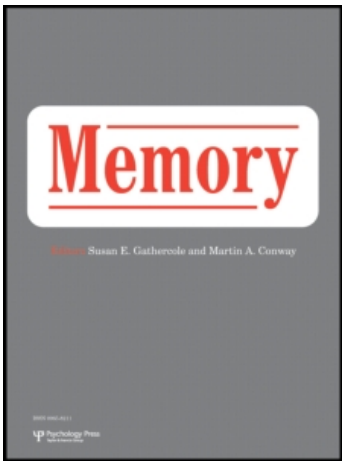

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Building consensus about the past: Schema consistency and convergence in socially shared retrieval-induced forgetting

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Building consensus about the past: Schema consistency and convergence in socially shared retrieval-induced forgetting

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A large body of literature on ''within-individual retrieval-induced forgetting'' (WI-RIF; Anderson, Bjork, & Bjork, 1994) shows that repeatedly retrieving some items, while not retrieving other related items, facilitates later recall of the practised items, but inhibits later recall of the non-practised related items. This robust effect has recently been extended to ''socially shared retrieval-induced forgetting'' (SS-RIF; Cuc, Koppel, & Hirst, 2007). People who merely listen to a speaker retrieving some, but not other, items—even people participating as speakers or listeners in conversations—show the same facilitation and inhibition. We replicated and extended the SS-RIF effect with a structured story (Experiment 1) and in a free-flowing conversation about the story (Experiment 2). Specifically, we explored (1) the degree to which participants subsequently form a coherent ''collective memory'' of the story and (2) whether schema consistency of the target information influences both WI-RIF and SS-RIF. In both experiments, speakers and listeners showed RIF (that is, WI-RIF and SS-RIF, respectively), irrespective of the schema consistency of the story material. On final recall, speakers and listeners described similar renderings of the story. We discuss these findings in terms of the role of ''silences'' in the formation of collective memories.

Keywords: Silences; Collective memory; Schema consistency; Forgetting.

People often talk about the past (MacDonald & Hayne, 1996; Miller & Sperry, 1988). The conversations can, among other things, serve to reshape the memories of individual conversational participants (Hirst & Echterhoff, 2008; Hirst & Manier, 2008; Middleton & Edwards, 1990; see also Pasupathi, 2001). In turn, conversations can impact the way individuals view themselves and their personal identity (Park, 2007). In many instances, the capacity of conversations to influence subsequent remembering can lead not just to a change in individual memories, but also to a greater consensus among participants about the past. When conversational participants represent a stable social entity, the emergent consensus following a conversation can and has been treated as an identity-grounding ''collective memory'' (Hirst & Manier, 2008). Collective memories are often treated as memories shared across a group that help to shape the identity of the group

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(Wertsch & Roediger, 2008). Thus conversations have the capacity to change individuals' memories, thereby shaping personal identity, but also to alter collective memories and, in doing so, transforming collective identities. Not surprisingly, then, as interest in collective identity has increased (Brewer & Chen, 2007), so has an interest in the ways conversations can reshape memories and promote the formation of collective memories (Middleton & Brown, 2005; Reese & Fivush, 2008).

Conversations can play this formative role in promoting shared memories and, in turn, collective memories when one person introduces new information into the group, producing so-called social contagion (Cuc, Ozuru, Manier, & Hirst, 2006; Meade & Roediger, 2002). They can also facilitate the formation of collective memories by reinforcing previously shared memories.

The general aim of this study is to examine the way in which conversations promote the formation of collective memories through what is not said in the conversation rather than simply through what is said; that is, through what Cuc et al. (2007) have termed *silences*. In conversations, participants often fail to recount memories they have the capacity to remember (Marsh, 2007; Weldon, 2001). The reasons for these ''silences'' range from the intention to deceive to the ability of one participant to block the retrieval of another participant (Basden, Basden, Bryner, & Thomas, 1997; Zerubavel, 2006). Whatever the reason, as Anderson and colleagues have repeatedly shown, the combination of selective remembering and selective silences can induce forgetting.

Specifically, Anderson et al. (1994) showed that unmentioned material related to what is recalled is more likely to be subsequently forgotten than unrelated unmentioned material, a phenomenon they referred to as *retrieval-induced forgetting* (RIF). Although RIF is not necessarily found when participants are encouraged to undertake a broad, time-consuming retrieval search (Chan, McDermott, & Roediger, 2006), under many instances of selective retrieval, the findings are quite robust. RIF has been found for a wide range of stimulus material: e.g., category-exemplar word pairs (Anderson et al., 1994), stories (Cuc et al., 2007), autobiographical memories (Barnier, Hung, & Conway, 2004), and brief science articles (Carroll, Campbell-Ratcliffe, Murnane, & Perfect, 2007). It can occur in both experimentally controlled instances of selective remembering, as well as the selective remembering in a free-flowing conversation (Cuc et al., 2007).

RIF is relevant to the formation of shared or collective memories because it can be found not only for those actively retrieving an item, but also for those listening to the speaker remembering (Coman, Manier, & Hirst, 2009; Cuc et al., 2007). Cuc et al. referred to the former as within-individual RIF (WI-RIF), the latter as socially shared RIF (SS-RIF). Because it elicits similar remembering and forgetting in speakers and listeners, as the name implies, SS-RIF can serve as a mechanisms by which conversations promote the formation of a collective memory (or, perhaps *in extremis*, collective amnesia). With SS-RIF, speakers and listeners come to share the same memory, or to be more precise, forget the same information.

Although the connection between SS-RIF and the formation of collective memory seems reasonable, no one to date has empirically established the relation. Cuc et al., for instance, only showed that speakers could induce forgetting in listeners, not that this induced forgetting leads to a mnemonic convergence between speaker and listener. The first specific aim of this study, then, is to address this gap, testing the degree to which concurrent WI-RIF and SS-RIF produces a collective memory in the post-retrieval-practice recollection of the participants. We measured the degree to which a collective memory is formed by examining the extent to which group members remember the same items, as well as the extent to which they forget other items. A collective memory rests not only on what members of a community remember, but also what they forget.

