Published in final edited form as:

Memory. 2017 September ; 25(8): 1148–1159. doi:10.1080/09658211.2016.1274405.

"Going Episodic": Collaborative Inhibition and Facilitation When Long-Married Couples Remember Together

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Abstract

Two complementary approaches to the study of collaborative remembering have produced contrasting results. In the experimental "collaborative recall" approach within cognitive psychology, collaborative remembering typically results in 'collaborative inhibition': laboratory groups recall fewer items than their estimated potential. In the cognitive ageing approach, collaborative remembering with a partner or spouse may provide cuing and support to benefit older adults' performance on everyday memory tasks. To combine the value of experimental and cognitive ageing approaches, we tested the effects of collaborative remembering in older, long-married couples who recalled a non-personal word list and a personal semantic list of shared trips. We scored amount recalled as well as the kinds of details remembered. We found evidence for collaborative inhibition across both tasks when scored strictly as number of list items recalled. However, we found collaborative facilitation of specific episodic details on the personal semantic list, details which were not strictly required for the completion of the task. In fact, there was a trade-off between recall of specific episodic details and number of trips recalled during collaboration. We discuss these results in terms of the functions of shared remembering and what constitutes memory success, particularly for intimate groups and for older adults.

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We often remember the past in conversation with others. Two perspectives adopt complementary views on how best to conceptualise and quantify the costs and benefits of collaborative remembering (e.g., Dixon, 1999; Weldon & Bellinger, 1997). Within an experimental, laboratory-based approach in cognitive psychology, the canonical method is the *collaborative recall paradigm*, in which researchers compare the recall output of collaborating groups with that of nominal groups. Nominal group scores estimate the potential recall of a group of individuals, and are calculated by pooling the non-redundant recall of individuals recalling alone. A consistent finding is that collaboration is detrimental; collaborative groups recall less than nominal groups, an effect known as "collaborative inhibition" (see reviews by Harris, Paterson, & Kemp, 2008; Rajaram & Pereira-Pasarin, 2010). Notably, equivalent collaborative inhibition has been observed in younger and older adult groups (Henkel & Rajaram, 2011; Meade & Roediger, 2009; Ross, Spencer, Blatz, & Restorick, 2008).

Collaborative inhibition is typically attributed to retrieval disruption, where each individual recalls fewer items when exposed to contributions of other group members than they would have recalled alone, as hearing items from other group members causes them to depart from their idiosyncratic individual retrieval strategy (see Harris et al., 2008). Other mechanisms such as production blocking (Nijstad, Stroebe, & Lodewijkx, 2003; but see Wright & Klumpp, 2004), limited search (Hyman, Cardwell, & Roy, 2013), and retrieval inhibition (Barber, Harris, & Rajaram, 2015) may also explain the group detriment, and multiple processes may operate simultaneously to bring about collaborative inhibition (see also Barber et al., 2015; Hyman et al., 2013; Rajaram & Pereira-Pasarin, 2010). For instance, Hyman et al. (2013) found that collaborating groups sample from fewer categories than nominal pairs, such that collaboration resulted in groups terminating their search earlier. Moreover, although it might be expected that group members cross-cue each other to recall additional items, such cross cuing has rarely been identified in laboratory groups, and is not sufficient to offset the losses associated with retrieval disruption (Rajaram & Pereira-Pasarin, 2010; but see Harris, Barnier, & Sutton, 2013).

Although there are many strengths of this approach, most laboratory-based collaborative recall experiments have tested primarily young adults performing word-list recall tasks in groups of strangers, with measured outcomes limited to the number of list items recalled (for a notable exception see Meade, Nokes, & Morrow, 2009). There are however a handful of collaborative recall studies that have compared collaborative and nominal performance in intimate groups, particularly older long-married couples, recalling richer and more personal information such as stories (Johansson, Andersson, & Rönnberg, 2005), personally-developed shopping lists and familiar landmarks (Ross, Spencer, Linardatos, Lam, & Perunovic, 2004), and personally-relevant information about mutual acquaintances or events (Harris, Keil, Sutton, Barnier, & McIlwain, 2011). Although Johansson et al. (2005) and Ross et al. (2004) both reported overall collaborative inhibition, findings have suggested that underneath this broad group effect, at least some couples showed collaborative facilitation instead of inhibition, such that they remembered more to-be-recalled information when they collaborated instead of less (Harris et al., 2011; Johansson et al., 2005). These benefits depended on the use of specific and functional communication strategies available to collaborating long-term couples (Harris et al., 2011) and on agreement and division of

responsibility within the couple (Johansson et al., 2005). These studies provide some evidence that collaborative facilitation and cross-cuing are possible – collaborative groups can out-perform nominal groups – at least for particular groups remembering particular kinds of information. Such collaborative benefits may be due to well-developed systems for communicating and coordinating joint recall that older couples (compared to convenience groups of strangers) have developed, because they are well practised in remembering together ("transactive memory systems"; Wegner, 1987).

An alternative approach with similar research questions has developed relatively independently, in the collaborative cognition and ageing literature (Dixon, 2013). Within this literature, the effects of collaboration are often measured in terms of supplemental aspects of recall-related performance, interactive processes, and qualities of recall rather than simply amount recalled on a word list (Dixon, 2013; Gagnon & Dixon, 2008; Gould & Dixon, 1993), and studies of collaboration typically include more ecologically relevant memory tasks such as story recall (Gagnon & Dixon, 2008), autobiographical episodes (Gould & Dixon, 1993; Kemper, Lyons, & Anagnopoulos, 1995), life stories and personal facts (Usita, Hyman, & Herman, 1989), or prospective memory tasks (Margrett, Reese-Melancon, & Rendell, 2011). Older couples in particular have been found to collaborate effectively: they remember more together than older stranger dyads, and produce more elaborations, more reminisced items, and fewer negative statements about their memories than pairs of strangers (Gagnon & Dixon, 2008; Gould, Trevithick, & Dixon, 1991). Even in the case of Alzheimer's disease, there is some evidence that spouses can elicit autobiographical memories and personal information that the patient would not otherwise remember (Kemper et al., 1995; Usita et al., 1989).

