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Acknowledge, Repeat, Rephrase, Elaborate: Witnesses Can Help Each Other Remember More

Annelies Vredeveldt, Alieke Hildebrandt, and Peter J. van Koppen

VU University Amsterdam

Author note

Annelies Vredeveldt, Department of Criminal Law and Criminology, VU University Amsterdam; Alieke Hildebrandt, Department of Criminal Law and Criminology, VU University Amsterdam; Peter J. van Koppen, Department of Criminal Law and Criminology, VU University Amsterdam.

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Correspondence concerning this article should be addressed to Annelies Vredeveldt, VU University Amsterdam, Faculty of Law, Department of Criminal Law and Criminology, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands. E-mail: anneliesvredeveldt@gmail.com

Abstract

Crimes are often observed by multiple witnesses. Research shows that witnesses can contaminate each other's memory, but potential *benefits* of co-witness discussion have not yet been investigated. We examined whether witnesses can help each other remember, or prune each other's errors. In a research design with high ecological validity, attendees of a theatre play were interviewed approximately one week later about a violent scene in the play. The couples that signed up for our study had known each other for 31 years on average. Participants were first interviewed individually and then took part in a collaborative interview. We also included a control condition in which participants took part in two individual interviews. Collaboration did not help witnesses to remember more about the scene, but collaborative pairs made significantly fewer errors than nominal pairs. Further, quantitative and qualitative analyses of retrieval strategies during the discussion revealed that couples who actively acknowledged, repeated, rephrased, and elaborated upon each other's statements remembered significantly more information overall. Taken together, our findings suggest that, under certain circumstances, discussion between witnesses is not such a bad idea after all.

Keywords: social cognition; transactive memory; collaborative recall; eyewitness memory; retrieval strategy

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Crimes are often witnessed by more than one person. Over 85% of people who have witnessed a crime indicate that there was at least one other person present, and more than half of the people who witnessed a crime with someone else report that they discussed the event with the other witness (Paterson & Kemp, 2006; Skagerberg & Wright, 2008).

A plethora of research on eyewitness memory shows that witnesses can "contaminate" each other's memory (see e.g., Gabbert, Memon, & Wright, 2006; Loftus, 2003; Wright, Self, & Justice, 2000). In line with these findings, police officers are typically instructed to prevent witnesses from talking to each other (Paterson & Kemp, 2005). However, police officers can also think of several advantages of co-witness discussion. The most frequently reported advantage by officers in Paterson and Kemp's survey was that discussion can prompt witnesses to recall details they previously did not remember. In addition, various officers mentioned that discussion between witnesses could help the police to obtain a more accurate overall picture of the event. Can witnesses indeed help each other remember more, or more accurately? And if so, which collaborative strategies are most effective in facilitating recall performance? To our knowledge, the present study was the first to examine collaborative recall of a witnessed event in a naturalistic setting.

Eyewitness Memory

Discussion between witnesses has been investigated in three main paradigms: the social-contagion paradigm, the memory-conformity paradigm, and the collaborative-recall paradigm. In the social-contagion paradigm, participants discuss a witnessed event with a confederate posing

as a co-witness (e.g., Meade & Roediger, 2002; Roediger, Meade, & Bergman, 2001; Shaw, Garven, & Wood, 1997). The confederate introduces incorrect information into the discussion, and many participants subsequently report this information as if they had seen it themselves. This finding can be explained in light of the source-monitoring framework (Johnson, Hashtroudi, & Lindsay, 1993): a memory from one source (e.g., a statement made by a co-witness) is inadvertently misattributed to another source (e.g., the video-taped event). A serious critique of the social-contagion paradigm, however, is its lack of ecological validity. In real life, witnesses usually do not try to mislead their co-witness. Thus, although the findings from these studies prove that it is possible for a co-witness to contaminate another witness's memory, they do not provide any information about the incidence of such contamination in real-life discussions between witnesses.

In the memory-conformity paradigm, researchers have attempted to reduce this problem by abolishing the confederate. In these studies, two witnesses view two slightly different versions of an event (usually on video), and then discuss it without knowing that they have each seen a different version (e.g., French, Garry, & Mori, 2008; Gabbert, Memon, & Allan, 2003; Kanematsu, Mori, & Mori, 2003; Wright et al., 2000). Again, these studies show that witnesses end up reporting information that they obtained from their co-witness as if they had observed it themselves. However, the studies do not provide insight into the question whether witnesses can also help each other remember more, or more accurately. Because researchers in the memory conformity area are predominantly concerned with the potential harmful effects of co-witness discussion on subsequent individual recall, they typically do not analyse, or even record, the content of the discussion, and do not obtain an independent record of what each witness remembers prior to the discussion. An exception to the latter was a study by Kanematsu and

colleagues (2003), who found that witnesses reported more correct information post-discussion than pre-discussion. Because Kanematsu and colleagues assessed individual performance rather than pair performance, it is not clear whether the increased amount was due to the report of new information that emerged as a result of the discussion, or simply due to witnesses incorporating information obtained from the co-witness into their own accounts.