The second specific aim of this study rests in part on our claim about the connections between SS-RIF and collective memory. Collective memories are formed around memorable stories (Rubin, 1995; Zerubavel, 2004). Yet although WI-RIF and SS-RIF has been found for a wide range of material and testing conditions, few have explicitly studied whether RIF is less, more, or equally likely to be found for memorable or highly salient material. In particular, can silences in the joint act of remembering a story induce forgetting, not just for less-than-memorable, peripheral details, but also for memorable, salient, and central story elements? This question is particularly pertinent, not only to the study of collective memory but also to the role conversation plays in memory

more generally: RIF could not be considered a critical mechanism through which conversation shapes memory if it only induces forgetting for peripheral details.

One study does bear, albeit within limits, on our concerns about memorability and RIF. Coman et al. (2009) established that both SS-RIF and WI-RIF could be found when people jointly recounted the events on September 11, 2001. However, flashbulb memories may be the exception rather than the rule about memorability and RIF. Moreover, in the case of Coman et al., people were relating to each other distinct memories in that each person spent the day in a different way. There were structural similarities in their day (e.g., each person at some point in the day learned of the terrorist attack). But each memory of the day was different. Our concern is for shared memories, particularly since we are interested in the formation of collective memories. Finally, Coman et al. did not systematically manipulate memorability. They only looked for WI-RIF and SS-RIF for a highly memorable event.

We study the relation between memorability and RIF by examining whether RIF is a function of the extent to which a story element is schema consistent. The relation between schema consistency, memorability, and, to use the term evoked in the previous paragraph, saliency is complex (Alba & Hasher, 1983). As a substantial literature indicates, schema-consistent material is generally more memorable than schema-inconsistent material, especially when memory is assessed with a recall task (Anderson & Pichert, 1978; Kleider, Pezdek, Goldinger, & Kirk, 2007; Tuckey & Brewer, 2003). There are exceptions to this rule, which can be traced back to von Restoff (1933). By and large, schema inconsistent material is easier to remember, in particular, to recognise, when the schema inconsistency makes the material singularly stand out from its context (Strack & Bless, 1994).

We chose to emulate Anderson and Pichert's (1978) paradigm as it both specifically examines the role of schema consistency on memory and provides the to-be-remembered items at initial learning. This experimental paradigm alters schema consistency by changing the perspective of participants through the manipulation of a story's title. This shift in perspective switched the schema relevance of many story elements: what was schema consistent in one perspective was schema inconsistent in the other perspective. For instance, for a story about two people walking through a house, a perspective that treated them as burglars made the gems hanging out of a jewellery box schema consistent and the condition of the furnace schema inconsistent. However, a perspective that treated the two visitors as real-estate agents reversed the schema consistency. In this experimental setting, as Anderson and Pichert found, the memorable elements of the story shifted as their schema consistency changed.

Extant work on RIF does not offer any clear predictions about how RIF might vary with schema consistency. Anderson and Spellman (1995), for instance, suggest and then demonstrate that strongly associated word pairs (e.g., Fruit–Apple) should be remembered at least as well, if not better, than weakly associated word pairs (e.g., Fruit–Guava) and in turn produce more robust WI-RIF. In this case, apple may represent a more schema-consistent fruit than guava (at least in less tropical regions). Again employing paired associates, Storm, Bjork, and Bjork (2007) demonstrated that instructing participants to *remember*, as oppose to *forget*, also produces more robust WI-RIF. The instructions to remember presumably not only elicited a greater effort to remember but also made the to-be-remembered material more memorable. It is a challenge, however, to extend this work using paired associates to a story.

Other studies suggest that schema-consistent material may decrease, rather than increase, the level of impairment associated with RIF. Schema-consistent elements of a story are often tightly integrated; the schema itself serving as the glue that ties distinctive elements into a coherent narrative (Bransford & Johnson, 1972; Carroll et al., 2007). If this connection between schema consistency and integration is valid, schema-consistent material should be less, rather than more, susceptible to RIF. As previous research has established, integration reduces response competition by forming interconnections between competing memories (Smith, Adams, & Schorr, 1978). As a result, the more integrated the material, the less response competition, and hence the less robust the associated RIF. In support of this line of reasoning, Anderson and McCulloch (1999, see also Anderson & Bell, 2001) found that instructions to ''integrate'' significantly reduced the impairment associated with WI-RIF. Along the same lines, Carroll et al. (2007) found that experts studying and selectively practising science articles did not demonstrate the

same significant WI-RIF as did novices, even though they subsequently remembered the articles better than novices. The researchers suggested that experts were more likely to form an ''integrated'' representation than novices. Carroll et al. also asked participants to study either an article in which the sentences retained their original order or the same article in which the sentences were ordered alphabetically by their first word. Not surprisingly, given the other research on integration and RIF, Carroll et al. reported worse memory and strong WI-RIF for the disordered story, but better memory and nonsignificant WI-RIF for the ordered story. This research on RIF and stories is particularly pertinent to our concerns about conversations and collective memory because both conversations and collective memory often take the form of narratives (Middleton & Brown, 2005).

What predictions would we make about schema consistency and SS-RIF? Cuc et al. argued that SS-RIF occurs when a listener concurrently retrieves (even covertly) with the speaker. Once the concurrent retrieval takes place, then the processes involved in WI-RIF—be they inhibition or interference—come into play and produce the observed retrieval-induced forgetting. According to this argument, if WI-RIF cannot be found for schema-consistent or memorable material, then it should not be found for SS-RIF and, therefore, no collective memory is formed through this mechanism. However, when WI-RIF does occur it is possible that when schema-consistent material goes unmentioned by a speaker, listeners increase their attention to what the speaker is saying. A speaker's lapse in mentioning an ''obvious'' element may lead to higher scrutiny by the listener. This increased attention could, on the one hand, lead to an increase in concurrent retrieval. On the other hand, it might also lead the listener to retrieve the material the speaker did not recount; thereby creating conditions in which selective retrieval might elicit retrieval-induced facilitation rather than retrieval-induced forgetting (Chan et al., 2006). Of course, such facilitation would not necessarily take place. As Hirst and Echterhoff (2008) have argued, the quick give-and-take of a conversation might produce conditions more suited to retrieval-induced forgetting than retrieval-induced facilitation.

The present study, therefore, has two aims: (1) to determine whether SS-RIF promotes the formation of collective memory, and (2) given the uncertainty that exists in the research literature on the presence of both WI-RIF and SS-RIF for schema consistent material, to determine whether both forms of RIF are present for both memorable, schema consistent material and less memorable, schema inconsistent material. We are not predicting that one type of material produces more robust RIF than the other. Rather we only seek to find WI-RIF and SS-RIF for both.

