presented during the study phase such that this structure is later used for remembering the information. In as much as pre-existing cognitive histories overlap, or differ, the retrieval organization developed for the studied material may be aligned or non-aligned across the group members. In this way, pre-existing cognitive history becomes integral to the retrieval strategy disruption hypothesis which postulates that non-aligned idiosyncratic retrieval organization of studied information across group members results in lowered recall by each member and consequently, in lowered group recall, i.e., collaborative inhibition. Studies have evaluated some aspects of the role of idiosyncratic retrieval organization by manipulating variables prior to collaborative recall and during the study phase.

13.1 Antecedent conditions

In their seminal study, Basden et al. (1997a) reported that when participants recalled studied word list by category, collaborative inhibition disappeared (Experiment 4). During recall, participants were instructed to retrieve all items from one specified category before continuing to the next category to recall. This procedure required all group members to adapt the same retrieval organization to recall words under that category. Under these conditions, collaborating groups recalled an equivalent number of items as did the nominal groups, presumably because the categories guided participants to form similar retrieval organizations and this process also equated disruptive effects for collaborative and nominal group participants because category labels and structure and not their own idiosyncratic retrieval strategies guided their recall. In another study (Finlay et al., 2000), participants who later became group members were given study items in the same order with the expectation that aligned order of study presentation would reduce later disruptions in recall. The findings supported this argument as collaborative inhibition was reduced in comparison to the condition where participants studied the words in different orders.

We designed two experiments to manipulate the strength of retrieval organization developed during study to test the consequences on later collaborative recall (Pereira-Pasarin and Rajaram, 2011). In one experiment, we manipulated the number of study opportunities at encoding to strengthen each individual's retrieval organization (see Rundus, 1971). It was expected that group members' strengthened idiosyncratic organization would protect against retrieval disruption at recall and thereby reduce collaborative inhibition. In another experiment, we manipulated attention at study such that half of the information was encoded under conditions of divided attention and the other half under full attention. Encoding under conditions of divided attention was expected to reduce retrieval organization. We proposed that when there is not sufficient organization to disrupt, recall is also not likely to diminish considerably due to disruption. As a result, like strengthened retrieval organization (in Experiment 1), weakened retrieval organization was also expected to reduce collaborative inhibition (Experiment 2). The findings supported both these predictions. Overall, these findings support the proposal that collaborative inhibition and outcomes from group recall depend on the strength and similarity of the cognitive history and organization that individuals bring to group remembering.

We now turn to a different way to manipulate retrieval organization prior to collaborative recall. This approach involves not the initial encoding, but the construction and reconstruction of organization through retrieval that occurs prior to collaboration. In one study, we investigated how learning methods—repeated study versus repeated testing—can impact retrieval organization and consequentially impact collaborative and individual recall (Congleton and Rajaram, 2011). We drew this comparison from the literature on the robust testing effect phenomenon where repeated testing has been found to be a more effective learning method for long-term benefits, whereas repeated study shows immediate, but not long-term, benefits (Roediger and Karpicke, 2006a, 2006b). As both learning methods are aimed at consolidating new information, we were interested in how these learning methods may differ in the respective effects on retrieval organization, collaborative inhibition, and later individual memory. Repeated individual recall prior to collaboration was more effective for creating a strong retrieval organization such that collaborative inhibition was abolished following repeated retrieval while it was only reduced following repeated study. The development and strengthening of participants' retrieval structures with repeated retrieval compared to repeated study also allowed them to benefit more from re-exposure effects during collaboration which then transferred to greater memory in post-collaborative individual recall (Congleton and Rajaram, 2011). Together, these findings show that antecedent conditions to collaboration can affect group collaborative recall as well as post-collaborative individual recall.

13.2 The influence of pre-existing cognitive structures

There is a striking report of a reversal of the collaborative inhibition effect and an emergence of collaborative facilitation that is important for understanding the role of pre-existing cognitive structures. Collaborative facilitation in group recall occurred in a study for expert pilots who studied aviation-related scenarios during study (Meade et al., 2009). Because expertise in a domain of knowledge, such as aviation scenarios for experienced pilots, reflects shared, pre-existing cognitive histories for the information that the subjects are to study in the experimental setting, such pre-existing cognitive structures are likely to lead to strong and similar retrieval organization for that information. Thus, these subjects presumably organized the to-be remembered information similarly and were less likely to disrupt others' and be disrupted, thereby leading to enhanced group recall. The expert pilots also showed better communication style that aided recall of related information, a collaboration process that is reminiscent of the cross-cueing mechanism during collaboration that holds intuitive value (see Fig. 2, for the collection of mechanisms.)

Some studies have reported reduced collaborative inhibition in recall among friend dyads and couples (Andersson, 2001; Andersson and Rönnberg, 1995; Johansson et al., 2000; Johansson et al., 2005). As friends and couples have shared pasts, it is reasonable to assume that they also develop some shared ways of organizing that information, and therefore, they encode incoming information more similarly than do strangers. Systematic tests of this possibility are needed for stronger conclusions. The role of collaborative encoding can be tested experimentally as well, but as we discuss in the next section on collaborative encoding, the findings here are mixed.

13.3 Collaboration at encoding

In life, we experience countless events together. We go to the movies, celebrate birthdays and weddings, come together during losses and tragedies, take vacations with family and friends, or attend classes together where we might engage in discussions while learning new materials. The experimental work we have summarized so far focuses on the relationship between collaboration and memory when collaboration occurs at the time of retrieval. What are the consequences of collaboration if interactive processing occurs during the initial experiencing of episodes, that is, during the encoding of information?

Since the mid-1990s memory scientists have pursued tests of collaborative encoding, but the published literature is strikingly limited on this question. In our experience, this is not an oversight because it is difficult to create encoding conditions that lend themselves to systematic collaboration. The comparatively small number of studies that have resulted from extant efforts has yielded mixed patterns of results, with some studies showing that collaborative encoding impairs later memory while others show an improvement, and yet others show no particular effect at all (e.g., Andersson and Rönnberg, 1995, 1997; Barber et al., 2010; Barber et al., 2012a; Barber et al., 2012b; Conte et al., 2024; Finlay et al., 2000; Garcia-Marques et al., 2012; Harris et al., 2013). It is not yet clear why these differences have emerged, and the variations in procedures, materials, or type of subjects complicate ready understanding of these patterns.