The collaborative-recall paradigm stems from research on recall of simple stimuli (e.g., Basden, Basden, Bryner, & Thomas, 1997; Meudell, Hitch, & Boyle, 1995; Weldon & Bellinger, 1997). Unlike the other two paradigms, it does not involve trickery: participants simply view the same stimuli and participate in a naturalistic discussion about it. The performance of collaborative groups is then compared to that of nominal groups (i.e., the pooled output of an equal number of individuals recalling on their own). Collaborative groups typically remember fewer words than nominal groups (i.e., collaborative inhibition), but also make fewer errors (e.g., Harris, Barnier, & Sutton, 2013; Weigold, Russell, & Natera, 2014), particularly when they are instructed to arrive at a consensus (Harris, Barnier, & Sutton, 2012). Two recent studies have adapted the collaborative-recall paradigm to study memory for emotional events: the assassination of Israel's Prime Minister Rabin (Yaron-Antar & Nachson, 2006), and a video clip in which a boy gets killed by a drunk driver (Wessel, Zandstra, Hengeveld, & Moulds, 2014). Both studies found that collaborative groups of three reported significantly fewer correct and fewer incorrect details about the event than nominal groups of three. Thus, they replicated the collaborative inhibition effect, but also found support for the notion that collaboration serves as an error-pruning mechanism (see Rajaram & Pereira-Pasarin, 2010). This suggests that the contamination effects found in social-contagion and memory-conformity paradigms may not translate to more realistic discussions between witnesses.

Finally, a recent study on police officers' conferring during recall of a staged crime scenario (in groups of six) cannot be neatly categorized into one of the three paradigms discussed above (Hope, Gabbert, & Fraser, 2013). The study involved no trickery (i.e., the officers engaged in natural discussion about the event), but all officers in both conferring and non-conferring conditions wrote their own individual statement about the event. Hence the key dependent variables were the quantity and quality of individual written statements, rather than nominal and collaborative group output. Hope and colleagues found no significant differences between conferring and non-conferring groups in either the amount or the accuracy of reported information. A qualitative analysis showed that some errors were corrected during the discussion (error pruning), whereas other errors were transmitted to other officers' reports (contamination). However, the contamination effect was eliminated when officers wrote down their statement individually prior to conferring. In sum, the most realistic experimental set-up to date, in which police officers experienced an emotional event in real life, suggests that conferring between police officers may not be as harmful as previously thought. In the present research, we investigate whether discussion between witnesses is as harmful as it is often portrayed.

Transactive Memory

In sharp contrast with the near-exclusive focus on potential undesirable consequences of collaboration in the eyewitness memory literature, Wegner's (1987) transactive memory theory predicts that people can help each other remember more (see also Wegner, Giuliano, & Hertel, 1985). That is, groups can develop an effective system of shared encoding, storage, and retrieval of information, which results in the group remembering more than all of its individual members combined (i.e., emergence). A successful transactive memory system requires that each group

member has access to information that the others do not have (differentiation), but also that some knowledge is shared among group members (integration). For example, if a wife knows that her husband is a car expert, she can cue him to supplement her description of the car with technical details. Transactive memory systems become more effective over time, as group members experience and remember more events together (see Tollefsen, 2006). Support for transactive memory theory comes from findings that pairs of friends or romantic partners remember more on collaborative memory tasks than pairs of strangers (Andersson & Rönnberg, 1995, 1996; Johansson, Andersson, & Rönnberg, 2005; but see Gould, Osborn, Krein, & Mortenson, 2002). Interestingly, these benefits only occur when pairs do not explicitly discuss or receive instructions on how to encode or retrieve the information—when they do, pairs of strangers outperform romantic couples (Hollingshead, 1998a, 1998b; Hollingshead & Brandon, 2003; Wegner, Erber, & Raymond, 1991; see also Hollingshead & Brandon, 2003). Thus, it seems that romantic couples remember together most effectively when they use their implicit transactive memory system (see also Barnier et al., 2014; Harris, Barnier, Sutton, & Keil, 2014), whereas pairs of strangers can compensate for their lack of such a system by actively learning about each other's expertise and explicitly dividing responsibilities.

Although Wegner's (1987) theory has not yet permeated the literature on eyewitness memory, it has inspired research on romantic couples' collaborative recall of personal lists (e.g., naming members of the Rotary club). Harris, Keil, Sutton, Barnier, and McIlwain (2011) found that some couples inhibited each other's recall, whereas other couples facilitated each other's recall. Whether couples experienced collaborative inhibition or facilitation was related to the manner in which they interacted during collaborative remembering. Harris and colleagues identified three factors that predicted the amount of information recalled, which together

explained 84% of the variance in recall performance. A “group-enhancing” factor (characterized by successful cues, relevant elaborations in response to those cues, and repetitions) was positively associated with the number of items recalled, whereas a “group-diminishing” factor (characterized by references to one person’s expertise, disagreements about which strategy to use, corrections, and a lack of failed cues) and a “gap-filling” factor (characterized by simple acknowledgements and irrelevant elaborations) were both negatively related to the number of items recalled. A qualitative analysis of couples’ memories about significant autobiographical events illustrated how these strategies facilitated or impaired memory retrieval processes. Unfortunately, the accuracy of recalled information could not be determined, because there was no independent record of the recalled autobiographical information.