EXPERIMENT 1

This experiment probes for WI-RIF and SS-RIF using stories in an experimentally controlled setting. Following Experiment 2 of Cuc et al. (2007), an eight-episode story served as the stimulus material. Each episode contained at least three critical events allowing us to construct episode–event pairs. We manipulated the schema consistency of these critical episode–event pairs by changing the place of some of the story elements in the narrative, so that with one ordering the critical events were ''schema consistent'', with the other ordering they were ''schema inconsistent''. In order to assess both WI-RIF and SS-RIF participants were paired, with one serving as the ''speaker'', the other as the ''listener''. Both speakers and listeners studied the story individually but in front of each other. Immediately after studying the story, each participant recalled the story individually using a pen and paper. During the retrieval practice phrase the speakers were presented with sentences that described one of the critical episode–event pairings. One participant (the speaker) filled in missing information in the presented sentence, while another participant (the listener) was asked to monitor for the accuracy of this recollection. The selective practice was configured so that some items were practised (Rp+), some items were unpractised and related to the practised items (Rp–), and some items were unpractised and unrelated to the practised items (Nrp). After a delay, speakers and listeners individually recollected the story. The final recall was used to calculate Rp+, Rp–, and Nrp. WI-RIF and SS-RIF occurred if Nrp > Rp– for speaker and listener, respectively. By contrasting the performance of speakers and listeners who studied stories with schema-consistent critical events with the performance of speakers and listener who studied stories with schema-inconsistent critical events, we assessed whether WI-RIF and SS-RIF occurred for both schema-consistent

and -inconsistent material. We investigated whether a collective memory formed by measuring the overlap for the pairs' initial recall and their final recall.

Method

Participants and design. A total of 54 participants (27 pairs) were recruited from New School University (NSU) in New York City, USA, and from Macquarie University (MU) in Sydney, Australia. The participants from NSU were unpaid volunteers, while those from MU were compensated $20 (AUS) for their time. Three participants' final recall was more than 3 standard deviations away from the mean. These individual participants' data were removed from the final analysis. The experiment used a design with one within-participant factor (retrieval type: *Rp+*, *Rp–* and *Nrp*) and two between-participant factors (role: speaker and listener; and schema consistency: consistent vs inconsistent). A total of 13 pairs were given the schema-consistent story to read and remember; 12 pairs were given the schema-inconsistent story. This assignment was random. A preliminary analysis also revealed no difference between the recall of US and Australian populations and therefore is not considered any further.

Stimulus materials. A 982-word story was created comprising eight episodes. The story was about touring a house. Each episode took place in a different room (i.e., Living Room, Dining Room, Garage, Kitchen, Backyard, Laundry Room, Recreational Room, and Bedroom). For each episode, three of the story elements were designated as *critical story elements* (see Table 1). These critical story elements figured in later memory tests. In addition, two sentences in the episode were designated as possible *schema-driving sentences*. By *schema-driving sentence* we mean a sentence that changes the gist and the relative importance of the elements in the episode when its position in the episode changes. By manipulating the position in an episode of these *schema-driving sentences* we sought to manipulate the relative schema consistency of the critical story elements and, in turn, their memorability. When a schema-driving sentence was not at the beginning of an episode, it was located somewhere near the end. In this way we could vary the schema consistency and memorability of the critical story elements in an episode without changing the content of the critical elements or their placement in the story. Only the placement of the schema-driving sentences changed.

TABLE 1
Examples of a schema-consistent and schema-inconsistent episode

Living Room – *Schema consistent*
Aeneas is giving a tour of his house to Phil.
Aeneas walked into the living room.***
Aeneas urged Phil to look around.
There was a DVD player and a stereo system. ###
There are two windows to allow plenty of light in the room. ###
There was also a flat screen TV hanging from the wall. ###
Though, Phil was more interested in a place to take a nap.***
Aeneas told him about the beds they had available.
Aeneas also showed him where the blankets were in case he got cold.
Phil wanted Aeneas to wake him up in 20 minutes.
Aeneas then turned out the light.
He closed the door.
Living Room – *Schema inconsistent*
Aeneas is giving a tour of his house to Phil.
Though, Phil was more interested in a place to take a nap.***
Aeneas urged Phil to look around.
There was a DVD player and a stereo system. ###
There are two windows to allow plenty of light in the room. ###
There was also a flat screen TV hanging from the wall. ###
Aeneas told him about the beds they had available.
Aeneas also showed him where the blankets were in case he got cold.
Phil wanted Aeneas to wake him up in 20 minutes.
Aeneas then turned out the light.
He then walked out of the living room.***
He closed the door.

***The *schema-driving sentences* manipulated between schema-consistent or schema-inconsistent episodes.

###Examples of the critical items analysed in the two experiments.

In pilot work we created four versions of the story through manipulation of these schema-driving sentences, with one version comprising only episodes consisting of schema-consistent critical story elements (see Table 1), another comprising only episodes consisting of schema-inconsistent critical story elements (again, see Table 1), and the remaining two comprising an equal number of episodes consisting of schema-consistent and schema-inconsistent story elements. We constructed the mixed versions of the story because we wanted to test whether participants' perspectives could be manipulated episode by episode rather across an entire story. We recruited 16 participants (NYC). They were asked to rate how schema consistent the critical items

were within each episode (10 = highly schema consistent, 1 = not at all schema consistent). Schema-consistent items were defined as highly typical given the overall context of the episode (Anderson & Pichert, 1978). We found no difference in the level of schema consistency between those *schema-consistent items* in the completely schema-consistent story ($M = 7.63$; $SD = 1.16$) and those in the mixed stories ($M = 7.81$; $SD = 7.81$), $t(31) = -0.63$, $d = 0.23$, $p = .53$. Similarly, we found no difference between the level of schema consistency between those *schema-inconsistent items* in the completely schema-inconsistent story ($M = 3.47$; $SD = 1.52$) and those in the mixed stories ($M = 3.13$; $SD = 1.21$), $t(31) = 0.97$, $d = 0.35$, $p = .34$. We did find an overall significant difference between schema-consistent items ($M = 7.70$; $SD = 0.81$) and schema-inconsistent items ($M = 3.30$; $SD = 0.94$), $t(31) = 20.5$, $d = 7.36$, $p < .001$. Satisfied that perspectives could be manipulated episode by episode, we confined ourselves in the present study to the two stories in which all the episodes consist of entirely schema-consistent or entirely schema-inconsistent critical items. In other words, we used only two versions of the story on which we did pilot testing in the present experiment.