In our lab, we have explored the nature of collaborative encoding using the following procedure. At study, we presented participants with unrelated word pairs such as *citizen-trail* (see Graf and Schacter, 1985) and asked them to create a single sentence that connected the two words, e.g., *The citizen walked the winding trail* (Barber et al., 2010). Participants either performed this task alone or in pairs (taking turns to start the collaborative co-construction). We developed this procedure to ensure both members in a dyad engaged in the task, and did so equally, to create a joint and novel encoding experience from the information presented to them. At retrieval, we used a cued recall task where subjects saw the first word (*citizen*) and retrieved the second (*trail*) either working alone or in pairs, and if working in pairs then with either the same partner with whom they had encoded the word pair or with a different partner. We observed a collaborative encoding deficit at recall. Participants recalled less if they had studied word pairs in dyads than if they had studied alone. This outcome not only occurred when the partner changed from encoding to retrieval (but who had encoded the word with someone else) but also when the partner was the same (Experiment 1). The collaborative encoding deficit replicated when group were composed of triads instead of dyads, and the retrieval task consisted of the most typical free recall

task used in collaborative memory experiments instead of cued recall (Barber et al., 2012a), or when free-for-all encoding was used (although the deficit attenuated following these instructions) instead of turn-taking at study (Barber et al., 2010, Experiment 2).

Collaborative encoding deficit in our experiments seems, in part, related to the quality of the joint memories that partners construct where better quality sentences created at study were associated with a reduced magnitude of the collaborative encoding deficit (Barber et al., 2010, Experiment 2), and specific warnings during encoding about this deficit and specific task instructions for encoding eliminated this deficit (Barber et al., 2012b). However, it is not entirely clear why specific warnings work, because these warnings were not necessarily associated with better quality sentences. One possibility is that specific warnings nonetheless led to deeper encoding. Together, this empirical literature does not yet show a clear picture for the role of collaboration on encoding for future memory, but findings provide directions for future work. A final interesting point we note here is that when we compared collaboration at encoding with collaboration at retrieval within the same paradigm in the same experiment (Barber et al., 2012a), the recall deficit from collaboration at encoding was smaller than the memory deficit arising from collaboration at retrieval, i.e., the collaborative inhibition effect. This outcome is consistent with a greater focus of the field so far on the collaborative inhibition effect arising at retrieval.

14 Post-collaborative consequences of collaborative recall

14.1 Consequences on post-collaborative individual memory

We now turn to the stage after collaboration, to consider the cascading effects of collaboration. There is now an impressive body of findings to show that information mentioned during collaboration is remembered afterwards even when collaborating members are no longer present. As shown in the framework presented in Fig. 2, we call this process re-exposure (see Blumen and Rajaram, 2008). As we discussed in the Cognitive Processes Activated during Collaborative Recall section, re-exposure during collaboration refers to an experience where participants are exposed to group members' output of items that they did not recall, and might not have recalled, themselves. This re-exposure to items then serves as an extra study opportunity from which participants benefit when they later recall the study items alone. Unlike the benefits of cross-cueing and error pruning that typically improve memory during collaboration, the benefits of re-exposure on memory are realized on a subsequent memory task. This mechanism has been implicated for improving post-collaborative individual remembering across several studies (e.g., see Basden et al., 2000; Blumen and Rajaram, 2008, 2009; Thorley and Dewhurst, 2007; Weldon and Bellinger, 1997). These post-collaborative benefits in individual memory are greater than the effects of hypermnesia from individuals recalling repeatedly alone and have been found for both recognition memory and recall (Basden et al., 2000; Basden et al., 2002; Finlay et al., 2000; Rajaram and Pereira-Pasarin, 2007; Pereira-Pasarin and Rajaram, 2011; Weldon and Bellinger, 1997). Furthermore, these benefits have been observed in young as well as older adults (Gagnon and Dixon, 2008; Henkel and Rajaram, 2011). The benefits of re-exposure are presumably among the several motivating outcomes behind the pedagogical practices of student interaction during learning, in formats such as study groups and group projects (Garfield, 1993; Johnson and Johnson, 2009; Keeler and Steinhorst, 1995; Slavin, 1991). In this context, in a laboratory study with female participants, we observed benefits of re-exposure for educationally relevant materials about statistical problem solving that required a conceptual understanding of the central tendency measures (Pociask and Rajaram, 2014).

Re-exposure benefits can increase because of many reasons. For example, conditions that reduce retrieval disruption during collaboration can increase the opportunity for each group member to contribute more during collaboration, and this increased contribution can offer re-exposure to the group members, increasing the overall re-exposure benefit. Different lines of evidence support this reasoning. In one study, we observed that participants maximally benefited from collaboration when they performed a collaborative recognition task that is known to reduce or eliminate disruption (Clark et al., 2000), and when the collaboration task was repeated and matched to the format for the final individual test (Blumen and Rajaram, 2009).

In fact, when group members collaborate twice, even if they perform a recall task both times (risking greater disruption), the final individual recall of each member increases due to repeated re-exposure to the items produced by their group members when compared to the conditions where only a single collaboration precedes the final recall, even when controlling for the total number of recalls (Blumen and Rajaram, 2008). But what happens if the collaborating partners change across two group recall attempts? We tested this question in another study by manipulating group configuration across repeated collaborative recall sessions; in one condition identical triads collaborated twice to recall a list of studied words (the identical group condition), whereas in another condition the second collaborative recall session took place with triads who had previously collaborated with different group members (the reconfigured group condition; Choi et al., 2014). With exposure to the recall content of a wider variety of partners in the reconfigured group condition, the predicted re-exposure effect increased and led to increased post-collaborative individual recall compared to the identical group condition. The increased variety in recall was also computed by calculating the nominal group performance in the final individual recall, where those subjects in the reconfigured groups exhibited a greater variety of items in their final individual recall than those in identical groups.

Re-exposure benefits can also arise when retrieval organization is strengthened prior to collaborative recall. For example, in a study we discussed earlier (Congleton and Rajaram, 2011), repeated individual recall compared to repeated individual study, both carried out prior to collaborative recall, not only improved retrieval organization and eliminated collaborative recall, it also increased post-collaborative recall. Together, these studies provide converging evidence that collaborative retrieval can provide a boost to later individual recall performance—individual group members benefit from re-exposure to potentially forgotten material

when it is produced by their partners. As such, during subsequent individual recall tasks, former collaborators typically display recall gains that outpace their nominal counterparts.

While collaborators may experience benefits stemming from re-exposure to target material, group recall also presents a risk: Collaborators can introduce incorrect, non-studied material. On the one hand, at least in the case of freely collaborating groups, this input could be pruned and omitted from the group recall (see discussion of error-pruning above) and thus subsequent individual recalls. On the other hand, if erroneous responses go unchecked, group members may endorse them and recall this incorrect material during subsequent recall attempts. Classic work leveraging the social contagion paradigm demonstrates this downstream effect (Meade and Roediger, 2009; Roediger et al., 2001). For example, when a confederate introduces erroneous material during collaborative recall (e.g., saying they saw a toaster in a kitchen scene that did not include a toaster), people often go on to falsely recall that they had seen what was suggested by the confederate. Similar patterns are observed in the memory conformity literature when participants view short films depicting a crime from different perspectives; following a collaborative recall phase, participants recall details seen only by their collaborative partner (e.g., Gabbert et al., 2003).