Harris and colleagues’ (2011) findings are broadly consistent with those of Meade, Nokes, and Morrow (2009), who examined expert pilots’ collaborative recall of an aviation scenario. Unlike non-pilots and novice pilots, expert pilots remembered significantly more scenario segments when recalling together than when recalling alone (i.e., collaborative facilitation). Verbal protocol analyses revealed that expert pilots possessed effective communication skills as well as domain knowledge—key elements of transactive memory systems. Specifically, experts repeated and rephrased their partner’s statements and then elaborated on those statements with new information. In contrast, novices and non-pilots tended to simply acknowledge each other’s contributions (e.g., “yes” or “uh hm”) and did not elaborate as much on their partner’s contributions. Thus, both Harris and Meade and colleagues found that successful collaborative recall was characterized by repetitions followed by elaborations, whereas unsuccessful collaborative recall was characterized by simple acknowledgements or “gap-filling” features. Meade and colleagues noted that, although all types of acknowledgement

establish a common ground between collaborators, repetitions explicitly identify what the collaborators agree on and may therefore be more successful in facilitating the interaction (see also Clark & Wilkes-Gibbs, 1986). In addition, Meade and colleagues found that expert pilots explained their contributions more and corrected each other more than non-pilots. The latter finding contrasts with Harris and colleagues' finding that corrections were negatively related to the amount of information recalled, but this may be due to methodological differences between the two studies.

The present study

Transactive memory theory and recent findings on autobiographical memory suggest that, under certain circumstances, collaboration can facilitate recall. Specifically, the effectiveness of collaboration depends on the nature of the interaction between partners. In the present study, the role of collaborative retrieval strategies was examined for the first time in an eyewitness setting. We interviewed couples that had generally known each other for many years, about a violent scene in a theatre play they had attended a week earlier. To measure baseline individual recall performance (and to emulate common practice in which the police separate witnesses during their initial interview) we first asked witnesses to recall the event individually. Subsequently, we conducted a collaborative interview to investigate whether additional information can be obtained by allowing witnesses to talk to each other.

Based on transactive memory theory, we predicted that the addition of a collaborative interview would help participants to remember additional details from the witnessed event. However, it is possible that such benefits are simply due to reminiscence; that is, when individuals participate in a second recall attempt, they typically remember some new information

that they had not recalled during the first attempt (see Payne, 1987). To check this, we also included a control condition in which witnesses participated in two individual interviews. Based on findings of error pruning in collaborative recall (e.g., Ross, Spencer, Linardatos, Lam, & Perunovic, 2004; Warnick & Sanders, 1980; Wessel et al., 2014; Yaron-Antar & Nachson, 2006), we also predicted that collaborative pairs would make fewer errors than nominal pairs.

Although it is important to investigate *whether* witnesses can help each other remember more, it is perhaps even more important to examine *how* they can do so. Based on previous research with older married couples (Harris et al., 2011), we predicted that "group-enhancing" behaviours, such as repeating and elaborating upon each other's statements, would be positively associated with the amount of information recalled, whereas "group-diminishing" or "gap-filling" behaviours, such as corrections and simple acknowledgements, would be negatively associated with the amount of information recalled. Further, we predicted that corrections during collaborative recall (i.e., error pruning) would be associated with enhanced memory accuracy.

Method

Participants

Fifty-three community members (21 male and 32 female) participated, with ages ranging from 16 to 82 years (M = 57.66, SD = 12.81). Our sample included 36 participants who had signed up with a partner, and 17 who had signed up individually. Because the main focus of our research was to investigate how couples remember together, all participants who signed up together were assigned to the collaborative condition (N = 18 pairs). Ten collaborative pairs were married, five pairs were in a romantic relationship, two pairs were friends, and one pair did not

know each other prior to participating. Relationship duration for the 18 pairs ranged from 0 to 50 years, with a mean duration of 31.31 years (*SD* = 16.07).

The age of participants in the control condition (*M* = 53.88, *SD* = 12.49) did not differ significantly from participants in the collaborative condition (*M* = 59.44, *SD* = 12.73), *t* (51) = 1.49, *p* = .142, *d* = 0.44, 95% CI [-0.15, 1.02], but there was a significant gender difference between conditions, χ^2 (1) = 5.05, *p* = .035. The collaborative condition contained an equal number of male and female participants, whereas 14 out of 17 participants in the control condition were female. In addition, the delay between witnessing the play and the interview (see Procedure section) was significantly longer for participants in the control condition (*M* = 8.94 days, *SD* = 2.30) than for participants in the collaborative condition (*M* = 6.89 days, *SD* = 1.91), *t* (51) = 3.42, *p* = .001, *d* = 1.01, 95% CI [0.39, 1.61]. Because of these differences, and more generally because assignment to conditions was not random, comparisons between conditions should be interpreted with caution.

Materials

Participants attended a play entitled “Bossen” (Dutch for “Woods”), which lasted 2 hr 50 min in total. A 3 min scene was selected as the topic of the witness interviews. In that scene, one of the actors murders his father (who had a relationship with his twin sister) and then rapes his twin sister. These events were portrayed symbolically on stage (i.e., showing the movements associated with knifing the father and raping the sister, without actually showing the physical acts themselves). Concurrently, the perpetrator’s brother, who lives in a mental institution, explained to the audience what was happening. Anecdotally, many of the audience members indicated they had experienced the scene as highly emotional.

Procedure

Participants were recruited during three consecutive evenings at a theatre in Haarlem, the Netherlands. Four researchers handed out flyers to community members attending the play and asked them to sign up for a research project about “Bossen”, conducted by VU University Amsterdam. They were informed that participants would be enrolled in a lottery to win a gift voucher in the value of €50. Attendees willing to participate provided contact information and were contacted a few days later to schedule the interview session. Interviews were conducted approximately one week after the play (M = 7.55 days, SD = 2.24, range: 4-12). Two researchers at a time visited the participants at their home, or in a few cases, at a public place. All interviews were audio-recorded using digital voice recorders.