Another pilot study was conducted to make sure the story was readable. We recruited 10 (NYC) participants to rate how readable the schema-inconsistent and schema-consistent versions of the story were on a scale of 1 (not readable) to 10 (very readable). Five participants read the story comprising all schema-inconsistent episodes and the other five read the story comprising schema-consistent episodes. While we did find a significant difference between the readability of the schema-inconsistent ($M = 8.60$; $SD = 0.55$) and the schema-consistent version ($M = 9.60$; $SD = 0.55$), $t(8) = 2.89$, $d = 2.04$, $p < .05$, they were both found to be very readable with no episode rating lower than a 7.

Procedure. The participants were run in pairs: participants within each pair were unknown to each other. After the pair of participants arrived in the lab they were seated in front of separate computers. The experiment comprised five phases: Study Phase, Initial Cued-Recall Phase, Retrieval-Practice Phase, Distractor Phase, and Final Cued-Recall Phase.

In the *Study Phase* the story was displayed on a computer screen using *Super Lab*, one episode at a time. Each episode was presented on screen for 35 seconds and then completely erased before the next episode appeared. As soon as each participant finished reading the story three times, they were handed an initial cued-recall packet.

In the *Initial Cued-Recall Phase* participants were handed a cued-recall packet consisting of an instruction sheet and eight additional sheets with only the title of each episode at the top. Each participant was asked to recall in writing as much as they could about the episode captured by the heading on the sheet of paper. They were given as much time as needed to write down everything they could remember for each episode. They were instructed not to turn the sheet of paper to the next episode heading until they had written everything they wanted for the episode at hand. Extra paper was available if needed. As soon as each participant finished the cued-recall packet, the retrieval practice phase started.

In the *Retrieval Practice Phase* both participants were seated in front of the *same* computer. One participant was designated as the ''speaker''. The speaker was always the first participant to arrive at the lab. Speakers were seated directly in front of the computer. The other participant was designated the ''listener''. Listeners were positioned a couple of feet behind the speaker in a manner that ensured a clear view of the computer screen. The following instructions were presented on the screen:

> In the next part of the study, you will get practice remembering some of the things that happened in some of the episodes of the story. One of you will read the prompts out loud and fill in the missing portions to the best of your ability by speaking the material aloud. The other person will look on silently and rate their degree of confidence in how their partner is filling in the prompts on the provided sheet of paper. Each prompt will be on the screen for 10 seconds, and then will automatically go to the next prompt. After you have gone through it once, it will automatically return to the instructions page, please go through the slides a second time reading and filling in the blanks out loud. After you have finished going through the sentences a second time please wait for instructions from the experimenter. If you have any questions, ask the experimenter now. If not, press any key to continue.

There were a total of 16 slides, each containing a category label that indicated the name of the

room in which the episode took place and a fragment of one of the critical story elements in the episode. These fragments were constructed by eliminating key words from the story element. Thus, a screen might contain "Garage – Co_____ could be seen in the co_____ of the room". Half of the critical story elements from half of the rooms were presented. Which rooms and which critical story elements received this additional practice was counterbalanced across pairs.

Listeners were provided with a numbered sheet of paper on which, using a scale from 1 (low accuracy) to 7 (high accuracy), they indicated how accurate they believed the speaker's responses to be. As noted in the instructions, each pair went through the retrieval practice list twice, each maintaining their respective roles. The order of the items in the retrieval practice list was the same across practice trials and across pairs.

In the *Distractor Phase*, which proceeded immediately after completing the retrieval practice, each participant was asked to write for 20 minutes about five movies they had recently seen. After the time had elapsed, the experimenter collected the distractor sheets and handed the participants a final cued-recall packet.

In the *Final Cued-Recall Phase*, participants received a packet that was identical to the initial cued-recall packet, except for a demographics sheet stapled to the back.

Final analysis compared the means of the proportion of critical items selectively practised (Rp+), critical items semantically related to the practised items, but not practised (Rp–) and critical items not practised and not semantically related to the practised items (Nrp). It should be noted: regardless of whether the episode was schema consistent or not, the Rp+ items remained constant for both speaker and listener.

Results and discussion

We began our analysis by first looking at whether our manipulation of schema consistency produced different levels of memorability. We then examined whether WI-RIF and SS-RIF were a function of schema consistency. Finally, we assessed our first aim: whether selective practice promoted the formation of a collective memory.

A manipulation check: Memorability and schema consistency. Rp+ items were used as a measure to test whether our manipulation of schema consistency affected memorability, inasmuch as Rp+ items remained constant across participants. The difference between $p(\mathrm{Rp}+)$ for schema-consistent events ($M = 0.93$, $SD = 0.14$) episodes and schema-inconsistent events ($M = 0.82$; $SD = 0.21$) was significant, $t(49) = -2.29$, $d = 0.62$ $p < .05$.

WI-RIF, SS-RIF and schema consistency. In order to determine whether both speakers and listeners exhibited WI-RIF and SS-RIF for schema-consistent material we conducted a three-way ANOVA, with one within-participant factor (retrieval type: *Rp+*, *Rp–*, and *Nrp*) and two between-participant factors (role: speaker and listener and schema consistency; consistent vs inconsistent; see Figure 1). We found a main effect for retrieval type, $F(1, 47) = 47.8$, $\eta_p^2 = .645$, $p < .001$ and for schema consistency, $F(1, 47) = 19.2$, $\eta_p^2 = 0.29$, $p < .001$, but did not find an interaction between retrieval type, role, and schema consistency, nor interactions between retrieval type and schema consistency, and retrieval type and role, $F(1, 47) = .291$, $\eta_p^2 = .006$, $p = .592$, $F(1, 47) = .913$, $\eta_p^2 = .019$, $p = .344$, and $F(1, 47) = .632$, $MSE = 1.06$, $p = .430$, respectively.