Given the emerging possibility of collaborative benefits –for certain groups under certain circumstances and with a broader range of performance indicators – there is increasing interest within the collaborative recall literature in collaboration as a compensatory strategy for older adults who experience individual memory problems and cognitive decline (Blumen, Rajaram, & Henkel, 2013). However, laboratory-based collaborative recall studies generally have not studied the full range of effects of collaboration, particularly for more everyday, personally-meaningful material where how much is remembered may not be the most important metric of success (Gagnon & Dixon, 2008; Gould & Dixon, 1993; Marsh, 2007; see Barnier, Harris, & Congleton, 2013; Dixon, 2013). Remembering the past – both alone and with others – serves important functions for individuals and groups, and maximising reproductive recall output is less likely to be the primary goal of day-to-day remembering than is the shared retelling of narratives. Collaborating on recalling shared events can shape identity as well as our understanding of ourselves and our relationships. Sharing memories helps to maintain intimacy and link generations, particularly as we age (Harris, Rasmussen, & Berntsen, 2014).

On the other hand, in the collaborative cognition and ageing literature, the possible benefits of collaboration for older adults have long been of interest (see Dixon, 1999, 2011, 2013), and collaboration has been noted as a possible compensatory strategy for promoting adaptive everyday memory performance in older adults (Bäckman & Dixon, 1992; Hydén, 2011; Kemper, Lyons, & Anagnopoulos, 1995; Rauers, Riediger, Schmiedek, & Lindenberger,

2010; Usita, Hyman, & Herman, 1998). However, within this literature, collaborative success is operationalised in a number of different ways. Studies have utilised a variety of comparison groups (e.g. older pairs vs. younger pairs, couples vs. stranger pairs, collaborating pairs vs. single individuals) and performance and process measures. Notably, many of these conditions do not accommodate the use of nominal groups, making it difficult to make direct comparisons across the literatures. Without a nominal group comparison, it is possible that benefits of shared remember are only from the combining of two individuals' recall and not from the collaboration per se. Correspondingly, it is also unclear how the additional quantitative, qualitative, and process-based measures could be compared with nominal groups, as is the extent to which such measures are related to concepts of collaborative inhibition and facilitation from the laboratory-based collaborative recall literature. We need more integrative research to understand how collaborative inhibition and facilitation might best be conceptualised and scored in more real world contexts, especially for the kinds of personal memories that are important to people (Barnier et al., 2013). Combining methods and insights from the experimental collaborative recall literature and the cognitive ageing literature offers us a way to understand the full range of influences of collaboration (Dixon, 2013), especially with any move towards utilising collaborative recall as a therapy for enhancing and supporting memory in older adults (Barnier et al., 2013).

One important metric of successful remembering may be the particular details recalled. Older adults have been found to have an "episodic deficit"; they remember fewer specific episodic details and more semantic or external details when recalling autobiographical memories (Addis, Musicaro, Pan, & Schacter, 2010; Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002). This episodic deficit is argued to reflect fundamental neural changes with ageing that reduce older adult's ability to recall these kinds of details (Martinelli et al., 2013; Murphy, Troyer, Levine, & Moscovitch, 2008; Piolino, Desgranges, Benali, & Eustache, 2002), although longitudinal research suggests individual differences in episodic memory decline over time (Josefsson, De Luna, Pudas, Nilsson, & Nyberg, 2012). However, in addition to indicating differences in memory ability and neurocognitive changes across the lifespan, recalling different kinds of details might also serve different functions, especially for personal, autobiographical stimuli. That is, older adults may recall fewer episodic details because they cannot access them. However, an alternative and compatible explanation is that older adults prioritise different kinds of information, and focus on providing broader context and explanation, particularly for a younger experimenter who did not share the experience (James, Burke, Austin, & Hulme, 1998).

Thus, it is important to consider that much everyday collaborative memory occurs in a dynamic and interactive context. This includes the "audience" inherent in memory tasks, particularly when the task involves complex, autobiographical memories that can be recalled in different ways to fulfil different functions (Hirst & Echterhoff, 2012; Hyman, 1994; Marsh & Tversky, 2004; Pasupathi, Lucas, & Coombs, 2002). For instance, Hyman (1994) found that participants included more evaluations and less details when recalling stories for a peer rather than an experimenter. Collaborative remembering of personal stimuli shifts the audience of remembering: while individual recall is targeted to an experimenter or interviewer, collaborative remembering with an intimate partner now involves a broader audience, particularly one who has shared events and reminisced about it before. Thus,

collaborative remembering may result in the inhibition and facilitation of particular kinds of details consistent with this shift in audience, over and above the overall amount of information recalled.

In designing the current study, we selectively combined concepts from the collaborative recall, cognitive ageing, and functions of remembering literatures to study broader effects of collaboration on memory. We examined the *amount* recalled and the *kinds of details* recalled when older, long-married couples either remembered collaboratively or remembered alone. Motivated by the focus of experimental research on collaborative recall, we compared the amount recalled by collaborative and nominal groups across two different kinds of list tasks: a word list (as used in standard collaborative recall experiments) and a personally-relevant list (shared trips) that tested 'personal semantic memory' (Renoult, Davidson, Palombo, Moscovitch, & Levine, 2012). We expected that couples might show reduced collaborative inhibition for more personal material compared to less personal material, since they might be able to utilise their shared history and experiences to facilitate each other's recall (Wegner, 1987; Harris et al., 2013). To understand the processes that might result in collaborative inhibition vs. facilitation (i.e. the balance between retrieval episodic and semantic details recalled by collaborative and nominal groups while completing the personally-relevant list task. Although the list task formally tested personal semantic memory and did not require episodic information, participants' shared (episodic and semantic) autobiographical memories might be useful for cross-cuing recall. We expected that collaboration might influence the kinds of details recalled, over and above its influence on the number of items recalled.