At the start of the interview session, participants were informed about the study and consented in writing. In both conditions, the first interview was conducted individually. Participants who had signed up together were separated and each pair member was interviewed in a separate room by one of the interviewers. At the start of the first interview, the interviewer explained which scene was the subject of the interview, namely, “the scene in which the man in the mental institution explains how his brother went crazy”. If it was not clear to participants to which scene the interviewer was referring, a few more hints were provided.

The interview was modelled after Dutch police interviews and consisted of four phases. The first was a free recall phase, in which participants were asked to describe the scene in as much detail as possible, without interruption. In the second phase, the interviewer asked open-ended follow-up questions, tailored to what the participant had said during the free recall phase (typically three to six questions; e.g., “You said that he murdered his father, can you tell me

more about that?"). In the third phase, participants were asked to describe all persons in the play. For each person described by the participant, the interviewer asked a set of predetermined questions about that person's name, relationship to others, actions, and physical description (including prompts for estimated age, height, weight, hair, facial hair, and clothing). In the fourth phase, participants were asked to describe the context of the event. Participants received pen and paper and were encouraged to draw during their descriptions. After the participant's description of the context, the interviewer asked a set of predetermined questions about the set, lighting, sound, distance to stage, and feelings during the scene. Once participants indicated they had told the interviewer everything they could remember, the first interview was concluded.

After a short break, participants in the control condition were interviewed individually again, this time by the researcher who had not yet interviewed them. Participants in the collaborative condition were interviewed together, by one of the researchers. The instructions in the second interview were identical to the first interview, with the addition that participants should assume that the interviewer did not know what the participant had said during the previous interview. Participants in the collaborative condition were instructed to "work together to remember as much as possible". The questions posed during the second interview were identical to the first interview, with the exception of the follow-up questions, which were tailored to what the participant said during the free-recall phase and could thus differ slightly.

After the second interview, participants answered several questions about their background (e.g., age, profession, relationship duration). We also asked whether participants had discussed the play or the specific scene with anyone prior to the interview. Most participants indicated that they had discussed the play in general (e.g., its emotional impact; 94% in the collaborative condition and 88% in the control condition), but only few participants indicated

that they had discussed the specific scene that was the topic of our interviews (6% in the collaborative condition and 0% in the control condition). After answering our questions, participants were debriefed and thanked for their participation.

Data Coding

Content coding. A detailed coding scheme was constructed based on a video recording of the play. Additional items mentioned by participants that were not in the original coding scheme were added progressively. The final coding scheme contained 245 items that were relevant to the selected scene, of which 38 were central (i.e., about the perpetrator or the rape), and 207 peripheral (e.g., about background music or scenery).[1] One coder scored all interviews based on the audio-recordings. For each of the 245 items, the coder recorded whether the item was described correctly, incorrectly, both correctly and incorrectly, or not at all. A second blind coder independently coded 18% of the interviews (i.e., 20 interviews, 4900 data points). Interrater agreement was substantial (percentage agreement = 90%; $\kappa = .71$, $p < .001$; κ maximum = .93). The scores of the first coder were used in further analysis.

Retrieval strategy coding. All collaborative interviews were transcribed verbatim, and two coders independently inspected the transcripts to code for statements about collaborative retrieval strategies. Table 1 lists the coding categories with descriptions and examples. For each collaborative interview, each coder recorded how many statements in each category appeared in the transcript. Interrater reliability for recorded frequencies in each coding category ranged from r_s (18) = .86, $p < .001$ (for role division) to r_s (18) = .99, $p < .001$ (for acknowledgements), with very high overall interrater reliability, r_s (306) = .98, $p < .001$. After completing their

[1] Preliminary analyses revealed no differences between central and peripheral details, hence this variable is not discussed further.

independent coding, the two coders discussed all transcripts and agreed upon a final code, which was used in the main analysis.

[TABLE 1 ABOUT HERE]

Results

Because we were interested in how much information the police can obtain when they have access to two witnesses, our analyses concern pair performance (i.e., the number of non-redundant details reported by each pair of witnesses) rather than individual performance. To calculate nominal pair performance, accounts from witnesses in the control condition were randomly pooled to create 8 nominal pairs.

Correct recall

Per interview. Table 2 shows the number of non-redundant correct details about the event reported per pair in Interview 1, 2, and across both interviews, as well as the number correct details that were added and omitted during Interview 2. A 2 (Condition: control, collaborative) x 2 (Interview: 1, 2) mixed ANOVA on the number of correct details reported per pair revealed no significant effects of condition, F (1, 24) = 0.01, p = .910, η^2= .00, or interview, F (1, 24) = 0.03, p = .575, η^2= .01, and no significant interaction, F (1, 24) = 2.45, p = .131, η^2= .09. Thus, we found no evidence of collaborative facilitation or inhibition in the number of correct details reported.

[TABLE 2 ABOUT HERE]

Overall. In addition to examining recall performance per interview, we also wanted to know whether adding a collaborative interview after an initial individual interview would help

witnesses remember additional information about the witnessed event. Thus, we assessed the within-subjects effect of the number of interviews (one or two) on the number of non-redundant correct details reported overall. A 2 (Condition: control, collaborative) x 2 (Number of Interviews: 1, 2) mixed ANOVA on the number of correct details per pair revealed a significant effect of number of interviews, F (1, 24) = 60.84, $p < .001$, $\eta^2 = .72$, but no significant effect of condition, F (1, 24) = .13, $p = .722$, $\eta^2 = .01$, and no interaction, F (1, 24) = 1.19, $p = .287$, $\eta^2 = .05$. The addition of an extra interview helped witnesses remember significantly more about the event (see Table 2), but it did not matter whether the additional interview was collaborative or individual. In other words, the benefits of a second interview seem to be due to reminiscence rather than collaboration.