The main effect for retrieval type reflects the presence of RIF in our data. In our post hoc analysis we found a retrieval practice effect, with $p(\mathrm{Rp}+)$ ($M = 0.87$; $SD = 0.18$) recalled better in

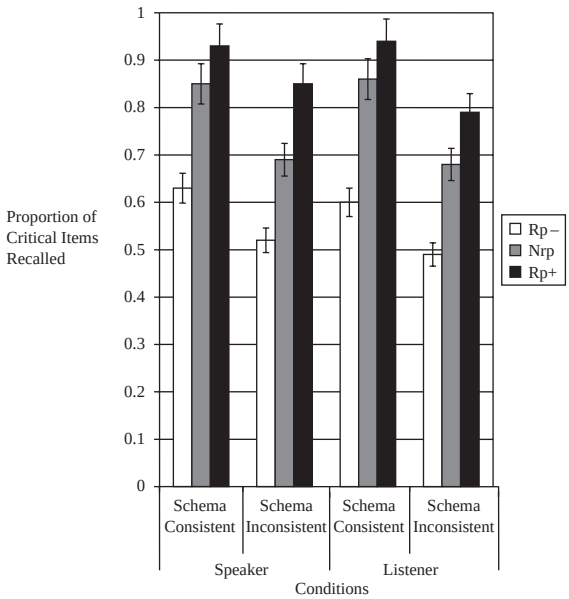

Figure 1. Schema-consistent and -inconsistent for listeners and speakers in the "overhearer" condition.

the final test than both p(Rp–) ($M = 0.56$; $SD = 0.22$) and p(Nrp) ($M = 0.77$; $SD = 0.16$), $t(50) = 9.11$, $d = 2.57$, $p < .001$ and $t(50) = 2.68$, $d = 0.76$, $p = .01$, respectively. We also found induced forgetting in that p(Nrp) ($M = 0.77$ $SD = 0.16$) was recalled significantly better than p(Rp–) ($M = 0.56$; $SD = 0.22$), $t(50) = 6.35$, $d = 1.80$, $p < .001$. The main effect for schema consistency indicated that schema-consistent events ($M = 0.93$, $SD = 0.14$) were remember overall better than schema-inconsistent events ($M = 0.82$; $SD = 0.21$).

The lack of an interaction between retrieval type and role indicates that the impairment associated with RIF were of equal size for both speaker (WI-RIF) and listener (SS-RIF). We calculated both absolute [p(Nrp) – p(Rp–)], and relative impairment, {[p(Nrp) – p(Rp–)]/p(Nrp)}, for both speakers and listeners. (For speakers, absolute impairment, $M = 0.19$; $SD = 0.01$; relative impairment, $M = 0.27$; $SD = 0.02$; for listeners, absolute impairment, $M = 0.24$; $SD = 0.01$; relative impairment, $M = 0.31$; $SD = 0.02$.) No significant differences were found between these means, $p > .10$.

As to our failure to find an interaction between retrieval type and schema consistency, again we calculated both absolute and relative impairment, now for both schema-consistent and schema-inconsistent events. (For consistent items, absolute impairment, $M = 0.23$; $SD = 0.01$; relative impairment, $M = 0.27$; $SD = 0.01$; for inconsistent items, absolute impairment, $M = 0.18$; $SD = 0.01$; relative impairment, $M = 0.26$; $SD = 0.01$.) Again, no significant differences were found between these means, $p > .10$. These results speak to a central concern in this paper: Whereas we found both WI-RIF and SS-RIF for both schema-consistent and schema-inconsistent material, we did not find any indication that the size of the impairment varied as the consistency changed. We also examined whether our experiment possessed enough statistical power to detect differences in the data. A retrospective power analysis revealed a 0.98 coefficient, indicating adequate power to detect differences among our variables at a $p < .05$ with a sample of our size.

As did Cuc et al. (2007), we investigated whether a generation effect emerged for the speaker, in as much as it was the speaker, not the listener, that completed the fragments during the practice phase of the experiment. A generation effect on the part of the speaker should lead to a better memory for Rp+ items (Slamecka & Graf, 1978). This is exactly what we found $t(24) = 2.86$, $d = 1.17$, $p = .009$ (see Figure 1).

Finally, our experimental procedure involved both an initial recall that preceded the selective practice and a final recall that followed the selective practice. It is possible that the pattern of data found in the final recall might be traced to the initial recall rather than to the selective practice itself. In order to assess this possibility, we randomly selected five items from the original story and determined whether one could predict how well these items were recalled in the final recall on the basis of whether they were recalled in the initial recall and whether they were related or not to the initially recalled item. The initial recall of these items did not predict their final recall.

Collective memory. We assessed whether selective practice promoted the formation of a collective or shared memory by measuring the overlap for the pairs' initial recall and for their final recall. We divided the proportion of critical items recalled in the final recollection into three categories: RR (proportion recalled by both participants; i.e., Participant A *remembered* and Participant B *remembered*), NN (proportion not recalled by both participants; i.e., Participant A did *not* remember and Participant B did *not* remember), and DM (discrepant memories: the proportion of items that are recalled by one but not the other participant; i.e., Participant A remembers but Participant B does not). We added the number of RR to the number of NN and divided them by the number of critical items to obtain a measure of the degree to which a collective memory was emerging in the final recall, a measure we will refer to as CM (collective memory). We combined RR and NN for analysis because, as we understand the concept, for a collective memory to emerge, the participants must not only both remember the same items but must also forget the same items. A collective memory was said to be emerging following the practice phase if either (1) CM for the final recall is greater than DM for the final recall, or (2) CM for the final recall is greater than CM for the initial recall. A (2) (Collective Response: CM vs DM) × (2) (Time: Initial CM vs Final CM) within-participants ANOVA demonstrated a main effect for Collective Response, $F(1, 26) = 75.1$, $\eta_p^2 = 0.74$, $p < .001$ and an interaction between Collective Response and Time, $F(1, 26) = 40.7$, $\eta_p^2 = 0.61$, $p < .001$. Planned t-tests

confirmed that there was a significant difference between CM ($M = 0.70$; $SD = 0.10$) and DM ($M = 0.30$; $SD = 0.10$) on final recall, $t(26) = 10.3$, $d = 4.03$, $p < .001$, whereas there was no significant difference between CM ($M = 0.53$; $SD = 0.09$) and DM ($M = 0.47$; $SD = 0.09$) on initial recall, $t(26) = 1.75$, $d = 0.69$, $p = .092$ (see Table 2). These results suggest that selective practice promoted the formation of a collective memory.