Recent work from our lab has assessed social contagion errors in the context of the collaborative memory paradigm. One way to assess how collaborative recall influences false memory downstream is to leverage elements of experimental paradigms that focus on eliciting false memories in individuals (e.g. using Deese-Roediger-McDermott [DRM] lists). As noted earlier, DRM lists consisting of words associated with a non-presented critical lure are highly effective at producing false recall and recognition in individuals (Roediger and McDermott, 1995; see Gallo, 2010 for a review). For example, a list of associatively related words might include *bed, rest, awake* and other words related to a non-presented critical lure (e.g., *sleep*) which is later falsely recalled or recognized at high rates. In one collaborative memory study, participants studied such DRM lists. At test, participants recalled these lists working either alone or in collaborative groups (either collaborating in a turn-taking or a free-for-all format) before completing an individual recall (Maswood et al., 2021). Irrespective of how collaboration unfolded, people that initially recalled with group members went on to recall more critical lures than those that never collaborated. At the same time, initial collaboration also boosted later correct recall. This illustrates both sides of the social contagion coin; re-exposure to targets may benefit later recall, but unchecked false information may infect later recall.

Thorley and Dewhurst (2007) earlier investigated a similar question and argued that because the level of pressure during turn-taking collaboration is similar to that of social contagion studies that report retention of misinformation, turn-taking group members would similarly demonstrate false memory retention after collaborative recall. Accordingly, they found that the false recall of critical lures was retained and individually recalled for those previously in turn-taking groups. Such retention of falsely recalled items has also been found in later individual recognition tasks administered after collaborative group recall (Thorley and Dewhurst, 2009; Basden et al., 2002).

Similar findings were reported in a study that manipulated (a) the distribution of information across collaborators (i.e., shared information, partially shared information, and unshared information; Abel and Bäuml, 2023; Choi et al., 2017; Meade and Gigone, 2011) and (b) whether collaborators worked with the same partners from one recall to the next (Choi et al., 2017). Compared to when people worked with the same collaborators, people that worked with a variety of partners went on to falsely recognize more non-studied material. That is, exposure to a larger pool of unshared information (i.e., that was only studied by their varied partners) increased later false recognition. Together, these studies and other work on social contagion and memory conformity converge to tell the same story: erroneous material introduced during collaborative recall can persist and influence subsequent individual memory.

In this context, we know of at least one type of to-be-remembered information that can reduce false memory contagion in social remembering—when participants are exposed emotionally positive or negative information such as picture-word pairs along with pairs that are neutral in valence. Across two paradigms associated with study of false memory contagion—the participant-confederate dyadic retrieval of studied and lure information and the collaborative recall of studied and nonstudied information—memory was tested for categorically related targets (i.e., studied information) and lures (non-studied information). Across two experiments, on a recognition memory task participants showed lower false memory contagion for emotionally valenced lures compared to neutral information along with the standard advantage for emotionally valence information for studied targets, demonstrating the efficacy of emotional information to increase memory accuracy (Kensinger et al., 2016).

In sum, conditions that maximize the opportunities for re-exposure during collaboration improve post-collaborative individual memory, but re-exposure to false information can also produce false memory contagion for some types of information, leading to an increase in false memory later.

14.2 Consequences of collaboration on memory structure

We have reviewed how collaboration can shape *what* we remember, but does collaboration have the potential to influence how we organize these memories? In the preceding sections, we discussed the critical role that the retrieval organization of individual group members plays in shaping the collaborative process during recall. Here we ask whether the collaboration process in turn changes the retrieval organization of group members even once they leave the group context. The empirical literature on this question is small but it is both interesting and consistent (see Greeley and Rajaram, 2023, for a recent review). In collaborative memory experiments, retrieval organization has been measured using adapted versions of two well-known indices in the individual memory literature, namely the paired-frequency (PF) measure (Sternberg and Tulving, 1977) and the adjusted ratio of clustering (ARC) measure (Roenker et al., 1971) discussed earlier. The PF measure has been particularly useful for computing the nature of internal

organization where studied stimuli may lack an obvious external structure, but participants nonetheless impose a subjective organization in retrieval by chunking items into units (Gates, 1917a, 1917b; Sternberg and Tulving, 1977; Tulving, 1962). The PF measure relies on the presence of two recalls and quantifies the extent to which they are similar by focusing on item transitions (e.g., were "apple" and "plane" recalled in adjacent positions during both recalls?). The ARC measure is prevalent in computing organization when there is a theoretical interest in whether retrieval is clustered into taxonomic categories (e.g., recalling fruits in adjacent positions; Bousfield, 1953), and can be assessed for a single recall output.

Every recall attempt presents an opportunity to reconstruct and reorganize recall. This newly reconstructed organization can potentially be used the next time one recalls the same information. Some of the questions, then, are whether the retrieval organization that groups used to recall information would be used again by the group at the second group recall opportunity, and by the individual group members later when recalling alone. Weldon and Bellinger (1997), using unrelated words as study materials, reported initial glimpses into such a process for collaborative recall; groups maintained marginally greater consistency in retrieval organization across two recalls (collaborative, collaborative) than did individuals across two recalls (individual., individual), suggesting that repeated collaborative recalls can begin to strengthen the group-level retrieval organization (also see Blumen and Rajaram, 2008; Choi et al., 2014, for similar patterns in later studies).

In a recent study, using categorized word lists as study materials, we examined the retrieval organization in final individual recall and found that it is influenced by the retrieval organization from prior recalls, where prior recalls consisted of a combination of individual and collaborative recall phases across conditions (Congleton and Rajaram, 2014). There was also an interesting difference in these patterns; final individual recall displayed retrieval organization that was similar to the retrieval organization evident in the most recent collaborative recall attempt, rather than the organization evident in an earlier collaborative recall attempt. We observed a converging pattern for the late collaboration effect when we examined the influence of repeated collaborative recall in reconfigured groups (where each group member collaborated twice, but each time with two different partners) where the retrieval organization of the second group configuration influenced final individual recall more than that of the first group configuration (Choi et al., 2014; also see Greeley et al., 2024). By contrast, aspects of retrieval organization from earlier individual recall attempts were evident in later individual recall regardless of whether individual recall occurred early or late in the sequence of multiple recalls (Congleton and Rajaram, 2014). These findings suggest that retrieval organization in individual recall has more enduring effects than the retrieval organization that develops during collaborative recall. This seems logical because collaborative recall brings together a new level of organization of information that subsumes idiosyncratic preferences of group members. Nonetheless, the influence collaboration has on later individual memory organization may translate to more downstream impacts, perhaps influencing subsequent learning, we have discussed this and related ideas at greater length in other work (Congleton and Rajaram, 2014; Greeley and Rajaram, 2023).

