Biol Philos (2017) 32:839–853
https://doi.org/10.1007/s10539-017-9593-z

Collective narratives, false memories, and the origins of autobiographical memory

Eva Jablonka[1]

Received: 27 April 2017 / Accepted: 10 September 2017 / Published online: 11 October 2017

Abstract Building on Dor's theory of language as a social technology for the instruction of imagination, I suggest that autobiographical memory evolved culturally as a response to the problems of false memory and deliberate deceit that were introduced by that technology. I propose that *sapiens'* linguistic communication about past and future events initially occurred in small groups, and this helped to correct individual memory defects. However, when human groups grew in size and became more socially differentiated, and movement between groups prevented story-verification, misattributions of events became more common. In such conditions individuals with better autobiographical memory had an advantage because they could evaluate their own contents and sources of information, as well as that of others, more accurately; this not only benefitted them directly, but also improved their reliability as social partners. Autobiographical memory thus evolved in the context of human linguistic communication through selection for communicative reliability. However, the advantages of imagination, which enables forward-planning and decision-Making, meant that memory distortions, although controlled and moderated by autobiographical memory, could not be totally eradicated. This may have driven the evolution of additional forms of memory control involving social and linguistic norms. I interpret the language and the social norms of the Pirahã as the outcome of the cultural-evolutionary control of memory distortions. Some ways of testing aspects of this proposal are outlined.

Keywords Autobiographical memory · Collective memory · Episodic memory · Evolution of language · False memory · Imagination · Pirahã

✉ Eva Jablonka
jablonka@post.tau.ac.il

[1] The Cohn Institute for the History and Philosophy of Science and Ideas, Tel-Aviv University, 69978 Tel-Aviv, Israel

Introduction

The arguments in this paper are based on the assumption, articulated and developed by Dor (2015), that the relations between language and imagination are central to the very definition of language. In "Language, imagination, and autobiographical memory" Section, I outline Dor's view of language as a social technology for the instruction of imagination. Building on this theory, in "The origins of AM in collective time travelling" section I suggest that individual autobiographical memory (also referred to as human episodic memory) was constructed through joint mental time travelling in small cooperative human communities. Collective remembering activities were a means of learning (and teaching) about how to respond to salient events and how to behave as a member of the social group. In this sense, this remembering was future-oriented, but it also had the function of bonding group members into a cohesive social unit. In "The Pandora's box of imagination instruction: false memory and deceit" section I suggest that collective recall led to frequent individual memory distortions because of the problem of distinguishing between the narrated experiences of others and one's own first-hand past experiences. Humans made new types of mistakes, similar to those observed in young children where "false" (misattributed) memory is common. Although initially of little consequence, when human communities became larger and more differentiated, false memories (Jablonka in press) and deliberate deceit (Dor 2017) led to new types of social manipulations. In this paper I focus mainly on the effects of memory distortion, and suggest that the construction of personal autobiographical memory (AM)—which I take to be the attribution of a train of memories to one's own first-hand experiences—partially ameliorated the problem of misattribution of memorized experiences and of deceit, and promoted communicative reliability. The problems of misattribution cannot, however, be fully avoided because of the trade-off with the advantage of imaginative future planning. An additional solution is social policing of memory. In "The Pirahã language: Policing memory through linguistic norms?" section, I interpret the curious cultural and linguistic practices of the Pirahã in the light of this hypothesis, and in "Conclusions and future directions" section suggest some ways of testing the validity of the overall proposal.

Language, imagination, and autobiographical memory

Dor's theory of language starts with an identification of the special function and structure of language. Language, he argues, is specifically designed to allow its speakers to communicate directly with their interlocutors' imagination (Dor 2015). Imagination is defined as the re-combination of recalled pre-existing experiences into new experiences through constructive processes that generate novel images, ideas, and narratives. Dor highlights the fact that our individual experiences are always private and somewhat different from the experiences of the others, or, as he puts it, we are separated from each other by experiential gaps. These experiential gaps are, crucially, informational gaps: individuals have information which is not