We sought to determine whether this "collective memory effect" could be attributed to the practice effect that facilitated subsequent remembering or the inhibition effect that lead to induced forgetting. We calculated the proportion of total items remembered ($M = 0.53$; $SD = 0.18$) and forgotten ($M = 0.47$; $SD = 0.18$). We are most interested here in whether the formation of a collective memory is driven mostly by the number of Rp+ and Nrp the participants both *recalled* (RR) or by the number of Rp– items they both *forgot* (NN). In as much as we failed to find any difference between RR and NN, $t(50) = –1.05$, $d = –0.30$, $p = .30$, we concluded that the "collective memory effect" could not be attributed proportionally either to enhanced remembering or induced forgetting, but rather to a combination of the two.

Finally we investigated whether schema-consistent material was more likely to lead to a collective memory than schema-inconsistent material. Although there was a tendency for the schema-consistent material ($M = 0.73$; $SD = 0.05$) to promote the formation of a collective memory as opposed to schema-inconsistent material ($M = 0.67$; $SD = 0.12$), there was no significant difference, $t(25) = 1.86$, $d = 0.74$, $p = .074$. (While we believe these results may have been significant had we conducted a one-tailed *t*-test, our lack of a directional hypothesis, precludes us from such an analysis.) This result is consistent with our finding that the level of impairment associated with retrieval-induced forgetting was similar for speaker and listener, as well as schema-consistent and schema-inconsistent material.

Our results confirm the findings of Cuc et al. (2007). We found both WI-RIF and SS-RIF, in our case, employing a different story from the one used by Cuc et al. Furthermore, we extended Cuc et al. by demonstrating that WI-RIF and SS-RIF could be found for both schema-consistent and schema-inconsistent material. Because the schema-consistent material was more memorable than the schema-inconsistent material, our findings would further suggest that WI-RIF and SS-RIF should hold for memorable as well as less-than-memorable material. Finally, we provided evidence suggesting SS-RIF may play a pivotal role in the formation of a collective memory, whether the material is schema consistent and memorable or schema inconsistent and less-than-memorable.

TABLE 2
The "overhearer" condition: Initial and final collective memory results

	Initial recall		*Final recall*	
	Means	*Standard deviations*	*Means*	*Standard deviations*
Collective memory (CM)	.53	.09	.70	.10
Discrepant memories (DM)	.47	.09	.30	.10

EXPERIMENT 2

In Experiment 1 the experimenter determined what was or was not practised. Moreover, the listener did not engage in a conversation with the speaker, only monitored what the speaker recalled. In Experiment 2 we follow Cuc et al.'s lead and extend our findings in Experiment 1 to instances in which the selective practice occur in the context of a free-flowing conversation. We felt it important to test the results of Experiment 1 in the context of a free-flowing conversation in as much as conversations provide a ubiquitous medium by which memories are shared in the real world. Cuc et al. found both WI-RIF and SS-RIF following a free-flowing conversation about a previously studied story. We are interested here in (1) whether the selective conversational remembering that produces WI-RIF and SS-RIF will promote the formation of a collective memory, and (2) whether WI-RIF and SS-RIF can emerge for both schema-consistent and schema-inconsistent material following a free-flowing conversation about the material. Experiment 2 follows the method of Experiment 1 with one exception: The selective practice in Experiment 1 is replaced by a

free-flowing conversation in which two participants are asked to jointly recall a previously studied story.

Method

Participants and design. A total of 48 participants (24 pairs) were recruited to participate in our second experiment. Participants were recruited from Macquarie University (MU) in Sydney, Australia. Participants were compensated $20 (AUS) for their time. Two participants' final recall was more than 3 standard deviations away from the mean. These individual participants' data were removed from the final analysis. As in Experiment 1, the experiment employed a design with one within-participant factor (retrieval type: *Rp+*, *Rp–*, and *Nrp*) and two between-participant factors (role: speaker and listener; and memorability: schema consistent vs schema inconsistent).

Stimulus materials. Experiment 2 employed the same story as Experiment 1, with all the episodes containing either schema-consistent or schema-inconsistent critical story elements.

Procedure. The procedure for Experiment 2 was similar to that of Experiment 1, except for the following changes/precautions: First, we removed the initial cued-recall test because it extended the experimental time beyond reasonable standards. Experiment 1 had already demonstrated the significant differences between initial and final recall. Second, each participant read the story only twice instead of three times, to prevent the participants from cross cueing each other until at least an item from each episode was recalled. Third, and most important, instead of a structured retrieval practice via the computer, the participants took part in a free-flowing conversation for 5 minutes. Five-minute conversations prevented the experiment from going on too long, while still giving the participants enough time to mention as many episodes and critical items they could remember before long pauses (roughly 7–10 seconds) began interrupting the conversation. Many real-world conversations are time limited. Finally, a cassette player was used to record each of the pairs' conversations.

Results and discussion

As in Experiment 1 we began our analysis by first examining whether our manipulation of schema consistency was effective in manipulating memorability. We then examined WI-RIF and SS-RIF and whether schema consistency moderates these effects. Finally we determined whether in the course of a conversation, a shared representation of the past was formed. Before undertaking these analyses, we need to specify how we coded the free-flowing conversations.

Coding scheme. Each conversation was transcribed. Two coders then used these transcripts to identify Rp+ (items mentioned in the conversation), Rp– (items semantically related to mentioned items, but not mentioned themselves), and Nrp (items from episodes not mentioned at all). Details of the coding scheme can be found in Table 3. Several points about the coding scheme in Table 3 need to be emphasised. Coders first identified whether a participant was a speaker or

TABLE 3
Classification of a recalled item from an episode on the basis of what was said in a conversation if participant serves the role of speaker or listener

	Speaker	*Listener*
Rp+	The speaker mentions a critical item from an episode	The participant listens to the critical item/episode stated by the speaker. The mentioned item is not the one supplied by the listener. It is assumed that the listener concurrently (albeit covertly) remembered the critical item mentioned by the speaker from the episode
Nrp	No response from the episode mentioned by any participant	No response from the episode mentioned by any participant
Rp–	The speaker does not mention the critical item, but a related item from the same episode is mentioned. As with Rp+, this is a response that was stated by the speaker from an episode	The speaker does not mention the critical item, but does mention a related response. The mentioned related critical item is not the response supplied by the listener during the conversation, rather the response the speaker supplied in the conversation. Moreover, the listener never mentioned any response from the episode

a listener. That is, for each item mentioned in the conversation one participant was coded as a speaker, the other as the listener. Coders then determine for each item in the original story as to whether it was Rp+, Rp–, or Nrp for the speaker and for the listener. When a critical item was mentioned in the course of a conversation, it was coded as an Rp+ for the speaker and the listener. Rp– items represent those items semantically related to the Rp+ items, but not mentioned in the course of a conversation. For a listener, Rp– items were unmentioned items related to what the speaker stated, but were unrelated to anything the listener had stated. For a speaker, Rp– items were unmentioned items related to what the speaker herself stated. Nrp items are those items from episodes that were not mentioned by either participant in the course of the conversation. Reliability between the two coders was good, $\kappa = .89$. Disagreements were discussed and resolved to each party's satisfaction. All the pairs provided a sufficient amount of Nrp and Rp– items to permit data analysis.