15 Collaborative recall and collective memory

In this chapter, we have focused on the nature of collaborative memory, but we touch upon a related concept of collective memory here. A fuller treatment of this topic is beyond the intended scope of this chapter, but we briefly consider it because the process of collaborative remembering plays an important role in the formation of collective memory. The study of collective memory has had a long history of scholarly consideration in disciplines such as anthropology, history, and sociology (Bodnar, 1992; Cole, 2001; Halbwachs, 1980) whereas it is relatively new in experimental memory research. Within psychological research, collective memory has come to represent shared memories for a past that relates to the cultural, social, or political identity of the rememberers (Hirst and Manier, 2008; Wertsch and Roediger III, 2008). In the experimental work on memory, the aspect about identity in this definition is not explicitly, or sometimes even implicitly, explored. The concept of collective memory is currently being investigated in terms of shared, overlapping memories among the members of a group where these are experimentally constructed, culturally defined, or geographically represented (e.g., Abel et al., 2018; Barber et al., 2012a; Choi et al., 2014; Congleton and Rajaram, 2014; Luhmann and Rajaram, 2013, 2015; Muller et al., 2016; Roediger and Abel, 2015; Roediger and DeSoto, 2016; Stone et al., 2014; Yamashiro and Hirst, 2014; Zaromb et al., 2014).

While the concepts of collaborative memory and collective memory are related, these concepts also differ. In the current experimental framework, collaborative memory refers to the total number of memories that members produce together during group remembering, whereas collective memory refers to the total number of *overlapping* memories that the group members report. This memory overlap can be assessed following collaboration (i.e., by determining what material is recalled by all former members of a group) or with respect to some pre-existing group (e.g., by determining what material is recalled by the majority of a sample). Because of this operationalization, we have sometimes referred to collective memory as shared memory or collective memory (Barber et al., 2012a, 2012b; Choi et al., 2014; Congleton and Rajaram, 2014; Greeley and Rajaram, 2023).

What processes during collaborative recall shape collective memory? As we have discussed in greater detail previously (Rajaram and Pereira-Pasarin, 2010), the collection of processes that come into play during collaboration can, in some combination or another, bring disparate contents of recall together. For example, re-exposure to others' recall during collaboration can make group members remember details they had themselves forgotten. Such re-exposure can also occur via cross-cueing where group member B's recalled item can cue group member A to recall additional items which in turn provide re-exposure benefits to member B. Retrieval disruption and retrieval inhibition can diminish later recall of details for multiple group members because these details were not produced during collaboration by any group member. Error pruning (reflecting rejection of incorrect recall) can eliminate

false details from later recall (note that this can sometimes also lead to rejection of correctly recalled details), and social contagion of errors can transmit erroneous details across all group members. The operation of some or all these processes can together homogenize the contents of recall for group members and give rise to collective memory. In this vein, repeatedly collaborating with the same partners leads to greater collective memory than collaborating with different partners across the same number of opportunities (Choi et al., 2014).

The influence collaborative recall has on the development of post-collaborative collective memory is also apparent when considering false memory. For example, multiple studies from our lab suggest that when nonstudied material is recalled during collaboration, group members may adopt and falsely recall it during subsequent individual recall attempts (Choi et al., 2017; Maswood et al., 2021). Critically, former group members often report the same nonstudied material, giving rise to collective false memory (e.g., collectively recalling DRM critical lures; Maswood et al., 2021). This pattern suggests that deficient error-pruning during collaboration has downstream, group-level consequences. As such, this has important implications for how groups might converge on a homogenized but false representation of the past.

One might wonder about boundary conditions in this context—that is, does collaboration always promote collective memory, or does this effect emerge only after relatively rich, in-person collaborative discussions? In a recent project, we examined collective memory following a single collaborative recall that took place in an entirely virtual setting (members of a triad sent text messages to each other in a chat room; Greeley et al., 2022). Following this chat, compared to nominal groups that never collaborated, former group members collectively recalled significantly more overlapping material. This again underscores the power of group recall and suggests that even a single, text-based collaboration is enough to synchronize the contents of memory.

15.1 Collective memory organization

Beyond collective memory for what people remember, collaborative recall can also shape the structure of this memory. As we note in the section on consequences of collaborative recall on memory structure, repeated collaborative recall stabilizes the structure of collaborative recall (Weldon and Bellinger, 1997). In our work, we have also observed when identical groups engaged in repeated collaborative recall the retrieval organization of their recall output is more consistent than if they collaborated only once (Blumen and Rajaram, 2008), or if the group members collaborated the second time with different partners (reconfigured groups; Choi et al., 2014). Thus, collaborative recall changes the structure of memory not only for each group member as we noted earlier in this chapter, but also for the group's collective memory. In our work, we have referred to this as *collective retrieval organization* (see Greeley and Rajaram, 2023, for a review). In a direct and quantitative test of this deep-structure consequence of collaborative recall, we observed that collaborative recall processes have a powerful effect on the shared retrieval organization group members develop in their collective memory (Congleton and Rajaram, 2014).

Other recent work conducted in our lab has extended this finding in several ways. In the fully virtual test study mentioned above, collaborative recall not only promoted post-collaborative collective memory; it also synchronized retrieval strategies (Greeley et al., 2022). That is, former collaborators recalled more of the same material, and they did so in more similar sequences compared to members of nominal, control groups who never collaborated. In another study, we leveraged data from an in-person collaborative memory task (Choi et al., 2014) to assess how group reconfiguration—working with different partners from one recall to the next—influences post-collaborative retrieval strategies (Greeley et al., 2024). We found that any collaboration synchronized how former group members retrieved material. Notably, whether collective organization was computed based on the original grouping of participants or the more recent reconfigured grouping, we observed above chance collective organization. Consistent with collective memory findings and the other post-collaborative effects discussed above, these results highlight the persisting influence of group recall.

16 Concluding remarks

The arena of collaborative memory research in the cognitive experimental tradition lies in the middle of the Ebbinghaus tradition of individual memory experiments and the vast topic of social memory. Collaborative memory research leverages the former tradition and enables systematic steps towards incorporating the social influences. In this sense, the collaborative memory movement embodies the spirit of the approach Frederic Bartlett espoused. This chapter provides a selective overview of the progress made in collaborative memory research in the last couple of decades. This body of research provides a methodological platform to both press on the theoretical questions that arise from these early, exciting explorations, and explore questions of wide-ranging societal interest and significance such as how small groups and large communities transmit memories, influence one another's cognitive structures, and develop collective memories.

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References

Abel M and Bäuml KHT (2017) Collaborative remembering revisited: Study context access modulates collaborative inhibition and later benefits for individual memory. *Memory & Cognition* 45: 1319–1334. https://doi.org/10.3758/s13421-017-0737-9.

Abel M and Bäuml KHT (2023) Joint contributions of collaborative facilitation and social contagion to the development of shared memories in social groups. *Cognition* 238: 105453. https://doi.org/10.1016/j.cognition.2023.105453.

Abel M and Roediger HL III (2018) The testing effect in a social setting: Does retrieval practice benefit a listener? *Journal of Experimental Psychology: Applied* 24(3): 347–359. https://doi.org/10.1037/xap0000148.

Abel L, Umanath S, Wertsch JW, and Roediger HL (2018) Collective memory: How groups remember their past. In: Meade ML, Barnier A, Van Bergen P, Harris C, and Sutton J (eds.) *Collaborative Remembering: How Remembering With Others Influences Memory*. New York: Oxford University Press.