New and omitted details. To provide more insight into the trajectory of reported details from the first to the second interview, we evaluated the number of new and omitted details. For the number of new correct details (i.e., not mentioned by either pair member during Interview 1, but added in Interview 2), we found no significant difference between conditions, t (24) = 0.65, $p = .524$, d = -0.28, 95% CI [-1.11, 0.56]. Similarly, for the number of omitted correct details (i.e., mentioned by at least one pair member in Interview 1 but not mentioned again in Interview 2), there was no significant difference between conditions, t (24) = -1.39, $p = .179$, d = 0.59, 95% CI [-0.27, 1.43].

Incorrect recall

Per interview. Table 3 shows the number of non-redundant errors reported per pair. A 2 (Condition: control, collaborative) x 2 (Interview: 1, 2) mixed ANOVA on errors revealed no significant effects of condition, F (1, 24) = 2.29, $p = .144$, $\eta^2 = .09$, or interview, F (1, 24) = 0.00,

p = .976, η^2= .00, but a significant interaction between condition and interview, F (1, 24) = 4.82, p = .038, η^2= .17. Simple effects analyses revealed no baseline difference between conditions during Interview 1, F (1, 24) = 0.08, p = .778, d = -0.12, 95% CI [-0.95, 0.71], but collaborative pairs reported significantly fewer errors during Interview 2 (10 on average) than nominal pairs (15 on average), F (1, 24) = 7.69, p = .011, d = -1.18, 95% CI [-2.06, -0.27].

[TABLE 3 ABOUT HERE]

Overall. A 2 (Condition: control, collaborative) x 2 (Number of Interviews: 1, 2) mixed ANOVA on the number of errors per pair revealed no significant effect of condition, F (1, 24) = 1.68, p = .207, η^2= .07, but a significant effect of number of interviews, F (1, 24) = 28.71, p < .001, η^2= .54, and a significant interaction between condition and number of interviews, F (1, 24) = 13.20, p = .001, η^2= .36. Table 3 shows that pairs reported more errors after two interviews than after one interview. However, this detrimental pattern was only significant for nominal pairs, F (1, 24) = 29.19, p < .001, d = 0.86, 95% CI [0.26, 1.45]; not for collaborative pairs, F (1, 24) = 2.42, p = .133, d = 0.22, 95% CI [-0.35, 0.78]. In addition, information obtained after two interviews from collaborative pairs contained significantly fewer errors (13 on average) than information obtained from nominal pairs (18 on average), F (1, 24) = 4.59, p = .042, d = -0.91, 95% CI [-1.77, -0.03].

New and omitted errors. We also examined errors that were new and omitted, respectively, during Interview 2. Prior to the analysis of new errors, one significant outlier was replaced by the mean plus three standard deviations, resulting in normally distributed data for all variables. Nominal pairs reported almost twice as many new errors during Interview 2 (6 on average) than collaborative pairs (3 on average), t (24) = 3.58, p = .002, d = -1.52, 95% CI [-

2.45, -0.57]. There was no significant difference between conditions in the number of errors omitted in Interview 2, t (24) = 0.29, p = .771, d = -0.13, 95% CI [-0.96, 0.71].

Retrieval strategies

Next, we investigated whether the use of certain collaborative retrieval strategies was associated with differences in memory performance. Because collaborative retrieval strategies in long-term couples have been investigated in only one previous study with a relatively small sample size (12 couples; Harris et al., 2011), we conducted exploratory analyses to extract principal components from our data. Harris and colleagues examined the role of retrieval strategies only for the *amount* of reported information, because the accuracy of information in their study was unknown. To enable comparisons with their data, we similarly conducted an analysis of the amount of reported information (i.e., total number of details reported across both interviews), but we also examined the accuracy of the reported information (i.e., proportion of reported details that was correct).

Table 1 shows the average frequency of retrieval strategy statements during the collaborative interview. Prior to analysis, frequencies were square-root transformed to counter positive skew. Further, we eliminated one variable that was still skewed after transformation ("relationship negative") and one variable that did not correlate significantly with any of the other variables ("role division"). To determine the relationship among the ten remaining variables, we conducted principal components analysis with direct oblimin rotation (Field, 2009). Two factors reached an eigenvalue greater than 1, and the two-factor solution accounted for 68.9% of the variance. Table 4 shows the loadings of each retrieval strategy variable on the two components.

[TABLE 4 ABOUT HERE]

The first component, which we named Process-Focused Interaction, includes explanations, corrections, positive references to the relationship, expressions of renewed remembering, and failed and successful cuing attempts ($\alpha = .85$). What these behaviours seem to have in common is that they focus predominantly on the process of remembering together, with witnesses explaining themselves, correcting each other, actively trying to cue each other, and talking about their relationship and the retrieval process. The second component, named Content-Focused Interaction, includes acknowledgements, repetitions, restatements, and elaborations ($\alpha = .86$). These behaviours suggest that pair members were actively listening to what their partner was saying, and building upon their partner's contributions by elaborating with additional information.