Manipulation check: Memorability and schema consistency. Our analysis began by investigating whether our manipulation of memorability was effective. Focusing on p(Rp+), for both listeners and speakers, there was a significant difference in the final recall of schema consistent events ($M = 0.87$; $SD = 0.14$) and schema inconsistent events ($M = 0.65$; $SD = 0.30$), $t(44) = 3.32$, $d = 1.00$, $p < .05$.

WI-RIF, SS-RIF and schema consistency. We conducted a three-way ANOVA, with one within-participants factor (retrieval type) and two between-participants factor (role and schema consistency) (see Figure 2). We found a main effect for retrieval, $F(1, 36) = 18.8$, $\eta_p^2 = .343$, $p < .001$, as well as a main effect for schema consistency, $F(1, 36) = 7.80$, $\eta_p^2 = .178$, $p < .05$. However, as in Experiment 1 we found no interaction between retrieval type, role and schema consistency, $F(1, 36) = 0.03$, $\eta_p^2 = .001$, $p = .870$, retrieval type and schema consistency, $F(1, 36) = 0.11$, $\eta_p^2 = .003$, $p = .748$, nor retrieval type and role, $F(1, 36) = .05$, $\eta_p^2 = .001$, $p < .819$.

The main effect for retrieval type reflect the presence of RIF, with induced forgetting being observed as p(Rp–) ($M = 0.32$; $SD = 0.29$) was significantly less than p(Nrp) ($M = 0.58$; $SD = 0.26$), $t(39) = 5.45$, $d = 1.75$, $p < .001$. The main effect for schema consistency indicated that schema-consistent events (M = 0.87; SD = 0.14) were remembered better overall than schema-inconsistent events ($M = 0.65$; $SD = 0.30$).

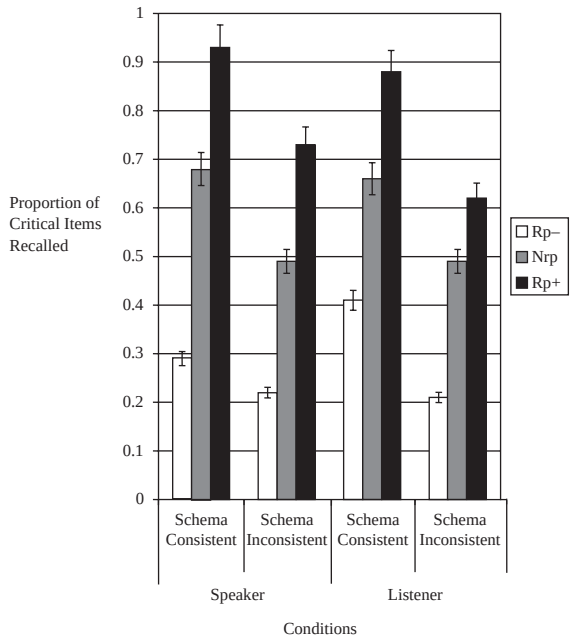

Figure 2. Schema-consistent and -inconsistent for listeners and speakers in the conversation condition.

As for our failure to find any interactions, the lack of an interaction between retrieval type and role indicates that the impairment associated with RIF were of equal size for both speaker (WI-RIF) and listener (SS-RIF). We calculated both absolute and proportional impairment for both speakers and listeners. (For speakers, absolute impairment, $M = 0.33$; $SD = 0.02$; relative impairment, $M = 0.56$; $SD = 0.03$; for listeners, absolute impairment, $M = 0.27$; $SD = 0.01$; relative impairment, $M = 0.47$; $SD = 0.02$). No significant differences were found between these means, $p > .10$.

As to our failure to find an interaction between retrieval type and schema consistency, again we calculated both absolute and proportional impairment for both schema-consistent and schema-inconsistent items. (For consistent items, absolute impairment, $M = 0.32$; $SD = 0.02$; relative impairment, $M = 0.48$; $SD = 0.02$; for inconsistent items, absolute impairment, $M = 0.27$; $SD = 0.01$; relative impairment, $M = 0.55$; $SD = 0.03$.) Again no significant differences were found between these means, $p > .10$. These results speak to a central concern in this paper: Whereas we found both WI-RIF and SS-RIF for both schema-consistent and schema-inconsistent material, we did not find any indication that the size of the impairment

varied as the consistency changed. We also investigated whether our experiment could provide enough statistical power. A retrospective power analysis revealed a 0.88 coefficient, indicating adequate power to detect associations among our variables at a $p < .05$ with a sample of our size.

Unlike Experiment 1, we did not find a generation effect. Although there was greater $p(\text{Rp}+)$ for the speakers than listeners, there was no significant difference, $t(34) = 1.22$, $d = .411$, $p = .232$. Thus, the speaker's final recall of the Rp+ did not benefit from generating the items themselves in the conversation.

Collective memory. As in Experiment 1 we investigated whether a collective memory of the story was created by the conversation. We analysed how similar each of the speakers' and listeners' final recall were to each other. However, unlike Experiment 1 we did not have an initial recall with which to compare the final recall. Consequently, we focused only on final recall, finding that the proportion of CMs ($M = 0.74$; $SD = 0.09$) was significantly higher than the proportion of DMs ($M = 0.26$; $SD = 0.09$), $t(23) = 13.6$, $d = 5.67$, $p < .001$. These results strengthen those found in Experiment 1. It is noteworthy, as in Experiment 1, that we did not find a significant difference between the formation of a collective memory of schema-consistent material ($M = 0.77$; $SD = .076$) as opposed to schema-inconsistent material ($M = 0.71$; $SD = 0.09$), $t(22) = 1.57$, $d = 0.67$, $p = .131$.