Alea N and Bluck S (2003) Why are you telling me that? A conceptual model of the social function of autobiographical memory. *Memory* 11(2): 165–178. https://doi.org/10.1080/741938207.

Anderson MC and Bjork RA (1994) Mechanisms of inhibition in long-term memory: A new taxonomy. In: Dagenbach D and Carr TH (eds.) *Inhibitory Processes in Attention, Memory, and Language*, pp. 265–325. San Diego, CA: Academic Press.

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 and Rönnberg J (1995) Recall suffers from collaboration: Joint recall effects of friendship and task complexity. *Applied Cognitive Psychology* 9(3): 199–211. https://doi.org/10.1002/acp.2350090303.

Andersson J and Rönnberg J (1996) Collaboration and memory: Effects of dyadic retrieval on different memory tasks. *Applied Cognitive Psychology* 10(2): 171–181. https://doi.org/10.1002/(SICI)1099-0720(199604)10:2%3C171::AID-ACP385%3E3.0.CO;2-D.

Andersson J and Rönnberg J (1997) Cued memory collaboration: Effects of friendship and type of retrieval cue. *European Journal of Cognitive Psychology* 9(3): 273–287. https://doi.org/10.1080/713752558.

Andersson J, Hitch G, and 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.

Andersson J, Helstrup T, and Rönnberg J (2007) Collaborative memory: How is our ability to remember affected by interaction with others. In: Magnussen S and Helstrup T (eds.) *Everyday Memory*, pp. 135–156. New York, NY: Psychology Press.

Asch SE (1951) Effects of group pressure upon the modification and distortion of judgments. In: *Groups, Leadership, and Men*, pp. 222–236. Carnegie Press.

Aslan A and Bäuml KH (2009) The role of item similarity in part-list cueing impairment. *Memory* 17(7): 697–707. https://doi.org/10.1080/09658210902740886.

Assmann J and Czaplicka J (1995) Collective memory and cultural identity. *New German Critique* 65: 125–133. https://www.jstor.org/stable/488538.

Barber SJ, Rajaram S, and Aron A (2010) When two is too many: Collaborative encoding impairs memory. *Memory & Cognition* 38(3): 255–264. https://doi.org/10.3758/MC.38.3.255.

Barber SJ, Rajaram S, and Fox EB (2012a) Learning and remembering with others: The key role of retrieval in shaping group recall and collective memory. *Social Cognition* 30(1): 121–132. https://doi.org/10.1521/soco.2012.30.1.121.

Barber SJ, Rajaram S, and Paneerselvam B (2012b) The collaborative encoding deficit is attenuated with specific warnings. *Journal of Cognitive Psychology* 24(8): 929–941. https://doi.org/10.1080/20445911.2012.717924.

Barber SJ, Harris CB, and 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* 41(2): 559–566. https://doi.org/10.1037/xlm0000037.

Barber SJ, Castrellon JJ, Opitz P, and Mather M (2017) Younger and older adults' collaborative recall of shared and unshared emotional pictures. *Memory & Cognition* 45(5): 716–730. https://doi.org/10.3758/s13421-017-0694-3.

Bartlett FC (1932) *Remembering: A Study in Experimental and Social Psychology*. New York, NY: Cambridge University Press.

Basden DR and Basden BH (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 DR, Basden BH, and Galloway BC (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.

Basden BH, Basden DR, Bryner S, and Thomas RL III (1997a) A comparison of group and individual remembering: Does collaboration disrupt retrieval strategies? *Journal of Experimental Psychology* 23(5): 1176–1189. https://doi.org/10.1037/0278-7393.23.5.1176.

Basden BH, Basden DR, Thomas RL, and Souphasith S (1997b) Memory distortion in group recall. *Current Psychology* 16(3): 225–246. https://doi.org/10.1007/s12144-997-1001-4.

Basden BH, Basden DR, and Henry S (2000) Costs and benefits of collaborative remembering. *Applied Cognitive Psychology* 14(6): 497–507. https://doi.org/10.1002/1099-0720(200011/12)14:6%3C497::AID-ACP665%3E3.0.CO;2-4.

Basden BH, Reysen MB, and Basden DR (2002) Transmitting false memories in social groups. *The American Journal of Psychology* 115(2): 211–231. https://doi.org/10.2307/1423436.

Bäuml K-H (2008) Inhibitory processes. In: Roediger HL III (ed.) *Cognitive Psychology of Memory. Learning and Memory – A Comprehensive Reference*, vol. 2, pp. 195–220. Oxford: Elsevier.

Bäuml KH and Aslan A (2004) Part-list cuing as instructed retrieval inhibition. *Memory & Cognition* 32(4): 610–617. https://doi.org/10.3758/BF03195852.

Bäuml KH and 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.

Berger J and Milkman KL (2012) What makes online content viral? *Journal of Marketing Research* 49(2): 192–205. https://doi.org/10.1509/jmr.10.0353.

Bernsten D and Rubin DC (2012) Understanding autobiographical memory: An ecological theory. In: Berntsen D and Rubin DC (eds.) *Understanding Autobiographical Memory: Theories and Approaches*. Cambridge University Press.

Blumen HM and 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 HM and Rajaram S (2009) Effects of repeated collaborative retrieval on individual memory vary as a function of recall versus recognition tasks. *Memory* 17(8): 840–846. https://doi.org/10.1080/09658210903266931.

Blumen HM, Rajaram S, and Henkel L (2013a) The applied value of collaborative memory research in aging: Behavioral and neural considerations. *Journal of Applied Research in Memory and Cognition* 2(2): 107–117. https://doi.org/10.1016/j.jarmac.2013.03.003.

Blumen HM, Rajaram S, and Henkel L (2013b) The applied value of collaborative memory research in aging: Considerations for broadening the scope. *Journal of Applied Research in Memory and Cognition* 2(2): 133–135. https://doi.org/10.1016/j.jarmac.2013.05.004.

Bodnar J (1992) *Remaking America: Public Memory, Commemoration, and Patriotism in the Twentieth Century*. Princeton, NJ: Princeton University Press.

Bousfield WA (1953) The occurrence of clustering in the recall of randomly arranged associates. *The Journal of General Psychology* 49(2): 229–240. https://doi.org/10.1080/00221309.1953.9710088.