accessible to others. Communication creates common ground either by enabling the direct sharing of information (this is what non-linguistic ostensive systems, such as pointing, do), or through the translation of private information into a socially constructed code which can be decoded back into privately experienced information (this is what language does). Language does this by using a jointly identified set of conventional signs and norms of communication: "the communicator provides the receiver with a code, a plan, a skeletal list of the basic coordinates of the experience—which the receiver is then expected to use as scaffold for experiential imagination. Following the code, the receiver raises past experiences from memory and then reconstructs and recombines them to produce a novel, imagined experience" (Dor 2015, p. 24–25). A web of socially agreed signs (the "semantic landscape") and a set of prescriptive rules for the regulation of the process of instructive communication (the "protocol") are formed gradually through joint identification and agreement, a process involving social negotiations and cultural evolution. There is an intervening level of meaning—semantic, digital, social—between the analog, private representations of communicators and the signifiers they use. Following many other scholars, Dor argues (2015, chapter 10) that the process of information-sharing through language expanded the scope of cooperation, providing multiple benefits at both the individual and group level.

This view of language gives a central role to the ability to imagine, which entails, as noted above, the reconstructive recombination and transformation of facets of episodes that were experienced in one's past. Event memory and imagination are therefore tightly linked, since imagination depends on memory and is involved in the reconstruction of memories. Both behavioural and brain imagining studies show that recollecting the past and imagining the future share many cognitive features and involve similar brain-activation patterns (Schacter et al. 2014). Planning for the future has obvious advantages, so it has been suggested that such planning may have been the selective context in which the evolution of human episodic, narrative memory occurred, because such memory is the basis for current and future actions (Klein 2013). Indeed, collective future-thought—imagining an event in the future on behalf of, or by, a group—is, as Szpunar and Szpunar (2016) describe, an important and ubiquitous facet of social life. From a learning-informed perspective, past and future are always bound: memory (of the past) enables adaptive responses to present and future contingencies. Imagining desired goal states (based on goals reached in the past) and the actions performed to reach them are integral parts of the affordance provided by constructive episodic memory. Since the environment is ever-changing, some improvisation is always necessary, and goal-oriented, learning-based behavior is always based on improvised reconstructive processes. The extent of improvisation is of course important, and language provides one of the most important scaffolds for adaptive (imaginative) improvisation.

There are many definitions of episodic memory and of AM, which have been considered from several different philosophical and cognitive perspectives [summarized in Perrin and Rousset (2014)]. According to Tulving (1983, 2002), human-specific episodic memory can be regarded as "mental time travel," a type of recall in which an individual can recall the "what", "where" and "when" of past events and re-experience the past. It is acknowledged today that such memory can, in fact,

take several forms, and that episodic and semantic memory (memory of "facts" but not their spatial and temporal context) may be, in some respects, continuous (Renoult et al. 2016). What is important for the current argument is that a distinction can be drawn between personal narrative autobiographical memory, which places the individual as a protagonist in a story about her past, and more rudimentary types of event memory where such a clear personally-attributed narrative is not yet evident. For example, an individual may remember where, when, and what happened (and often also how it happened and who was involved), but these episodes are not linked together, nor is the source of memory (one's own first-hand or second-hand) known. This form of memory, sometimes referred to as "episodic-like memory" to avoid an unproductive discourse regarding the phenomenology of human episodic memory, may have evolved independently in the vertebrates, cephalopods and possibly also in some social arthropod lineages (Crystal 2009). Allen and Fortin (2013) have convincingly argued that the evolutionary precursors of episodic recall may be shared by all vertebrates. However, what I shall focus on here is the evolution of the very advanced, human-specific, narrative personal memory that builds on these ancient foundations. This is autobiographical memory, which has been defined as "…that uniquely human form of memory that moves beyond recall of experienced events to integrate perspective, interpretation, and evaluation across self, other, and time to create a personal history. To put it succinctly, autobiographical memory is memory of the self interacting with others in the service of both short-term and long-term goals that define our being and our purpose in the world" (Fivush 2011, p. 560).