Method

Participants

Participants were 38 (19 women, 19 men) older adults, ranging in age from 69 to 86 years (M = 77.18, SD = 5.12). They made up 19 heterosexual, long-term couples, married for between 15 and 62 years (M = 50.68, SD = 9.92). We recruited participants from local branches of the Rotary and Probus organization in Sydney, Australia. Participants were simply told we were interested in learning more about the way that couples remember, both alone and together, and that they may be asked to talk about life events. We did not conduct formal neuropsychological assessment, but participants were a community sample living independently in their own homes and reported that they had not received any diagnosis of memory problems. We paid participants AU $50 each ($100 per couple), and randomly allocated couples to either a nominal (n = 9 couples) or collaborative condition (n = 10 couples). There were no significant differences in participant age or years married across conditions, all Fs < 3.10, all ps > .09.

Materials

Word List—The word list stimuli came from the Hopkins Verbal Learning Test– Revised (HVLT–R; Benedict, Schretlen, Groninger, & Brandt, 1998). The HVLT–R consists of six equivalent lists of 12 words, with 4 words from each of 3 categories. Words are concrete nouns and are high-frequency category exemplars (e.g., gemstones: opal, pearl; animals:

cow, horse). As per the standard methodology, words were presented in a randomised order, without any category labels, such that the categorical associations between items were implicit. Because of possible ceiling effects (Harris et al., 2011) we combined List 1 and List 4 to develop a set of 24 words (4 words from 6 categories).

Procedure

The memory tasks reported here were collected in the context of a broader study in which participants recalled a range of memory materials, including a number of detailed autobiographical memories. Results from these additional memory tasks are not reported here, and we focus our analysis on the two list-based tasks described in detail below. All sessions were audiorecorded with the participants' permission.

Session 1—Two experimenters arrived at each couple's home, introduced themselves to participants, and obtained informed consent. Couples then separated and the remainder of Session 1 was conducted as simultaneous individual interviews. First, we asked participants to recall a list of trips or vacations they had been on with their partner since they were married. To make the list output comparable across participants and recall occasions, we instructed participants to list and label discrete trips (i.e., "in 2006 we travelled around Europe") rather than simply listing individual places visited during each trip (i.e., "Greece, Italy, Spain") or providing additional details about the trips. Once recall appeared blocked, the experimenter gave one standard prompt, "Is there anything else you can remember?", before terminating the recall test. Next, we conducted the word list recall task. The experimenter presented a list of 24 words on a laptop computer. Words appeared in the centre of the screen at a rate of 1 word per 5 seconds. Then after a 5-minute delay during which participants recalled an autobiographical event (results not reported here), participants completed a recall test in which they listed aloud as many of the words as they could recall. Once recall appeared blocked, the experimenter gave one standard prompt, "Is there anything else you can remember?", before terminating the recall test. Finally, participants spent 5 minutes recalling a second autobiographical event (results not reported here).

Session 2—Session 2 commenced immediately after Session 1. Half of the couples (n = 10) completed Session 2 collaboratively; half (n = 9) completed Session 2 individually and their responses were later pooled to make nominal groups. Couples in the collaborative condition completed the same memory tasks as before but in a joint interview with both the interviewers present. After coming back together, the interviewer explained that they should give each task "a fresh go" and remember as much as possible. Couples in the nominal condition also completed the same memory tasks as before, but they remained in their separate rooms and the interviewers swapped places from Session 1. These couples were similarly told that they should give each task "a fresh go" with the new interviewer and remember as much as possible.

In Session 2, we began by conducting the word list task. Participants again recalled the words they had studied in Session 1. Couples in the collaborative condition were encouraged to work together to complete this task. Couples in the nominal condition completed this task on their own exactly as they had during Session 1. Once recall appeared blocked, the

experimenter gave one standard prompt, “Is there anything else you can remember?”, before terminating the recall test. Then, we conducted the personal list task exactly as in Session 1, with the same instructions not to list each individual place visited or to provide additional details about the trips. The only difference was that couples in the collaborative condition recalled together and couples in the nominal condition recalled individually. Once recall appeared blocked, the experimenter gave one standard prompt, “Is there anything else you can remember?”, before terminating the recall test. Finally, participants recalled the two autobiographical events again and individually completed several questionnaires and a semi-structured interview about their everyday memory practices, the results of which are not reported here.

Interviews were conducted by one male and one female interviewer. We counterbalanced interviewer across couples and conditions. For the collaborative condition, half of the couples completed Session 1 with a gender matched interviewer and half with an opposite gender interviewer, before completing Session 2 together (with both interviewers). For the nominal condition, half of the couples completed Session 1 with a gender matched interviewer and half with an opposite gender interviewer, before the interviewers switched places for Session 2.

Scoring and Coding

All recall sessions were transcribed verbatim from the audiorecording for scoring and coding purposes. To determine whether collaboration resulted in collaborative inhibition or facilitation, we scored the change in the number of items recalled across recall occasions in both memory tasks. For the word list task, we counted words correctly recalled from the study list. For the personal semantic task, we counted the number of unique trips mentioned; we only counted each trip once regardless of whether it was mentioned more than once, and we had no objective measure for accuracy (i.e. we counted every trip mentioned as a correct item).