We also investigated whether the act of forgetting was the driving force behind the formation of a collective memory. To do this we calculated the proportion of items remembered versus the proportion of the items forgotten, as was done in Experiment 1. While the results show a tendency for a higher proportion of remembered items ($M = 0.55$; $SD = 0.20$) compared to those forgotten ($M = 0.45$; $SD = 0.20$), as in Experiment 1, this difference was not significant, $t(45) = 1.69$, $d = 0.50$, $p = .098$. This suggests that both remembering and forgetting play important roles for SS-RIF; the overall effects are not driven merely by one mechanism or the other.

Our results further support Cuc et al.'s (2007, Exp. 3) findings that WI-RIF and SS-RIF can be found in free-flowing conversations. Beyond that, we were able to extend their findings to a novel story, as well as to schema-consistent (memorable) and schema-inconsistent (less-memorable) material. The results provide evidence that by selectively practising some items at the expense of others, both listeners and speakers in a conversation can converge around a shared representation of the past.

GENERAL DISCUSSION

Our study had two specific aims: (1) exploring whether the effects of WI-RIF and SS-RIF promote the formation of a collective memory between a speaker and a listener and (2) investigating whether both WI-RIF and SS-RIF can be found for both schema-consistent and hence memorable material and schema-inconsistent and hence less-than-memorable material. In the process of accomplishing (2), we also intended to replicate Cuc et al.'s (2007) findings.

The present results not only replicate Cuc et al. (2007) but also indicate that WI-RIF and SS-RIF can be found for both schema-consistent and schema-inconsistent material. This later result extends the finding of Anderson and Spellman (1995) on WI-RIF to schema consistency and stories. On the other hand, it seems contrary to the findings of Anderson and McCulloch (1999), who found that integrated material should produce less RIF impairment than unintegrated material. Anderson and McCulloch based their predictions about integration on the observation of Smith et al. (1978). These researchers argued that a central claim of interference theory defies common sense—that is, the more one learns about an item, the greater subsequent response competition, and hence worse memory for related items. Smith et al. observed that, in many instances, as information is acquired, it is possible to integrate it and, in doing so, eliminate response competition. Two facts about Marty, such as *Marty broke the bottle* and *Marty did not delay the trip*, would presumably compete with each other when one tries to remember something about Marty and bottles, but, as Smith et al. showed, the addition of a third fact, *Marty was chosen to christen the ship*, can actually introduce less competition.

Given this work on integration, why did we continue to find robust WI-RIF for schema-consistent and hence presumably well-integrated items? We suspect what differentiated our study from the other two studies (i.e., Anderson & McCulloch, 1999; Smith et al., 1978) was that the target items in the other two studies were

predictable, given the general category term, whereas our target items were less so. One can predict, for instance, that a champagne bottle is broken when christening a ship, but one is less likely to predict that old furniture is stored in a garage, a paired associate employed in the story used in our study. Or, to state it slightly differently, we asked participants to remember not the kind of general actions employed by Smith et al. in their study (a general action like *breaking a bottle of champagne*), but slot fillers (that the champagne was Piper Heidsieck).

Why did we also find SS-RIF, as well as WI-RIF, for schema-consistent and schema-inconsistent material? Schema consistency clearly did not encourage listeners to covertly retrieve the unmentioned material. If it had, we would not have observed the strong SS-RIF that we did. Rather, it would appear that listeners only retrieve covertly what the speaker overtly remembered. Such selective covert retrieval was partially the result of the goals that we set for the listener: in Experiment 1, to monitor for the accuracy of what the speaker said; in Experiment 2, to recount jointly the studied story. Yet even if SS-RIF might depend on the goals of a listener, it is still the case that the extent and the selective nature of covert remembering does not vary with the schema consistency of the material.

A key result in the present study is that collective or shared memories are formed following selective remembering and that their formation is as much a result of collective forgetting as collective remembering. In as much as WI-RIF and SS-RIF apply equally to both schema-consistent, memorable material and schema-inconsistent, less-than-memorable material, the collective forgetting and the collective memories built around RIF should and do occur for both types of material. This result deserves more attention. While it is common sense that what is mentioned in a conversation is more memorable, if for no other reason than the practice effect, these results indicate the dynamism of material left unmentioned. In particular they suggest not all silences are created equal. Participants could have been silent about material related to recalled items or they could have been silent about items unrelated to the mentioned material. These different silences exhibit different trajectories (i.e., related material is remembered worse; unrelated material is remembered better). Thus, on final recall both participants remembered the same mentioned items from their social interactions. More intriguing, though, they also both remembered the unrelated items left silent yet forgot the silent, related items. These dynamics, in turn, facilitated the formation of a particular kind of collective memory built around mentioned items and items unrelated to the mentioned items. The unmentioned but related items may be collectively forgotten. SS-RIF may then provide a systematic means by which to investigate how both mentioned memories and those left silent help a speaker and listener converge around a particularly shaped, shared representation of the past. Various social memory paradigms have been developed that have helped shed light on the psychological processes behind the formation of collective memories: collaborative recall (Basden, Basden, & Henry, 2000), the ''saying-is-believing'' effect (Higgins & Rhodes, 1978), and social contagion (Meade & Roediger, 2002) among others. The present results place WI-RIF and SS-RIF alongside these.

Of course, we only tested the formation of a shared memory between a pair of conversing individuals, but we believe that our results could be extrapolated to collective memories held by larger aggregates (i.e., communities, states, nations, etc). To the extent that such extrapolation is possible, then the present results underscore the importance of silences not only shaping collective memories but also individual and collective identities. What you do not say matters, perhaps as much as what you do say. Silences are generally accepted as unavoidable occurrences in everyday conversations, with people opting to remain completely silent about a topic or selectively choosing to remain silent about some but not all of the details. This ubiquity makes them a powerful device for promoting collective memories (Coman et al., 2009; Cuc et al., 2007; Hirst & Echterhoff, 2008). Although the definition of what truly constitutes a silence remains debatable, it is clear that a greater emphasis needs to be placed on incorporating into the study of collective memory not just what is said, but also what is left unsaid. Identifying the necessary processes behind when, why, and how a collective memory forms is no simple matter, but the present study underscores a pertinent role for silences.

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