To get further insights into the evolution of human-specific, narrative, personal AM, we need to understand its ontogenetic development and the social conditions that promoted its construction during evolution. We know that AM develops gradually and matures late, and is dependent on linguistic recall of events. In a behavioural test, young children who could speak yet could not verbally recall a learned causal association, also failed to recall this causal association later. Although children under four remember events that happened to them some time ago (sometimes as early as when they were 1.5 years old; Cleveland and Reese 2008), and children of 3–4 years of age slot the episodes they remember into "scripts", they do not yet have a sense of individual, personal narrative (Fivush 2011). Importantly, the more complex the causal chain of episodes, the more dependent is AM on narrative-linguistic skills, which seem to organize events into a recollectable narrative (Nelson and Fivush 2004), and seem to depend on the emergence of auotnoetic consciousness, which usually emerges after the age of 5 (Wheeler et al. 1997). These observations suggest that the evolution of AM may have been dependent on language. Many studies show the dependence of proficient AM on social-reminiscing with adults (in Western societies, mainly with the mother), who help to construct the child's AM through ongoing guided, joint, remembering (Nelson and Fivush 2004; Fivush 2011). The more general cultural context is also important: cross-cultural comparisons show that content of AM varies among cultures, being more self-focus in Western societies and more interdependent in Eastern ones (e.g., Wang 2011). However, it is still not clear what the evolutionary nature of the relationship between language and AM was. Is

autobiographical memory an inevitable, late-maturing product of linguistic communication? Is it an adaptation, and if so, an adaptation to what? What were its precursors, and in what social context did its evolution occur? In the next section I suggest that collective recollection in small groups of highly cooperative humans was the social context in which the communication of memories of events occurred, and this shaped the human memory system. Hence, I see AM as an adaptation whose function is to overcome the memory-misattribution problems generated by imagination-instructing language, and to foster reliability in social communication.

The origins of AM in collective time travelling

According to Michael Tomasello (2014), the evolution of thinking in the human lineage went through two distinct evolutionary stages. During the first stage, humans became more dependent on the dyadic cooperation that is required for hunting big game. This drove the evolution of better communication and led to the emergence of a proto-language, a simple form of linguistic communication with only a few hundred lexical items and very simple syntax. The emotions of humans also changed: they evolved in ways that improved cooperation between them. The human-specific compassionate emotional predispositions of very young, pre-linguistic, modern human infants are thought to reflect these changes (Tomasello 2009). One of Tomasello's major assumption is that at this stage all communication was dyadic and did not involve group norms. He writes, referring to early humans who lived 400,000 years ago: "…their early collaborative activities were ad hoc collaborations for particular goals on a particular occasion with a particular person, with their joint attention similarly structured in a second person way" (Tomasello 2014, p. 48). It was in Tomasello's second stage in the evolution of human thinking, which took place as group-size increased and individuals began to identify with their group's traditions and institutions, that a truly cultural mode of learning, thinking and feeling evolved (Tomasello 2014). During this stage, the collective "we mode" emerged in association with the evolution of the mature human linguistic capacity and distinctly human modes of feeling and thinking and, by implication, recalling.

Tomasello's view that the first stage of human evolution was based on dyadic rather than group intentionality is problematic. Evidence from studies of cooperative hunting, alloparenting (which according to Hrdy 2009 was already present 1.6 million years ago), cooperative foraging (e.g., stone gathering, which according to Shipton 2013 was present 1.1 million years ago in Isampur), fire-making and tending (Burton 2009; Wrangham 2009), and instructive tool-making (present in in later Acheulian erectile hominins, according to Goren-Inbar 2011; Stout 2011; Sterelny 2012; Vaesen 2012) suggest that the level of cooperation within groups was far more extensive than that suggested by Tomasello, and involved not only dyadic relations, but also interactions among several cooperating individuals [see Bader (in press), and Dor et al. (2014) for reviews of group cooperation]. This early and intimately cooperative life style would have generated corresponding local traditions—simple traditions are apparent even in chimpanzees and other social

mammals. These traditions included traditions of cooperation and societal norms, which altered the emotional profile of early hominins and constructed the social emotions of guilt, shame, and pride (Jablonka et al. 2012).