In the collaborative recall literature, collaborative inhibition occurs when collaborative groups recall less than “nominal groups” consisting of the same number of individuals recalling alone, because individuals forget items during collaboration that they would have otherwise recalled. We pooled non-redundant individual recall to calculate nominal group scores for each of the individual recall occasions, so that the unit of analysis was couples throughout. Thus our design was 2 (condition: collaborative vs. nominal) × (2) (recall occasion: 1 vs. 2). We also compared couples to their own baseline of individual recall in Session 1. Because of individual differences in baseline output at Recall 1 especially for personally-relevant material, we indexed the effects of collaboration by calculating a ‘percentage change score’ for each couple in both conditions. This was computed as the difference between Recall 2 and Recall 1, as a percentage of Recall 1, such that a negative score indicated lower Recall 2 performance than Recall 1 performance. For collaborative couples, this change would measure the effects of collaboration, and for the nominal control couples this change would measure the effects of simply recalling twice. Thus, a difference in “percentage change scores” between conditions would indicate the effects of collaboration over and above the effects of recalling twice.

To give further insight into the effects of collaboration on memory, we calculated two additional indices: (1) items 'gained' across recall occasions: the percentage of Recall 2 items that were new items that neither partner had produced at Recall 1; and (2) items 'lost' across recall occasions: the percentage of Recall 1 items that had been produced by at least one partner but then not recalled during Recall 2. We expected that new items gained might indicate the operation of cross-cuing, while old items lost might indicate the operation of retrieval disruption (see Harris et al., 2013, for a similar argument). The balance of these two processes would lead to the net effect of collaboration, potentially either collaborative inhibition or collaborative facilitation. Again, for couples in the collaborative condition, items gained and lost would measure the effects of collaboration, and for couples in the nominal control condition, items gained and lost would index the effects of simply recalling twice.

To determine whether collaboration produced differences in the nature of details recalled, we coded the transcripts for the presence of episodic recall during the personal list task. Based on distinctions in the literature between different levels of specificity in autobiographical recall (Raes, Hermans, Williams, & Eelen, 2007), we coded three kinds of episodic details. These details were technically unnecessary to the task of listing trips; utterances that were counted when scoring amount recalled (as described above) were not counted in these qualitative coding categories. First, we coded "episodic-specific" details or utterances referring to a specific, time limited event (e.g. "It was so hot in that train"). Second, we coded "episodic-extended" details, referring to a lengthier event that ran over multiple days (e.g., "we had a campervan/ and we travelled throughout Europe/with the three kids"). Third, we coded "episodic-categoric" details, referring to repeated events (e.g. "We would usually spend about 10 days there"). Fourth, we coded semantic details extraneous to the list (e.g. "we love cruising"). Trained coders counted each discrete "idea unit" as one detail (e.g., the example given above for "episodic-extended" was counted as three details: we had a campervan (1), we travelled throughout Europe (2), and with the three kids (3)). One primary coder coded all the transcripts, and a second coder coded 50% of the transcripts across conditions. Their inter-rater reliability (measured by correlations between raters' total scores on each of the four detail types, since the scores were continuous) was high, all rs > 0.87. As for item recall, we scored change in each type of detail across recall occasions, as a percentage of total details scored for baseline Recall 1, and we compared collaborating couples to separate recall by individuals in the nominal condition. The time taken to complete the different recall tasks was measured from the audiorecording for all individuals and couples across recall sessions.

Results

Differences in Amount Recalled

Word list task—For couples who collaborated, their pooled individual Recall 1 performance averaged 16.80 items (SD = 4.76) and their collaborative Recall 2 performance averaged 15.00 items (SD = 4.76). For couples who did not collaborate, their pooled individual Recall 1 performance averaged 14.44 items (SD = 2.30) and their pooled individual Recall 2 performance averaged 14.11 (SD = 2.36). There was a great deal of

individual difference in initial recall performance, with scores for individuals on Recall 1 ranging from 3 to 20 items from the 24-item list. To adjust for these individual differences, we calculated percentage scores to score couples against their own baseline, and we used these in the analyses below to determine the effects of collaboration on recall. As noted above, we calculated three scores for each couple (see Table 1 for the means): (1) overall net change, subtracting Recall 2 scores from Recall 1 scores, as a percentage of Recall 1, such that a positive number would indicate a net gain across recall occasions and a negative number would indicate a net loss; (2) percentage of "items gained", calculated as the percentage of Recall 2 items that were new items not previously recalled; and (3) percentage of "items lost", calculated as the percentage of Recall 1 items that did not re-appear at Recall 2. Participants also varied in age, and age of both wives and husbands within the couple was correlated with pooled, baseline Recall 1 performance, $r = -.82$, $p < .001$, and $r = -.72$, $p = .001$ respectively, such that older individuals recalled less. Therefore we included the age of both wife and husband as covariates in the analyses reported below. Despite variations in length of relationship, this was not significantly correlated with pooled, baseline Recall 1 performance, $r = -.13$, $p = .585$, and so we did not include this in any subsequent analyses.

A 2-level (Condition) one-way ANOVA on the percentage change scores yielded a trend for an effect of condition on overall percentage change, $F(1, 15) = 3.77$, $p = .071$, $\eta_p^2 = .20$, such that those in the collaborative condition tended to show decreased recall across recall occasions of about 12% (see Table 1), consistent with typical collaborative inhibition effects. Overall across conditions, 8.62% of Recall 2 output consisted of new items not previously recalled. There was no difference between conditions in terms of percentage of items gained, $F(1, 15) = 0.86$, $p = .367$, $\eta_p^2 = .05$. 95% confidence intervals suggested that percentage of items gained were positive for both collaborative and nominal condition (see Table 1). For percentage of items lost, overall across conditions, 14.93% of Recall 1 items were not recalled on Recall 2. However, there was a significant effect of condition, $F(1,15) = 4.94$, $p = .042$, $\eta_p^2 = .25$. 95% confidence intervals suggested that the couples in the collaborative condition lost items across recall occasions, while the percentage of items lost by those in the nominal condition was not different from zero (see Table 1). Overall, these results suggest collaborative inhibition for long-married couples on this word list task, driven by a disruption of individual retrieval strategies in the collaborative condition (whereby couples forgot previously recalled items when they collaborated), as well as no evidence for cross-cuing (such that couples did not tend to generate additional new items during collaboration).