We conducted linear regressions to assess relationships between the type of collaborative interaction (content-focused or process-focused) and the amount and accuracy of reported information. The model with both types of interaction as predictors explained a significant proportion of the variance in the total amount of information reported per pair across both interviews, $R^2 = .61$, $F\ (2, 15) = 5.27$, $p < .001$. Process-Focused Interaction did not significantly predict the amount of information reported, $\beta = -.09$, $t\ (17) = -0.50$, $p = .626$, but Content-Focused Interaction was a significant predictor, $\beta = -.82$, $t\ (17) = -4.41$, $p < .001$.[2] Couples who displayed more content-focused interactive behaviours recalled significantly more information overall. In terms of accuracy, the model did not explain a significant proportion of the variance, $R^2 = .06$, $F\ (2, 15) = 0.47$, $p = .632$. Neither Process-Focused Interaction, $\beta = -.28$, $t\ (17) = -0.97$, $p = .348$, nor Content-Focused Interaction, $\beta = -.16$, $t\ (17) = -0.55$, $p = .591$, significantly

[2] Note that negative loadings on the Content-Focused Interaction component (see Table 4) are negatively related to the amount of information reported, which means that content-focused interactive behaviour is a positive predictor of the amount of information reported.

predicted the accuracy of reported information. Because we had the a priori prediction that corrections would be positively related to memory accuracy, we also inspected the correlation between corrections and accuracy, but found no significant association, r (18) = .04, p = .890, r^2 = .00.

To provide further insight into the observed association between Content-Focused Interaction (acknowledgements, repetitions, restatements, and elaborations) and the amount of information reported, we conducted a qualitative analysis. We present several excerpts from interview transcripts below (translated from Dutch) that illustrate Content-Focused Interaction.

M: "Some type of dress"

F: "Dress thing that opens at the front."

M: "Yes. Which colour? White, white…"

F: "White but very old white, so broken white. Dirty white, broken white."

M: "Yes."

In this example, the female witness (F) repeats her partner's statement ("dress") and elaborates ("opens at the front"). Her partner (M) acknowledges her elaboration ("yes") and adds additional information ("white"). Again, she repeats ("white") and elaborates ("old", "broken", "dirty"), and he acknowledges her elaboration ("yes").

M: "Ehm… the brother… what's his name again?"

F: "Edgar."

M: "Yes Edgar starts on the right of the stage. He looks at the situation and then murders ehm…"

F: "Albert. Here in the middle of the stage."

M: "Murders Albert in the middle of the stage, while he is having sex with Hélène."

In this example, the male witness successfully cues his partner to remember the name of the perpetrator ("Edgar"). He then repeats the name and elaborates ("starts on the right of the stage", "looks at the situation", "murders"). Then, when he pauses at the name of the victim, his partner again supplies the name ("Albert"), and also adds new information ("middle of the stage"). The male witness repeats that information and again adds new information ("while he is having sex with Hélène").

M: "It is about two brothers, uhm…"

F: "One is Edgar the giraffe boy and he is in the loony bin."

M: "Yes, yes. Edmond, Edgar."

F: "Edmond, Edgar. Oh yes Edmond"

M: "Yes Edmond the giraffe boy"

F: "Oh yes, Edmond that was it! Edmond."

In this example, the male witness successfully cues his partner, who elaborates by providing the name and additional information ("Edgar", "the giraffe boy", and "loony bin"). He acknowledges her elaboration ("yes, yes"), repeats the name of the first brother ("Edgar"), and elaborates with the name of the second brother ("Edmond"). She then repeats this information

and acknowledges the elaboration ("Oh yes Edmond"). The male witness then adds that Edmond was the giraffe boy, and his partner expresses that she remembers it again ("Oh yes, Edmond that was it!").

In sum, we obtained more information about the witnessed event from couples who had a content-focused interaction style, characterized by acknowledging, repeating, restating, and elaborating upon the partner's contributions. The qualitative examples illustrate that elaborations containing new information were often preceded by active listening to the partner, as reflected in repetitions, restatements, and acknowledgements.

Relationship duration

Finally, to investigate whether collaborative recall was more effective for couples that had been in a relationship for longer (as transactive memory theory predicts), we examined correlations between relationship duration and the total amount and accuracy of information recalled, respectively. Because participants who had known each other for longer were also generally older, r (18) = .66, p = .003, r^2 = .43, and because older couples reported fewer, r (18) = -.62, p = .006, r^2 = .38, and less accurate details, r (18) = -.55, p = .017, r^2 = .31, we conducted partial correlations controlling for participant age. Relationship duration did not correlate significantly with the amount, r (15) = -.08, p = .763, r^2 = .01, or accuracy of the reported information, r (15) = -.05, p = .863, r^2 = .00.

Discussion

Our data provide important new insights into collaborative memory. First, although pairs who worked together did not remember more details about the event than pairs who did not work

together, collaborative pairs did make significantly fewer errors than nominal pairs. Second, by interviewing participants a second time, we obtained significantly more information overall than had been obtained after only one interview. It did not matter whether the second interview was collaborative or individual, suggesting that the benefits were due to reminiscence (cf. Krix, Sauerland, Lorei, & Rispens, 2015). Third, we found that content-focused interaction (acknowledgement, repetition, restatement, and elaboration) significantly predicted the overall amount of information obtained from collaborative pairs, whereas process-focused interaction (corrections, explanations, positive references to the relationship, expressions of renewed remembering, and failed and successful cuing attempts) were unrelated to the amount reported. Neither of these types of interaction predicted the accuracy of witnesses' statements. Finally, relationship duration did not significantly affect the amount or accuracy of reports in the collaborative condition. We will review each of these findings in turn.