Cepeda NJ, Vul E, Rohrer D, Wixted JT, and Pashler H (2008) Spacing effects in learning a temporal ridgeline of optimal retention. *Psychological Science* 19(11): 1095–1102. https://doi.org/10.1111/j.1467-9280.2008.02209.x.
Choi HY, Blumen HM, Congleton AR, and 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 HY, Kensinger EA, and 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. https://doi.org/10.1037/xge0000327.
Clark SE, Hori A, Putnam A, and Martin TP (2000) Group collaboration in recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 26(6): 1578–1588. https://doi.org/10.1037/0278-7393.26.6.1578.
Cole J (2001) *Forget colonialism? Sacrifice and the art of memory in Madagascar*. Berkeley, CA: University of California Press.
Congleton AR and 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 AR and 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.
Conte N, Pelegrina S, Padulo C, Marascia E, and Fairfield B (2024) Collaborative encoding with a new categorization task: A contribution to collaborative memory research. *Psychological Research*: 1–13. https://doi.org/10.1007/s00426-024-01929-w.
Crowder RG (1976) *Principles of Learning and Memory*. Hillsdale, NJ: Erlbaum: Psychology Press.
Deese J (1959) On the prediction of occurrence of particular verbal intrusions in immediate recall. *Journal of Experimental Psychology* 58(1): 17–22. https://doi.org/10.1037/h0046671.
Dixon RA and de Frias CM (2007) Mild memory deficits differentially affect 6 year changes in compensatory strategy use. *Psychology and Aging* 22(3): 632–638. https://doi.org/10.1037/0882-7974.22.3.632.
Dixon RA, Gagnon LM, and Crow CB (1998) Collaborative memory accuracy and distortion: Performance and beliefs. In: Intons-Peterson MJ and Best DL (eds.) *Memory Distortions and their Prevention*, pp. 63–88. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
Durkheim E (1915) *The Elementary Forms of the Religious Life: A Study in Religious Sociology*. Macmillan.
Ebbinghaus H (1885) *Uber Das Gedachtnis*. Leipzig: Dunker & Humblot.
Finlay F, Hitch GJ, and Meudell PR (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.
Bäuml K-HT and Kliegl O (2024) Retrieval-induced remembering and forgetting. In: Byrne JH (ed.), *Learning and Memory: A Comprehensive Reference, vol. 1. Learning Theory and Behavior (J. Wixted, editor for Cognitive Psychology of Memory section)*, 2nd ed. Oxford: Elsevier.
Fivush R and Graci ME (2024) Autobiographical memory. In: Byrne JH (ed.), *Learning and Memory: A Comprehensive Reference, vol. 1. Learning Theory and Behavior (J. Wixted, editor for Cognitive Psychology of Memory section)*, 2nd ed. Oxford: Elsevier.
Gabbert F, Memon A, and Allan K (2003) Memory conformity: Can eyewitnesses influence each other's memories for an event? *Applied Cognitive Psychology* 17(5): 533–543. https://doi.org/10.1002/acp.1784.
Gabbert F, Memon A, Allan K, and Wrigth DB (2004) Say it to my face: Examining the effects of socially encountered misinformation. *Legal and Criminological Psychology* 9(2): 215–227. https://doi.org/10.1348/1355325041719428.
Gagnon LM and Dixon RA (2008) Remembering and retelling stories in individual and collaborative contexts. *Applied Cognitive Psychology* 22(9): 1275–1297. https://doi.org/10.1002/acp.1437.
Gallo DA (2010) False memories and fantastic beliefs: 15 years of the DRM illusion. *Memory & Cognition* 38(7): 833–848. https://doi.org/10.3758/MC.38.7.833.
Garcia-Marques L, Garrido MV, Hamilton DL, and Ferreira MB (2012) Effects of correspondence between encoding and retrieval organization in social memory. *Journal of Experimental Social Psychology* 48(1): 200–206. https://doi.org/10.1016/j.jesp.2011.06.017.
Garfield J (1993) Teaching statistics using small-group cooperative learning. *Journal of Statistics Education* 1(1): 1–9.
Gates AI (1917a) *Recitation as a Factor of Memorizing*. New York, NY: Archives of Psychology.
Gates AI (1917b) Recitation as a factor in memorizing. *Archives of Psychology* 40.
Glenberg AM (1979) Component-levels theory of the effects of spacing of repetitions on recall and recognition. *Memory & Cognition* 7(2): 95–112. https://doi.org/10.3758/BF03197590.
Graf P and Schacter DL (1985) Implicit and explicit memory for new associations in normal and amnesic subjects. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 11(3): 501–518. https://doi.org/10.1037/0278-7393.11.3.501.
Greeley GD and Rajaram S (2023) Collective memory: Collaborative recall synchronizes what and how people remember. *Wiley Interdisciplinary Reviews: Cognitive Science* 14(4): e1641. https://doi.org/10.1002/wcs.1641.
Greeley GD, Peña T, and Rajaram S (2022) Social remembering in the digital age: Implications for virtual study, work, and social engagement. *Memory, Mind & Media* 1: e13. https://doi.org/10.1017/mem.2022.3.
Greeley GD, Chan V, Choi HY, and 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.
Greene RL (1989) Spacing effects in memory: Evidence for a two-process account. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 15(3): 371–377. https://doi.org/10.1037/0278-7393.15.3.371.
Halbwachs M (1980) *The Collective Memory* (La Memoire Collective) (F.J. Ditter, Jr. and V.Y. Ditter, Trans.). New York: Harper & Row [Original Work Published 1950].
Halbwachs M and Coser LA (1992) *On Collective Memory*. University of Chicago Press.
Hamilton M and Rajaram S (2003) States of awareness across multiple memory tasks: Obtaining a "pure" measure of conscious recollection. *Acta Psychologica* 112: 43–69. https://doi.org/10.1016/S0001-6918(02)00100-2.
Harris CB, Keil PG, Sutton J, Barnier AJ, and McIlwain DJ (2011) We remember, we forget: Collaborative remembering in older couples. *Discourse Processes* 48(4): 267–303. https://doi.org/10.1080/0163853X.2010.541854.
Harris CB, Barnier AJ, and Sutton J (2012) Consensus collaboration enhances group and individual recall accuracy. *The Quarterly Journal of Experimental Psychology* 65(1): 179–194. https://doi.org/10.1080/17470218.2011.608590.
Harris CB, Barnier AJ, and Sutton J (2013) Shared encoding and the costs and benefits of collaborative recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 39(1): 183–195. https://doi.org/10.1037/a0028906.
Harris CB, Barnier AJ, Sutton J, Keil PG, and Dixon RA (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.
Henkel LA and 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.
Hirst W and Echterhoff G (2012) Remembering in conversations: The social sharing and reshaping of memories. *Annual Review of Psychology* 63(21): 55–79. https://doi.org/10.1146/annurev-psych-120710-100340.
Hirst W and Manier D (2008) Towards a psychology of collective memory. *Memory* 16(3): 183–200. https://doi.org/10.1080/09658210701811912.
Hyman IE Jr, Cardwell BA, and Roy RA (2013) Multiple causes of collaborative inhibition in memory for categorised word lists. *Memory* 21(7): 875–890. https://doi.org/10.1080/09658211.2013.769058.