Personal list task—For couples who collaborated, their pooled individual Recall 1 performance averaged 20.70 trips ($SD = 6.22$) and their collaborative Recall 2 performance averaged 17.30 ($SD = 6.84$). For couples who did not collaborate, their pooled individual Recall 1 performance averaged 18.56 trips ($SD = 5.85$) and their pooled individual Recall 2 performance averaged 21.44 trips ($SD = 7.75$). There was a great deal of individual difference in initial recall performance, with scores for individuals on Recall 1 ranging from 4 to 25 items, and with no set maximum. As for the word list, to adjust for these individual differences, we calculated percentage scores to score couples against their own baseline, and we used these in the analyses below to determine the effects of collaboration on recall. Once again, we calculated three scores for each couple (see Table 2 for the means): (1) overall net

change; (2) percentage of “items gained”; and (3) percentage of “items lost”. Although participants varied in age and length of relationship, neither the age of wives and husbands within the couple nor the length of their relationship were significantly correlated with pooled, baseline Recall 1 performance, all *r*s < .36, all *p*s > .134. Therefore we did not include these variables in any subsequent analyses.

A 2 (Condition) one-way ANOVA on the percentage change scores yielded a significant effect of condition, $F(1, 17) = 9.27$, $p = .007$, $\eta_p^2 = .35$. 95% confidence intervals suggested that the change for those in the collaborative condition was negative, while the change for those in the nominal condition was not different from zero, although they tended to remember more across occasions (see Table 2). The analysis of items gained and lost also indicated collaborative inhibition. There was no difference between conditions in terms of items gained, $F(1, 17) = 1.09$, $p = .310$, $\eta_p^2 = .06$. 95% confidence intervals suggested that the couples in both groups gained new trips across recall occasions (see Table 2). For items lost however, there was a significant effect of condition, $F(1, 17) = 10.52$, $p = .005$, $\eta_p^2 = .38$. 95% confidence intervals suggested couples who collaborated lost more items than couples who did not collaborate (see Table 2). Overall, these results suggest collaborative inhibition for long-married couples on this personal semantic list task. With a similar pattern of results to the non-personal list task, this inhibition was driven by a disruption of individual retrieval strategies in the collaborative condition (whereby couples forgot previously recalled items when they collaborated), as well as no evidence for cross-cuing (such that couples did not tend to generate additional new items during collaboration).

Differences in Details Recalled

During the personal list task (listing shared trips), many couples who collaborated began to reminisce about events associated with their trips, inconsistent with an interpretation of their performance solely in terms of collaborative inhibition. Instead, collaboration was often characterised by lively discussion and detailed remembering. We transcribed their collaborative recall and scored the transcripts for four kinds of additional details: episodic-specific, episodic-extended, episodic-categoric, and semantic. For this analysis it was not possible to pool details recalled to calculate nominal scores, and so we compared collaborating couples ($n = 10$ couples) with individuals from the nominal condition ($n = 18$ individuals). For the collaborating couples, we calculated their Session 1 scores as the average of the two individuals.

On average, couples who collaborated recalled 52.30 additional details ($SD = 23.78$) in their individual session 1, and 73.10 additional details ($SD = 38.96$) when they collaborated, while those individuals who did not collaborate recalled 37.61 additional details ($SD = 22.33$) and 42.33 additional details ($SD = 22.53$) in their two individual recall sessions respectively. There was large variability, ranging from an individual recalling 7 additional details, to a collaborating couple recalling 150 additional details. For the total additional details scored, we conducted a 2 (Condition: collaborative vs. nominal) × (2) (Session: 1 vs. 2) mixed models ANOVA. This analysis yielded a condition main effect, $F(1,26) = 5.95$, $p = .022$, $\eta_p^2 = .19$, and a session main effect, $F(1,26) = 7.86$, $p = .009$, $\eta_p^2 = .23$, but the interaction was not significant, $F(1,26) = 3.13$, $p = .088$, $\eta_p^2 = .108$. That is, collaborative

couples recalled more additional details than nominal couples regardless of recall session, and Session 2 included more additional details than Session 1 regardless of condition. Overall, despite these differences and the complexities of comparing single individuals with collaborating couples, all couples included a large number of additional details in both individual and collaborative recall sessions (see Table 3).

To look for differences across conditions and to avoid collaborative groups scoring more simply because they involved two individuals instead of one, we calculated the percentage of total details that belonged to each of the four categories (see Table 3). Note that because the percentages take into account the total number of details produced, the average number of details in Table 3 does not necessarily match the average percentage. For each of the percentages of each of the four kinds of details scored, we conducted a 2 (Condition: collaborative vs. nominal) × (2) (Session: 1 vs. 2) mixed models ANOVA. For specific episodic details, this analysis yielded a near significant Condition × Session interaction, $F(1,26) = 4.05$, $p = .055$, $\eta_p^2 = .135$. 95% confidence intervals (see Table 3) suggested that, during individual Session 1, all couples recalled few specific episodic details, not different from zero. In Session 2, individuals in the nominal condition still recalled few specific episodic details, and were not different from zero. However, couples in the collaborative condition now recalled a significant percentage of specific episodic details, with very high numbers of these details recalled for some couples.

For extended and categoric episodic details, this analysis yielded no significant main effects or interactions, all Fs < 0.46, all ps > .505. 95% confidence intervals confirmed that in both conditions, the majority of details recalled were from these two categories, and this did not change across recall sessions (see Table 3). Finally, for semantic details, the analysis yielded a significant Condition × Session interaction, $F(1,26) = 6.53$, $p = .017$, $\eta_p^2 = .201$. 95% confidence intervals (see Table 3) suggested that, during individual Session 1, all couples recalled semantic details. However, for couples in the collaborative condition, although the raw number of details produced, the percentage of total details that were semantic decreased in collaborative Session 2 and was not greater than zero. Taken together, these analyses indicate that, while all individuals and couples recalled a large number of additional, extraneous details, collaborating couples showed a particular increase in recall of specific episodic details and a relative decrease in recall of semantic details when they collaborated.