If pre-sapiens social individuals were engaged in diverse cooperative and often highly skilled activities that require natural pedagogy (Csibra and Gergely 2011), their proto-languages must have evolved culturally to accommodate the necessary communication related to this cooperative life style. Hence, I adopt the position that the evolution of symbolic human language was gradual (Dediu and Levinson 2014), was constructed through ongoing processes of borrowing and hybridization between neighboring groups engaged in exogamous matings, and was the result of the co-evolution of cultural practices that guided the selection of the genes underlying the learning and memorizing of these practices (Dor 2015). It was this co-evolution that generated a human-specific cognitive suite in which social emotions and episodic memory were evolutionarily intertwined (Dor and Jablonka 2010; Jablonka et al. 2012; Ginsburg and Jablonka 2014).

Early humans lived and linguistically shared their memories in intimate social settings. We know that recollection in such conditions strongly affects individual memory. Collective reminiscing and planning in modern humans involves retrieval-induced forgetting (what is highlighted during remembering leads to the forgetting of other episodes) and socially reconstructed recall (group members help each other recollect joint experiences by reminding each other of past things on which they can build future plans) (Michaelian and Sutton 2017). What collective recollection by modern humans makes clear is the importance of word-based recall. While individual recollection can be based on a train of associations that are only partially supported by lexical "anchors", collective memorizing and scheming in modern humans is highly dependent on language, although as in our pre-modern ancestors, it is also reinforced by collective mimetic activities such as rituals.

Modern hunter-gatherers live in small groups and most of what they do occurs in a social context: it is disadvantageous (e.g., dangerous) to forage and hunt big game on one's own. They discuss newsworthy events that happened recently (e.g., during the past day), and plan the activities of the group on the basis of what they know about current resources and past memories. These collective discussions, and, more generally, stories related to foraging and other important activities, can be elaborate and long-lasting (Sugiyama 2001). Exactly what happened during a particularly salient episode may be tremendously important, so reliably remembering the details of what took place and who did what, is critical. Human episodic memory probably evolved in the context of learning and planning similar to that found in modern hunter-gathers, and crucially, I suggest, within the context of *collective* learning and planning, which entailed communication. Even in modern Western cultures, recollection is typically a socially embedded activity. As Halbwachs noted: "it is in society that people normally acquire their memories. It is also in society that they recall, recognize and localize their memories" (Halbwachs 1992, p. 38).

How were communicated recollections constructed in the small and intimate ancestral *sapiens'* societies? I suggest that an individual's memory of her own specific role in a group event was less distinct than it is for individuals in modern societies. In such settings, not only was recollection spurred on by others, other

individuals contributed to the recall of the event that the individual had experienced. The distinction between collective memory and of "private" (self-attributed) memory was therefore probably fuzzier than it is today in modern Western societies, with their impoverished collective life and their great emphasis on privacy.[1]

The Pandora's box of imagination instruction: false memory and deceit

I assume that language was necessary for the evolution of AM, and that event memory (though not mature AM) was, in turn, necessary for language evolution. The idea that the evolution of language depended on the evolution of memory was first suggested by Wright (1873), who proposed that selection for enhanced memory led to recall of communication signs *as signs*, and hence to the growth of a semantic lexicon. He suggested that humans evolved a special memory system, a lexical-semantic memory system, which interacted with the representations of past events and led to communicable recall of events that depend on syntactic language, something which we now term language-based recall (Ginsburg and Jablonka 2014). If we accept, as Dor suggested, that language functions as a communication technology for the instruction of imagination, then the evolution of the control and the sophistication of memory and imagination must have been intimately related to the emergence of language.

The benefits of an imagination-instructing communication technology are self-evident: it expanded the experiential world of individuals and allowed ready communication about events and narratives that transcend the here-and-now of private and joint experiences. However, there is no great innovation that does not carry with it its Pandora's box of troubles. The trouble that language introduced was a huge increase in misinformation, both accidental and deliberate. Language presented humans with a new kind of challenge. Humans had to remember not only who did what to whom, but also who *said* what to whom, and had to be able to distinguish between reported-imagined and first-hand experiences, something that is still a big problem today (Ginsburg and Jablonka 2014; Jablonka in press).