Previous research has highlighted the role of error pruning in collaborative recall; that is, collaborative groups typically make fewer errors than nominal groups do (Rajaram & Pereira-Pasarin, 2010; Ross et al., 2004; Wessel et al., 2014; Yaron-Antar & Nachson, 2006). Our findings provided further support for error pruning in collaborative recall, this time for recall of an emotional event witnessed live during a theatre play. Interestingly, and contrary to our prediction, we found no relationship between the frequency of partners correcting each other and the accuracy of reported information. This suggests that, in our study, error pruning was not achieved by means of explicit corrections. Perhaps, error pruning took place in more subtle ways, which were not picked up by our coding of corrections. For example, in the final qualitative example provided in the Results section, the dialogue starts off with incorrect information ("Edgar the giraffe boy"), but the collaborators eventually arrive at the correct

information (“Edmond the giraffe boy”). Nevertheless, none of the statements in this excerpt were coded as an explicit correction, because the error got corrected through an intricate process of repetitions, acknowledgements, and elaborations. This example illustrates that qualitative coding of error pruning is not as straightforward as it may seem.

When considering the comparisons between collaborative and nominal pairs presented here, we must take into account the limitations of our control condition. Because too few theatre-goers signed up to take part in the study, the sample size in the control condition was small and we were unable to randomly assign pairs to conditions. Therefore, comparisons between collaborative and nominal pairs must be interpreted with caution. Unfortunately, this kind of problem is often inevitable in field research, in which there is considerably less control than in laboratory research. The advantage of this type of research, however, is that it provides a more realistic simulation of what happens in real life—couples in the present study witnessed a live, emotional, complex event, and were unaware that they would be questioned about the rape-murder scene. Further research is required to investigate whether our findings replicate in larger samples.

Our analysis of the role of retrieval strategies in collaborative recall, on the other hand, did not involve the control group and therefore did not suffer the same limitations. Our findings suggest that when collaborators repeat and build upon each other’s contributions, they disrupt each other’s retrieval processes less (see Basden et al., 1997, for more on retrieval strategy disruption). Our findings support Clark and Wilkes-Gibbs’ (1986) “collaborative model”, in which a mutual belief that conversation partners have understood each other is key to successful collaboration. According to the model, mutual acceptance can be “asserted” by acknowledging (or repeating or restating) the partner’s statement, or “presupposed” by elaborating on the

statement. The present data also reveal striking similarities with Harris and colleagues' (2011) and Meade and colleagues' (2009) findings: in all three studies, pairs who actively repeated, rephrased, and elaborated upon each other's statements reported more information. In contrast, simple acknowledgements were associated with increased output in the current study, but decreased output in the other two studies. We can only speculate about the reasons for this discrepancy, but it remains possible, as Meade and colleagues suggested, that repetitions, restatements, and elaborations are simply more effective ways of establishing mutual acceptance than acknowledgements.

The findings regarding Process-Focused Interaction are somewhat less consistent. Unlike Harris and colleagues, we did not find that successful and failed cuing attempts predicted the amount of information recalled. Unlike Meade and colleagues, we did not find that explanations were associated with increased recall output. Finally, corrections have been found to increase (Meade et al., 2009), decrease (Harris et al., 2011), and have no impact (current study) on the amount of information recalled. Future research could provide more insight into the mixed findings on the impact of process-focused interactive behaviours by assessing the role of contextual factors, for example, the relationship between participants (e.g., romantic couples versus colleagues) and the type of to-be-remembered information (e.g., long-ago autobiographical events versus recently witnessed events).

The finding that a couple's interaction style can facilitate or inhibit how much they report about an event provides one potential explanation for previous mixed findings regarding the overall effect of collaboration on the number of event details reported. If researchers do not take retrieval strategies into account, important differences may be obscured. For example, the performance of successful and unsuccessful collaborative groups may cancel each other,

resulting in an average amount recalled that is equivalent to nominal groups (as observed in the current study and by Hope et al., 2013). In a similar vein, if most groups in the study sample do not communicate effectively, then researchers will find collaborative inhibition at the group level (Wessel et al., 2014; Yaron-Antar & Nachson, 2006), even though *some* collaborative groups may have remembered much more than nominal groups.

At first sight, the failure to find an association between relationship duration and recall performance seems to contradict the idea that transactive memory systems develop over time (Tollefsen, 2006; Wegner, 1987). However, since all but one of our couples had known each other for at least two years (with an average of 31 years), they had had more than sufficient time to develop a transactive memory system. In other words, it is possible that developing a transactive memory system indeed requires time, but that it reaches a plateau after some amount of time. Interestingly, Wegner and colleagues (1991) similarly found no association between relationship duration and collaborative recall performance for couples who had known each other for approximately two years on average, with a minimum of three months. Future research could investigate how much time it takes to develop a transactive memory system by recruiting a more heterogeneous sample with varying relationship durations. In addition to relationship duration, future work should take into account the quality of the relationship (cf. Barnier et al., 2014; Johansson et al., 2005).