Interestingly, for couples in the collaborative condition, the percentage of trips “lost” during collaboration was significantly associated with the percentage of specific episodic details recalled in their collaborative recall (Recall 2), $r = .81$, $p = .005$. Including more detailed episodic reminiscing during collaboration was associated with loss of (countable) items from individual recall (Recall 1). Conversely, couples’ recall of more general, extended episodic details was associated with new trips gained during collaboration, $r = .81$, $p = .004$, and negatively associated with trips lost during collaboration, $r = -.79$, $p = .006$ (with no significant correlations for the other details, all ps > .083). That is, collaborating couples’ recall of specific episodic information was associated with worse performance in formal terms – lower scores for number of trips listed – on the personal list task, while their recall of more general details was associated with better performance. For individuals in the

nominal condition, there were no significant correlations between number of trips recalled and the kinds of details recalled (all *p*s > .100).

An analysis of the time taken to complete the personal list task yielded similar findings. Participants were given an open amount of time, and allowed to recall until they said they could not recall any more, since the baseline number of trips might be quite different for different couples. A 2 (Condition: collaborative vs. nominal) × (2) (Session: 1 vs. 2) mixed models ANOVA of time take in minutes yielded a significant main effect of condition, $F(1,26) = 4.88$, $p = .036$, $\eta_p^2 = .16$, but no significant effect of session and no interaction, all *F*s < 2.74, all *p*s > .11. Couples in the collaborative condition tended to spend longer on this task than couples in the nominal condition, regardless of whether they were collaborating or recalling alone. Thus, collaboration itself did not result in significantly longer recall. For couples in the collaborative condition, the amount of time they spent on the task was correlated with proportion of items lost, $r = .69$, $p = .029$. In terms of the percentage of coded details, time take by the collaborating couples was correlated with recall of specific episodic details, $r = .831$, $p = .003$, semantic details, $r = .730$, $p = .016$, and negatively with extended episodic details. That is, collaborating couples who spoke for longer lost more items from their list but engaged in more reminiscing. These associations were not present for couples in the nominal group, for whom time taken was not correlated with holidays recalled, proportion items gained, proportion items lost, or the percentage of the 4 kinds of details recalled, all *r*s < .40, all *p*s > .099. Overall, these findings support the “trade-off” between formally listing trips and reminiscing that couples in the collaborative condition engaged in, using a similar amount of time to produce quite different kinds of recall.

Discussion

When recall was scored strictly as number of list items recalled, couples showed collaborative inhibition when they remembered together, even on a recall task relevant to their shared experiences (see also Harris et al., 2011). This finding adds to the literature on collaborative inhibition, and confirms its robustness across a range of memory tasks. While collaborative inhibition has previously been identified for a whole range of memory stimuli including categorised and uncategorised word list recall (e.g. Basden, Basden, & Henry, 2000; Weldon & Bellinger, 1997), story recall (e.g. Weldon & Bellinger, 1997), and historical facts (Yaron-Antar & Nachson, 2006), this study demonstrated collaborative inhibition for a personally-relevant semantic memory task, even in very intimate, long-married couples. These findings are consistent with existing literature suggesting that – on list-based tasks where quantity of output is the primary index of recall – even intimate groups experience collaborative inhibition (see Harris et al., 2011; Harris et al., 2013; Ross et al., 2008, 2004) and older adults experience collaborative inhibition similarly to young adults (Henkel & Rajaram, 2011; Meade & Roediger, 2009). The source of this collaborative inhibition appeared to be retrieval disruption, as previously identified in the collaborative recall paradigm (see Harris et al., 2008 for review), although other mechanisms such as production blocking and retrieval inhibition cannot be discounted in our data. Those who collaborated forgot items during collaboration that they had previously recalled, with a similar pattern for both non-personal and personal stimuli.

However, a more fine-grained analysis of the kinds of details recalled yielded a different picture, inconsistent with inhibition of recall during collaboration. On the 'personal list' task of recalling as many shared trips as possible, collaborating couples' recall output showed a decrease in semantic details but a corresponding increase in specific episodic details. Couples who collaborated performed quite differently when together than how they had performed as individuals in the immediately preceding session. All individuals and couples recalled extraneous but elaborative details when listing shared trips. However, through the course of remembering together, couples who collaborated appeared to "go episodic", selectively increasing their recall of rich, episodic details. Interestingly, this increase in specific episodic details during collaboration came at the expense of performing well on the assigned task: higher recall of episodic details was associated with fewer listed trips. More provocatively, however, these findings suggest that the effects of remembering with others (particularly when intimate partners collaborate to recall personally-relevant information) may not be fully understood by simply scoring how much they remember on a strict list-based task – a finding more consistent with approaches within the cognitive ageing literature than with the cognitive collaborative recall literature (see also Barnier et al., 2014, 2013; Dixon, 2013; Gagnon & Dixon, 2008; Meade, 2013).