Janis IL (1972) *Victims of Groupthink: A Psychological Study of Foreign-Policy Decisions and Fiascoes*. Oxford: Houghton Mifflin.
Johansson O, Andersson J, and Rönnberg J (2000) Do elderly couples have a better prospective memory than other elderly people when they collaborate? *Applied Cognitive Psychology* 14(2): 121–133. https://doi.org/10.1002/(SICI)1099-0720(200003/04)14:2%3C121::AID-ACP626%3E3.0.CO;2-A.
Johansson N, Andersson JAN, and Rönnberg J (2005) Compensating strategies in collaborative remembering in very old couples. *Scandinavian Journal of Psychology* 46(4): 349–359. https://doi.org/10.1111/j.1467-9450.2005.00465.x.
Johnson DW and Johnson RT (2009) An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher* 38(5): 365–379. https://doi.org/10.3102/0013189X09339057.
Karpicke JD and Roediger HL (2007) Repeated retrieval during learning is the key to long-term retention. *Journal of Memory and Language* 57(2): 151–162. https://doi.org/10.1016/j.jml.2006.09.004.
Karpicke JD and Roediger HL (2008) The critical importance of retrieval for learning. *Science* 319(5865): 966–968.
Keeler CM and Steinhorst RK (1995) Using small groups to promote active learning in the introductory statistics course: A report from the field. *Journal of Statistics Education* 3(2): 1–8. https://doi.org/10.1080/10691898.1995.11910485.
Kensinger E, Choi H-Y, Murray B, and Rajaram S (2016) How social interactions affect emotional memory accuracy: Evidence from collaborative retrieval and social contagion paradigms. *Memory & Cognition* 44(5): 706–716. https://doi.org/10.3758/s13421-016-0597-8.
Latané B, Williams K, and 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 EM and Bäuml KHT (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. https://doi.org/10.1037/xlm0000517.
Lehmer EM and Bäuml KHT (2018b) The many faces of part-list cuing—Evidence for the interplay between detrimental and beneficial mechanisms. *Frontiers in Psychology* 9: 372507. https://doi.org/10.3389/fpsyg.2018.00701.
Leman PJ and Oldham Z (2005) Do children need to learn to collaborate? The effect of age and age differences on collaborative recall. *Cognitive Development* 20(1): 33–48. https://doi.org/10.1016/j.cogdev.2004.07.002.
Luhmann CC and Rajaram S (2013) Mnemonic diffusion: An agent-based modeling investigation of collective memory. In: *Proceedings of the 35th Annual Conference of the Cognitive Science Society*, pp. 936–941.
Luhmann CC and Rajaram S (2015) Memory transmission in small groups and large networks an agent-based model. *Psychological Science* 26(12): 1909–1917. https://doi.org/10.1177/0956797615605798.
Luminet O, Bouts P, Delie F, Manstead ASR, and Rime B (2000) Social sharing of emotion following exposure to a negatively valenced situation. *Cognition & Emotion* 14(5): 661–688. https://doi.org/10.1080/026999300501176666.
Maki RH, Weigold A, and Arellano A (2008) False memory for associated word lists in individuals and collaborating groups. *Memory & Cognition* 36(3): 598–603. https://doi.org/10.3758/MC.36.3.598.
Marion SB and 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 EJ and Tversky B (2004) Spinning the stories of our lives. *Applied Cognitive Psychology* 18(5): 491–503. https://doi.org/10.1002/acp.1001.
Maswood R, Luhmann CC, and Rajaram S (2021) 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 and 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.
McDougall W (1920) *The Group Mind: A Sketch of the Principles of Collective Psychology, With Some Attempt to Apply Them to the Interpretation of National Life and Character*. New York, NY: GP Putnam's Sons.
Meade ML and Gigone D (2011) The effect of information distribution on collaborative inhibition. *Memory* 19(5): 417–428. https://doi.org/10.1080/09658211.2011.583928.
Meade ML and Roediger HL (2009) Age differences in collaborative memory: The role of retrieval manipulations. *Memory & Cognition* 37(7): 962–975. https://doi.org/10.3758/MC.37.7.962.
Meade ML, Nokes TJ, and Morrow DG (2009) Expertise promotes facilitation on a collaborative memory task. *Memory* 17(1): 39–48. https://doi.org/10.1080/09658210802524240.
Meudell PR, Hitch GJ, and Kirby P (1992) Are two heads better than one? Experimental investigations of the social facilitation of memory. *Applied Cognitive Psychology* 6(1): 525–543. https://doi.org/10.1002/acp.2350060606.
Meudell PR, Hitch GJ, and Boyle MM (1995) Collaboration in recall: Do pairs of people cross-cue each other to produce new memories? *The Quarterly Journal of Experimental Psychology* 48(1): 141–152. https://doi.org/10.1080/14640749508401381.
Momennejad I, Duker A, and Coman A (2019) Bridge ties bind collective memories. *Nature Communications* 10(1): 1578. https://doi.org/10.1038/s41467-019-09452-y.
Muller F, Bermejo F, and Hirst W (2016) Argentines' collective memories of the military Junta of 1976: Differences and similarities across generations and ideology. *Memory* 24(7): 990–1006. https://doi.org/10.1080/09658211.2015.1061013.
Nickerson RS (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, Li M, Xiao Y, and Wang S (2023) Together we lose or gain: Ongoing and enduring impacts of collaboration in episodic memory of emotional DRM lists. *Current Psychology* 42(32): 27965–27982. https://doi.org/10.1007/s12144-022-03940-z.
Olick JK and Robbins J (1998) Social memory studies: From" collective memory" to the historical sociology of mnemonic practices. *Annual Review of Sociology* 24: 105–140. https://doi.org/10.1146/annurev.soc.24.1.105.
Payne DG (1987) Hypermnesia and reminiscence in recall: A historical and empirical review. *Psychological Bulletin* 101(1): 5–27. https://doi.org/10.1037/0033-2909.101.1.5.
Peker M and Tekcan AI (2009) The role of familiarity among group members in collaborative inhibition and social contagion. *Social Psychology* 40(3): 111–118. https://doi.org/10.1027/1864-9335.40.3.111.
Pereira-Pasarin LP and Rajaram S (2011) Study repetition and divided attention: Effects of encoding manipulations on collaborative inhibition in group recall. *Memory & Cognition* 39(6): 968–976. https://doi.org/10.3758/s13421-011-0087-y.
Pociask S and 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.
Pritchard ME and Keenan JM (2002) Does jury deliberation really improve jurors' memories? *Applied Cognitive Psychology* 16(5): 589–601. https://doi.org/10.1002/acp.816.
Raaijmakers JG and Shiffrin RM (1981) Search of associative memory. *Psychological Review* 88(2): 93–134. https://doi.org/10.1037/0033-295X.88.2.93.
Rajaram S and Pereira-Pasarin LP (2007) Collaboration can improve individual recognition memory: Evidence from immediate and delayed tests. *Psychonomic Bulletin & Review* 14(1): 95–100. https://doi.org/10.3758/BF03194034.
Rajaram S and Pereira-Pasarin LP (2010) Collaborative memory: Cognitive research and theory. *Perspectives on Psychological Science* 5(6): 649–663. https://doi.org/10.1177/1745691610388763.
Reese E and Fivush R (2008) The development of collective remembering. *Memory* 16(3): 201–212. https://doi.org/10.1080/09658210701806516.
Reysen M (2005) The effects of conformity on recognition judgements. *Memory* 13(1): 87–94. https://doi.org/10.1080/09658210344000602.
Rimé B (2009) Emotion elicits the social sharing of emotion: Theory and empirical review. *Emotion Review* 1(1): 60–85. https://doi.org/10.1177/1754073908097189.
Roediger HL and Abel M (2015) Collective memory: A new arena of cognitive study. *Trends in Cognitive Sciences* 19(7): 359–361. https://doi.org/10.1016/j.tics.2015.04.003.