Numerous studies have shown that the recall of past events in a social setting can distort an individual's later memories of those same events and generate entirely imaginary narratives (Loftus and Palmer 1974; Principe and Schindewolf 2012; Stone et al. 2013). Such distortions include those due to imagination inflation (false recollection or increased certainty about a non-existent past event, which result from imagining a new event in the present); gist-based associative memory errors (false recall or recognition of a past-experienced percept or word due its association with a newly introduced, different, percept or word); and post-event information effects, where the introduction of erroneous information about a past event leads to false

[1] Although of relevance to my thesis, the collective memory on which I focus here *is not* collective-mythical memory, such as the collective memory of a genocide that no extant human experienced, or a creation myth (both of which may be collectively and directly experienced through rituals and commemorations). I focus here mainly on the collective remembering of experienced episodes in the more immediate past of the individuals that are important for emotional-sharing, ongoing group cohesion and practical future planning.

memories about it (Addis et al. 2007; Schacter et al. 2011). These distortions are common among present-day humans, and are especially evident among young children (see, for example, Drummey and Newcombe 2002; Principe and Schindewolf 2012). I suggest that AM, which is an sophisticated and specialized form of event-recall, is a socially evolved adaptation to control the reliability of communication about events, and that memory distortions are inevitable, given the nature of language as a technology for the instruction of imagination.

The hypothesis that social-collective memorization led to the fusion (and confusion) of individual experiences in our ancestors can be tested only indirectly, but observations and experiments show that individuals who discuss and experience events with other people often report information from their partner's version instead of their own. Moreover, subjects who discuss the event with their romantic partner (rather than with a stranger) are even more likely to have false memories (French et al. 2008). What people in different cultures perceive as individual experiences (as compared to familial and collective ones), and how they value them, may also influence memory distortion. For example, it seems that the children of Asian mothers develop more "collectivistic" norms, whereas the children of Western mothers acquire from them a more differentiated sense of self (Leichtman et al. 2003). For memory distortion, people from an Eastern ("collectivistic") background show greater imagination inflation than people from Western ("individualistic") societies (Basu 2011). Wang (2008) has shown how the different mnemonic traditions and norms of remembering and forgetting found in different cultures are reflected in differences in the importance ascribed to past memories and the uses to which they are put.

Misattribution of memories must have been common during the early evolution of imagination-instructing language, probably resembling what we see in young children today. It became a major problem as the size of social groups increased and recalled episodes could not be checked by full collective reminiscing. Incorrect information told to an individual would not have been doubted and may have been thought to have been directly experienced. The type of reliability problem this could create is obvious if one thinks about information about social interactions. Dunbar (1996) suggested that "gossiping/grooming" was an important function of language because the exchange of social information helped manage the complex social relations that developed in large and increasingly diverse groups. Deliberate misinformation about social interactions—say, A telling B that X was seen having sex with Y—would have disastrous personal consequences for B, Y's partner, if he believed that he himself saw this happen. Another problem is bragging—exaggerating the importance of one's role in a hunt or protecting the young—which could lead to the misguided trust in untrustworthy individuals, as would belittling the role of others or the challenges they overcame. Individuals who were able to distinguish between events that they experienced first-hand and those that they were told about and imagined would have had an advantage, especially when there was no possibility of confirming the story by communicating with other people who participated in the same event. This type of situation may be relatively uncommon within a small group, although it can never be entirely avoided, and probably always exists for events in the very distant past. It became much worse, however, when groups became larger and individuals moved between them. For

similar reasons, deceit became a problem: it is unlikely to occur in small groups, where people are always in the presence of others and gossiping has a strong and effective policing function, but when exogamous mating structures made individuals move between loosely related groups, deceit became a potential problem, because verification of stories by the newcomer as well as the group members was more difficult (see Dor 2017, for a discussion of various types of lies and their social significance). Epistemic vigilance towards both the source and content of the story told (the "testimony") is therefore likely to develop in listeners (Sperber et al. 2010), while self-directed epistemic vigilance is likely to develop in tellers.