Why was it particularly specific episodic details that were facilitated when older couples collaborated on this task, when recall of all other kinds of details decreased during collaboration? We suggest three, non-mutually exclusive possibilities. First, based on research on encoding specificity (Tulving & Thomson, 1973), it is possible that remembering in the context of one's spouse provided a strong match between encoding and retrieval that facilitates episodic recall of shared events – the kind of match that could not be provided by an interviewer or a laboratory recall environment. This explanation is consistent with another aspect of our findings – the hypermnesia experienced by couples in the nominal group who increased their recall of semantic details. Taken together, our findings suggest that couples in both conditions attempted to recall additional information on the second recall test. Whereas individuals in the nominal condition could only access additional semantic information when recalling for a second time alone, for couples in the collaborative condition the presence of their spouse enabled them to access specific episodic details. However, if encoding specificity was a sufficient explanation, we might also have expected collaborating couples to generate more new items at Recall 2, and more of all kinds of details, compared to those recalling alone. In fact, the generation of new items was relatively low for both groups, and there was not facilitation of more general details. Second, it is possible that collaboration resulted in a limited search, such that collaborating couples perseverated on particular items rather than searching broadly, as noted for both recall and brainstorming in collaborating groups (Diehl & Stroebe, 1987; Hyman et al., 2013). However, we did not find any evidence for this in the word list task, where category recall was close to ceiling across both individual and collaborative settings. That is, collaborative inhibition in the word list was not due to couples neglecting whole categories. And when recalling the trips, both individuals and collaborating couples produced a large number of extraneous details, suggesting that participants in both conditions perseverated on individual items to a similar extent. But future research with materials specifically designed to test this question would be needed to investigate the role of limited search.

Finally, as suggested in the Introduction, it is possible the functional context of remembering shifted substantially between the individual and collaborative recall. This explanation fits most closely with our findings, and is consistent with some related earlier research (Dixon, 1999; Hyman, 1994). In the individual interviews, the task demanded that participants remember as much as possible. In the collaborative interviews, participants overtly had the same task and were given exactly the same instructions – to list as many trips as possible – but often shifted away from this task. Instead, they began jointly reminiscing; producing rich, detailed recall, often laden with affect, and frequently physically shifting to turn and speak directly to each other instead of addressing the experimenters. This shift is illustrated in the following excerpt:

Experimenter: And how many more trips did you do? There's the Greek Islands.

> Wife: South America.
>
> Husband: We did South America, yes, we did Peru and Brazil and Argentina and Bolivia and The Andes. We went up to…
>
> H: Do you remember munching the coca leaf to try…
>
> W: Oh yes.
>
> H: We went up to The Andes at 5,000 metres, and munching coca leaf, and [wife] decided that she needed to have a pee.
>
> W: So we were on the road here, you see, but the little latrine was up on the top.
>
> H: It was about 50 metres higher.
>
> W: So we had to climb up from the road.
>
> H: So I said, alright, I'll take you up there. By the time I got down, which at 5,000 metres climbing, I'd just about had it.
>
> W: Yes, we thought we were going to faint, but we didn't. But those coca leaves were very good, I rather liked them.

This interpretation is consistent with the fact that recalling episodic details was associated with loss of items from Recall 1. Since recalling episodic details did not help the couples to complete their assigned recall task, they were not "going episodic" to aid their recall and maximise their score. Instead, this could have been to entertain and instruct the interviewers, although then we might have expected similar effects findings across individual and collaborative recall sessions. More likely, is that it was enjoyable and relationship-building to reminisce with their spouse rather than to list as many trips as possible.

Noting that the function of remembering varies across tasks and contexts, often in ways that are not explicit or planned, is particularly important when considering how our current results fit with previous findings regarding older adults' recall. As noted in the Introduction, remembered number of previous researchers have noted that older adults recall fewer specific episodic details and more semantic details when recalling autobiographical events for a younger interviewer. That is, in previous research, older adults (recalling alone) remembered many semantic details when the experimental task demanded episodic recall

and counted specific episodic details as success. In our current study, older adults (recalling together) remembered many specific episodic details when the experimental task demanded semantic recall and counted semantic information as success.

One way to interpret these contrasting findings is to consider the function of recall in the recall contexts established by the two studies. Tested alone (e.g. Addis et al., 2010, as well as in our nominal condition), older adults compared to young adults may include extraneous semantic detail to provide context and explanation for the younger interviewer (e.g. “what you have to understand about those days…”). Tested with a spouse, the functional demands are just the opposite – with no need to provide context and explanation to each other, couples abandon the relatively mundane task of creating a list for the much more engaging and relationship-building task of reminiscing together (see also Alea & Bluck, 2003; Gould & Dixon, 1993; Hyman, 1994; Marsh & Tversky, 2004). Although in our study, the experimenters were still present during collaboration and likely still influencing the recall context, their role seemed to diminish and memories were recounted in a way more consistent with enjoying joint reminiscing than informing the experimenter or scoring as highly as possible.

We also found notable individual differences between couples, particularly in the kinds of details recalled, as evidenced by large measures of variance. This is consistent with our previous findings (Harris et al., 2011) that some couples showed collaborative facilitation and others showed collaborative inhibition on the personally-relevant task of recalling names of social club members. These individual differences may reflect differences in the quality of the relationship and the extent to which a partner cues specific episodic details, and perhaps these individual differences are driven by cognitive processes (encoding specificity and limited search) noted above. They also may indicate personality differences in the extent to which participants are concerned with staying on task vs. enjoying reminiscing together. These individual differences have been a hallmark of our work on shared remembering in couples (Barnier et al., 2014; Harris et al., 2011). We argue that they reflect meaningful differences in individual and relationship factors, but identifying and accounting for these factors remains an ongoing project.