Roediger HL and DeSoto KA (2016) Recognizing the presidents was alexander Hamilton president? *Psychological Science* 27(5): 644–650. https://doi.org/10.1177/0956797616631113.
Roediger HL and Karpicke JD (2006a) The power of testing memory: Basic research and implications for educational practice. *Perspectives on Psychological Science* 1(3): 181–210. https://doi.org/10.1111/j.1745-6916.2006.00012.x.
Roediger HL and Karpicke JD (2006b) Test-enhanced learning taking memory tests improves long-term retention. *Psychological Science* 17(3): 249–255. https://doi.org/10.1111/j.1467-9280.2006.01693.x.
Roediger HL and McDermott KB (1995) Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 21(4): 803–814. https://doi.org/10.1037/0278-7393.21.4.803.
Roediger HL, Meade ML, and Bergman ET (2001) Social contagion of memory. *Psychonomic Bulletin & Review* 8(2): 365–371. https://doi.org/10.3758/BF03196174.
Roenker DL, Thompson CP, and Brown SC (1971) Comparison of measures for the estimation of clustering in free recall. *Psychological Bulletin* 76(1): 45–48. https://doi.org/10.1037/h0031355.
Ross M, Spencer SJ, Linardatos L, Lam KC, and 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.
Ross M, Spencer SJ, Blatz CW, and 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.
Rossi-Arnaud C, Spataro P, Santirocchi A, Pesola MC, Costantini L, and Cestari V (2024) Positive and negative effects of collaboration on suggestibility and false memory in online groups. *Current Psychology* 43(6): 5703–5715. https://doi.org/10.1007/s12144-023-04775-y.
Rubin DC (1997) *Memory in Oral Traditions: The Cognitive Psychology of Epic, Ballads, and Counting-Out Rhymes*. New York, NY: Oxford University Press.
Rundus D (1971) Analysis of rehearsal processes in free recall. *Journal of Experimental Psychology* 89(1): 63–77. https://doi.org/10.1037/h0031185.
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.
Saraiva M and Garrido MV (2024) Misinformation in social interaction: Examining the role of discussion. *Memory* 32(2): 156–165. https://doi.org/10.1080/09658211.2023.2300671.
Slavin RE (1991) Synthesis of research on cooperative learning. *Educational Leadership* 48(5): 71–82.
Sternberg RJ and Tulving E (1977) The measurement of subjective organization in free recall. *Psychological Bulletin* 84(3): 539–556. https://doi.org/10.1037/0033-2909.84.3.539.
Stone CB, van der Haegen A, Luminet O, and Hirst W (2014) Personally relevant vs. nationally relevant memories: An intergenerational examination of World War II memories across and within Belgian French-speaking families. *Journal of Applied Research in Memory and Cognition* 3(4): 280–286. https://doi.org/10.1016/j.jarmac.2014.08.002.
Takahashi M and Saito S (2004) Does test delay eliminate collaborative inhibition? *Memory* 12(6): 722–731. https://doi.org/10.1080/09658210344000521.
Thomson DM and Tulving E (1970) Associative encoding and retrieval: Weak and strong cues. *Journal of Experimental Psychology* 86(2): 255–262. https://doi.org/10.1037/h0029997.
Thorley C and Dewhurst SA (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.
Thorley C and Dewhurst SA (2009) False and veridical collaborative recognition. *Memory* 17(1): 17–25. https://doi.org/10.1080/09658210802484817.
Tulving E (1962) Subjective organization in free recall of "unrelated" words. *Psychological Review* 69(4): 344–354. https://doi.org/10.1037/h0043150.
Tulving E and Psotka J (1971) Retroactive inhibition in free recall: Inaccessibility of information available in the memory store. *Journal of Experimental Psychology* 87(1): 1–8. https://doi.org/10.1037/h0030185.
Vygotsky LS (1962) *Language and Thought*. Ontario: Massachusetts Institute of Technology Press.
Vygotsky L (1978) Interaction between learning and development. *Readings on the Development of Children* 23(3): 34–41.
Wang Q (2008) On the cultural constitution of collective memory. *Memory* 16(3): 305–317. https://doi.org/10.1080/09658210701801467.
Wegner DM (1987) Transactive memory: A contemporary analysis of the group mind. In: *Theories of Group Behavior*, pp. 185–208. New York: Springer.
Weigold A, Russell EJ, and Natera SN (2014) Correction of false memory for associated word lists by collaborating groups. *The American Journal of Psychology* 127(2): 183–190. https://doi.org/10.5406/amerjpsyc.127.2.0183.
Weldon MS (2001) Remembering as a social process. In: Medin DL (ed.) *The Psychology of Learning and Motivation: Advances in Research and Theory*, pp. 67–120. San Diego, CA: Academic Press.
Weldon MS and Bellinger KD (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 MS, Blair C, and Huebsch PD (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 JV and Roediger HL III (2008) Collective memory: Conceptual foundations and theoretical approaches. *Memory* 16(3): 318–326. https://doi.org/10.1080/09658210701801434.
Wertsch JV, Roediger HL, and Zerr CL (2022) Collective memory: Conceptual foundations and group formation. In: *Cultural Memory*, pp. 95–106. Routledge.
Wessel I, Zandstra ARE, Hengeveld HM, and Moulds ML (2015) Collaborative recall of details of an emotional film. *Memory* 23(3): 437–444. https://doi.org/10.1080/09658211.2014.895384.
Wixted JT, Ghadisha H, and Vera R (1997) Recall latency following pure-and mixed strength lists: A direct test of the relative strength model of free recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 23(3): 523–528. https://doi.org/10.1037/0278-7393.23.3.523.
Wright DB and 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.
Yamashiro JK and Hirst W (2014) Mnemonic convergence in a social network: Collective memory and extended influence. *Journal of Applied Research in Memory and Cognition* 3(4): 272–279. https://doi.org/10.1016/j.jarmac.2014.08.001.
Yaron-Antar A and 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.
Zaromb FM and Roediger HL III (2010) The testing effect in free recall is associated with enhanced organizational processes. *Memory & Cognition* 38(8): 995–1008. https://doi.org/10.3758/MC.38.8.995.
Zaromb F, Butler AC, Agarwal PK, and Roediger HL III (2014) Collective memories of three wars in United States history in younger and older adults. *Memory & Cognition* 42(3): 383–399. https://doi.org/10.3758/s13421-013-0369-7.