Memory misattribution and the problems it causes are reduced when individuals have autobiographical memory and can locate a particular experience within a narrative, the structure of which enables them to distinguish between their own and other people's roles. The distinction between what they actually did and what they were told about is clearer and more readily tested. Language and AM introduced new emotions—feelings of doubt and certainty about self and others. What X is told is doubted more than what X remembers she had experienced herself. AM also leads to judgments about truth and falsity, which are attributes of propositions (sentences) that are central to human thinking.[2]

In summary, according to the line of reasoning just outlined, *modern human AM, which develops well after the child is able to use a fully syntactic language, was selected as a (inherently imperfect) counter-measure to memory distortions introduced by imagination-instructing linguistic communication and was used as an indicator of social reliability*. From the point of view of the listeners, for the communicator/teller to be seen as a reliable interlocutor, she should be able to tell a credible and detailed story and attribute it to a known source (herself), which the listeners could check and evaluate to justify their belief in the story's veracity. More generally, on the basis of such source-attributed stories, listeners could assess the social communicative reliability of the teller, who must therefore take responsibility for her stories. From the teller's point of view, the ability to distinguish between imagined-told-about events and those experienced-first-hand enables her to avoid social manipulation: what one has experienced first-hand can be relied on more than what one has heard.

Although good autobiographical memory may have diminished the problems of memory misattributions that result from imagination-instructing language, the many studies on memory misattribution show that they are not entirely eradicated. This is not surprising, because future planning and decision-making depend on the reconstruction processes employed during recollection, which must therefore remain flexible (Schacter et al. 2017; Roberts et al. 2017). In addition, AM may introduce new types of memory distortions, for example excessive gullibility when hearing elaborate and detailed stories. Control of both language and verbal memory through social-cultural norms is an additional way of ameliorating the problems introduced by language-based recall. The culture and language of the Pirahã can be interpreted in terms of such cultural-linguistic policing.

[2] Truth and falsity are built on the more basic notions of real and imagined, which are one of the many cognitive and emotional achievements scaffolded by pretend-play and are linked to the development of language in children and the acquisition of norms (Ginsburg and Jablonka 2014).

The Pirahã language: Policing memory through linguistic norms?

The Pirahã people of Brazil have both unique language and cultural norms. According to Dan Everett, who studied this language and culture for many years:

> Pirahã is the only language known without number, numerals, or a concept of counting. It also lacks terms for quantification such as "all," "each," "every," "most," and "some." It is the only language known without color terms. It is the only language known without embedding (putting one phrase inside another of the same type or lower level, e.g., noun phrases in noun phrases, sentences in sentences, etc.). It has the simplest pronoun inventory known, and evidence suggests that its entire pronominal inventory may have been borrowed. It has no perfect tense. It has perhaps the simplest kinship system ever documented. It has no creation myths – its texts are almost always descriptions of immediate experience or interpretations of experience; it has some stories about the past, but only of one or two generations back. Pirahã in general express no individual or collective memory of more than two generations past. They do not draw, except for extremely crude stick figures representing the spirit world that they (claim to) have directly experienced. (Everett 2005, p. 622)

From these and other peculiarities, Everett has concluded that the reduced linguistic structures in the Pirahã language are the results of "*the restriction of communication to the immediate experience of the interlocutors*" (Everett 2005, p. 622; Everett's italics).

Linguists argue about the extent and significance of the differences between Pirahã and other languages that Everett has analysed,[3] but there is little doubt that the Pirahã language has a different, and in some respects very restricted linguistic structure compared to most spoken languages. Additionally, the Pirahã custom of conversing only about what one has directly experienced seems extreme (although limited historical memory is evident, according to Sasnsom (2006), in some traditional Aboriginal societies), and Everett argues that it is through the restriction being imposed and accepted for many generations on what can be told that the peculiarities observed in the Pirahã language have come into being. For example, in most languages, the embedding of one phrase within another (such as "John said that Maria saw….") makes verifying a told-about event more difficult, but the problem of verifiability is diminished by the lack of embedding in the Pirahã language. The same can be said for the lack of kinship terms, since their use would require connecting with an unexperienced past. Similarly, number-based quantification requires abstract generalizations that requires knowledge beyond immediate experience. Following Everett's interpretation of the Pirahã language as reflecting the cultural norms in these people, I suggest that both the Pirahã's restriction of linguistic communication to events in the experienced present and the unique

[3] Limited embedding is common in languages of illiterate groups. Pirahã is, however, an extreme case (Dor 2015).

linguistic structures of this language, are (drastic) ways of culturally reducing the social problems caused by memory misattributions.