Another extension of the current research would be to introduce a final individual interview after the collaborative interview. Research on recall of simple stimuli shows that benefits of collaboration on the number of remembered items often emerge only *after* collaboration (Blumen & Rajaram, 2008; Blumen, Young, & Rajaram, 2014; Choi, Blumen, Congleton, & Rajaram, 2014). During an individual interview after collaborating, witnesses can

build upon the contributions of their partner without disruptions from their partner. Thus, the current findings may underestimate the potential benefits of collaborative remembering, since witnesses did not get a chance to recall the event on their own after participating in the collaborative interview. Finally, an important question for future research is whether we can successfully instruct witnesses to use effective collaborative strategies. Thus, if we instruct witnesses to acknowledge, repeat and rephrase what their partner is saying, and build upon their partner's contributions, will they report more information? Or do the memory benefits only emerge for people who naturally communicate in this manner?

In conclusion, the present findings suggest that previous observations of error pruning in collaborative recall extend to witness interviews about an emotional scene from a theatre play. In our study, the benefit of error pruning was not accompanied by the typical cost of collaborative inhibition in terms of the amount of information recalled (cf. Wessel et al., 2014; Yaron-Antar & Nachson, 2006). Moreover, we found that witnesses can help each other remember more by acknowledging, repeating, restating, and elaborating on each other's contributions. The current findings stand in sharp contrast with the prevalent emphasis on harmful effects of co-witness discussion in the scientific literature and police guidelines. Perhaps, allowing witnesses to talk to each other is not such a bad idea after all.

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Table 1. Retrieval strategy coding categories and means (*M*) and standard deviations (*SD*) for the frequency of occurrence per collaborative interview.

Strategy	**Description and examples**	***M***	***SD***
Successful cue	Cuing attempt (e.g., "What was his name again?") that is followed by retrieval of information by the partner (e.g., "It was Mark" or "Something starting with an M").	7.39	4.86
Failed cue	Cuing attempt (e.g., "What was his name again?") that is not followed by retrieval of information by the partner (e.g., "I don't remember").	6.33	4.77
Acknowledgement / confirmation	Indicating support for a partner's statement, such as "Yes", "Hm hm", or "That's right".	80.94	47.45
Correction / disagreement	Correcting a partner's statement (e.g., "No, it was David"), or questioning its accuracy (e.g., "I remember it differently").	12.39	6.57
Elaboration	Building on a partner's statement by providing additional information, either countable (i.e., a new detail as classified in the content coding scheme) or non-countable (e.g., "I didn't like his face").	28.22	13.93
Explanation	Explaining one's own statement to the partner (e.g., "He was about 1.80m. I know because our son is the same height.").	4.00	3.85
Repetition	Repeating a partner's statement verbatim.	9.78	7.54
Restatement	Reformulating a partner's statement without changing the content (e.g., rephrasing "loony bin" to "psychiatric institution").	7.17	5.18
Renewed remembering	Indicating that a partner's statement triggers a memory (e.g., "Now I remember it again" or "I had forgotten about that!").	2.89	2.08
Relationship positive	Positive statement about the partner's or the couple's ability (e.g., "I am impressed that you remember that" or "We remember this quite well").	1.33	1.37
Relationship negative	Negative statement about the partner's or the couple's ability (e.g., "You have such bad memory" or "We are probably wrong about this").	1.00	2.20
Role division	Dividing or organizing the retrieval task (e.g., "Do you want to start?" or "You describe him, and I'll add to your description").	0.94	0.64

Table 2. Mean number of non-redundant correct details reported per pair during Interview 1 and 2, and overall across both interviews. Mean number of new correct details added during Interview 2 is shown in green, and mean number of omitted correct details is shown in red.

	Interview					
	Interview 1		Interview 2		Overall	
	M	*SD*	*M*	*SD*	*M*	*SD*
Nominal pairs						
Total	40.50	13.02	42.50	19.28	50.88	17.41
New			12.00	5.50		
Omitted			10.75	6.45		
Collaborative pairs						
Total	44.44	17.47	40.17	17.53	52.28	19.65
New			10.61	4.85		
Omitted			15.22	8.02		
All pairs						
Total	43.23	16.08	40.88	17.73	51.85	18.65
New			11.04	4.99		
Omitted			13.85	7.73		

Table 3. Mean number of non-redundant errors reported per pair during Interview 1 and 2, and overall across both interviews. Mean number of new errors added during Interview 2 is shown in green, and mean number of omitted errors is shown in red.

	Interview					
	Interview 1		Interview 2		Overall	
	M	*SD*	*M*	*SD*	*M*	*SD*
Nominal pairs						
Total	12.63	5.48	14.63	4.93	18.13	7.18
New			5.67	2.34		
Omitted			5.13	4.12		
Collaborative pairs						
Total	12.00	5.02	10.06	3.35	13.06	4.75
New			2.89	1.57		
Omitted			4.72	2.76		
All pairs						
Total	12.19	5.06	11.46	4.37	14.62	5.95
New			3.74	2.22		
Omitted			4.85	3.16		

Table 4. Oblimin-rotated pattern matrix from the Principal Components Analysis showing Process-Based Interaction (α = .85) and Content-Based Interaction (α = .86). For ease of interpretation, variables are sorted according to the size of their contribution, and loadings smaller than .3 are not depicted.

	Component	
Variable	Process-Based	Content-Based
Explanation	.890	
Failed cue	.750	
Correction	.750	
Relationship positive	.701	
Remembers again	.691	
Successful cue	.560	
Restatement		-.948
Repetition		-.928
Acknowledgement		-.787
Elaboration		-.705