One limitation of this study is that we did not test young adults. If the explanation for these findings is a functional shift, then we might expect younger couples to show similar effects to the older adults in the current study. But if it is due to an overcoming of the episodic deficit, we might expect young couples to recall episodic details regardless of whether they remember together or alone (see Barnier et al., 2014). We also need to test details recalled in different kinds of tasks, both those that demand episodic details and those that demand semantic details, to determine whether these older adults were simply going “off topic” (c.f. James, Burke, Austin, & Hulme, 1998) or whether there is facilitation of episodic details both in tasks where these kinds of details are “off topic” and “on topic” (Gagnon & Dixon, 2008; Gould et al., 1991). Accordingly, future research could compare the functional demands of recalling individually for an experimenter vs. collaboratively with a spouse in both older and younger adults in different kinds of tasks (see also Barnier et al., 2014; Hyman, 1994; James et al., 1998). In testing across younger couples and older couples, relationship length is typically inherently confounded with age, meaning that older couples

often have both more experience remembering together and more need for cognitive support due to normal age-related declines (Barnier et al., 2014; Gagnon & Dixon, 2008). However, adjustments for interactive expertise effects in shorter-term marriages have been utilised (e.g., Gagnon & Dixon, 2008). Other studies have used stranger pairs as comparison groups for couples (e.g. Gould, Osborn, Krein, & Mortenson, 2002). However, this becomes complex when testing personally-relevant material since strangers do not have shared experiences to recall. Our word-list task and our personal-list task varied on a number of dimensions including the extent to which they were personally relevant, the extent to which they were meaningfully shared by the couple, the extent to which they involved broader knowledge and information, the extent to which there was an explicit upper limit or maximum to recall, and the extent to which they involved episodic and semantic memory. Developing ecologically-valid tasks to test everyday collaborative remembering – and to test both amount recalled and content recalled – remains challenging, reflecting the differences in research traditions. However, given the robustness of collaborative inhibition in the laboratory, determining how this collaborative inhibition applies to everyday remembering, beyond word lists and beyond the laboratory context, is an important research goal (Barnier et al., 2013). Overall, more work is needed to tease apart the relative contributions of intimacy, relationship length, age, and cognitive need in driving the effects of collaboration on memory for both personal and non-personal, episodic and semantic stimuli.

In sum, we suggest that in order to fully understand older adults' memory performance – both alone and in groups – the context and function of remembering need to be considered alongside how much is remembered, bringing together collaborative remembering, memory functions, and cognitive ageing literatures. Outcomes may vary across couples, contexts, and tasks because of encoding specificity, different search processes, individual differences like personality, and because the functions of remembering vary in different contexts. While strictly scoring only the amount recalled in memory tasks may yield findings of deficit or inhibition, considering memory performance within its broader physical, social, and functional context yields a more positive or adaptive view of everyday memory performance by older adults in the common context of their spouse or familiar others. Promisingly for interventions designed to support memory, older adults can recall rich episodic details about personally experienced events despite their neurocognitive changes, but perhaps only in the presence of an intimate, supportive collaborating partner who has shared the experience.

Acknowledgments

The research reported here and our collaboration was supported by an Academy of Social Sciences in Australia International Science Linkages grant to John Sutton, Roger Dixon, Amanda Barnier, and Celia Harris. Celia Harris, Amanda Barnier, and John Sutton are supported by research grants from the Australian Research Council (DE150100396, DP130101090, FT120100020, DP120100187). Roger Dixon is supported by National Institutes of Health (National Institute on Aging, AG008235) and the Canada Research Chairs program. We are most grateful for this support, and to Katya Numbers and Sophia Harris for research assistance.

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Table 1

Percentage Change in Word List Recall Across Occasions, by Condition

	Net Change	Items Gained	Items Lost
Collaborative Condition	−11.97% (3.70) [−19.86, −4.08]	10.13% (2.62) [5.31, 14.95]	20.87% (3.71) [12.95, 28.78]
Nominal Condition	−1.07% (3.92) [−9.43, 7.29]	6.94% (2.40) [1.83, 12.04]	8.34% (3.93) [−0.04, 16.72]

Note: Values are estimated marginal means, from the reported ANOVA, with standard error of the mean in parentheses and 95% confidence intervals in square brackets.

Table 2

Percentage Change in Trip List Recall Across Occasions, by Condition

	Net Change	Items Gained	Items Lost
Collaborative Condition	−16.79% (7.42) [−32.44, −1.15]	13.53% (4.18) [4.71, 22.35]	29.93% (4.28) [20.90, 38.95]
Nominal Condition	16.01% (7.82) [−0.48, 32.50]	19.88% (4.41) [10.58, 29.18]	9.76% (4.51) [−0.02, 19.23]

Note: Values are estimated marginal means, from the reported ANOVA, with standard error of the mean in parentheses and 95% confidence intervals in square brackets.

Table 3

Additional Details Recalled in the Personal List Task, Across Conditions and Recall Occasions (Number and Percentage of Total Details Scored)

		Episodic Specific	Episodic Extended	Episodic Categoric	Semantic
Collaborative Condition					
Recall 1	Number	1.40 (1.47)	34.55 (19.68)	8.35 (5.67)	7.90 (4.53)
	Percentage	3.27 (3.70) [−0.58, 7.12]	62.65 (13.15) [50.49, 74.84]	17.56 (11.11) [9.18, 25.94]	16.51 (8.72) [10.79, 22.04]
Recall 2	Number	15.60 (27.51)	40.70 (16.71)	8.60 (6.63)	8.20 (10.51)
	Percentage	13.36 (20.95) [4.76, 21.97]	63.29 (21.87) [47.55, 79.02]	15.11 (13.98) [5.02, 25.21]	8.23 (8.33) [−.96, 17.43]
Nominal Condition (Individuals)					
Recall 1	Number	0.83 (2.64)	24.61 (13.14)	7.17 (7.45)	7.90 (4.54)
	Percentage	1.94 (6.81) [−0.93, 4.81]	71.57 (21.09) [62.50, 80.65]	16.80 (13.74) [10.56, 23.05]	9.69 (8.40) [5.56,13.81]
Recall 2	Number	1.22 (4.02)	24.44 (9.29)	8.44 (9.28)	8.22 (10.72)
	Percentage	2.15 (5.94) [−4.26, 8.57]	66.10 (25.35) [54.38, 77.83]	17.09 (16.30) [9.56, 24.61]	14.66 (16.42) [7.80, 21.51]

NB. Values are means, with standard deviations in parentheses. 95% confidence intervals from the reported Condition × Occasion ANOVAs (with Bonferroni corrections) are in square brackets.