Two questions arise from this interpretation of the Pirahã culture and language. First, what past conditions led to the norm of not speaking about the directly unverifiable? Was it, as I suggest, selected as a way of avoiding the social problems of memory misattribution? Although it is impossible to answer this question for the Pirahã case, there may be other cultures (and languages) with less extreme but similar correlations between language structures (or lack of them) and memory-related norms that could point to the likely conditions that lead to this correlation. The second question is how did the Pirahã linguistic-cultural system evolve: did the language of this group at first develop in the same way as other groups with respect to embedding, color, number terms, etc., and then develop no further? Did the emerging confusions between directly experienced events and unverifiable memories of past events lead to a cultural dictum against talking about the unverifiable, which in turn prevented linguistic evolution that would aggravate it? If so, we must assume that this society never underwent the social changes such as an increase in the group's size and/or interactions with other groups that would have removed this constraint. This would make the Pirahã language and culture a living linguistic fossil. However, although not impossible, this is not likely, because humans arrived in South America at least 15,000 years ago, and it is doubtful that the peculiarities of the Pirahã language were preserved for tens of thousands of years of changes in cultural conditions and planet-wide migrations. An alternative hypothesis to explain the evolution of the peculiar Pirahã language is that it was originally more "usual" (e.g., it had some limited embedding), but the social problems caused by memory distortions and lying led to the cultural dictum restricting communication about events to their immediate experiences, and this in turn led to the simplification of the language. According to this hypothesis, features present in the original language were lost during the cultural evolution of Pirahã. Both evolutionary scenarios posit, as Everett suggested, that cultural, rather than genetic, evolution is responsible for the present form of Pirahã language, and that significant grammatical changes in linguistic features such as embedding, which is present in most languages, may be culturally constructed.

Conclusions and future directions

I have suggested that AM evolved within the context of the evolution of linguistic communication to promote communicative reliability. Although the linguistic instruction of imagination had enormous advantages, greatly expanding the range of communicable information, it also opened a Pandora's box of new problems. Whereas in small, intimate societies collective memory aligned individual and social experiences, increased group cohesion, and allowed the social control of collectively-constructed individual false memory through correction by knowledgeable group members, such memory-control may often have failed as societies grew in size and migration among them increased. In such conditions, the instruction of imagination brought about by language led to urgent problems of false

memory and deliberate deceit. I therefore argued that the evolution of language drove the evolution of AM, which ameliorated these problems by enabling the transfer of more reliable and testable information about the world and about self. The strong relation of AM with communication-based reminiscing and its appearance in already linguistically-fluent children, lends support to this suggestion. However, once developed, AM might have promoted, in turn, the cultural-evolutionary elaboration of linguistic communication enabling more accurate, reliable and testable reports, so a co-evolutionary spiralling interaction between AM and language may have become established. Nevertheless, the control of re-constructive memory cannot be perfect because imagination is inherent in memory reconstruction. An additional strategy to combat false memory is social control, and I proposed that the cultural and linguistic peculiarities of the Pirahã may be the result of such cultural memory-control.

Several facets of the proposals put forward in this paper can be tested. First, studies that examine the relations between false memory and autobiographical memory in children are required to find out if there are fewer memory distortions in children with well-formed autobiographical memory, and which type of distortions are correlated with mature AM. If a robust relation is found, AM should not be seen as the major source of memory misattribution, but rather as the (inherently imperfect) solution to the problems posed by imagination-instructing linguistic communication. Second, the relation between false memory in children and adults and the cultural stress on collectivity and individuality requires more studies to test: (1) whether different types of memory distortions, with more social or more individual content, differ between collectivistic and individualistic cultures; (2) whether cultural norms influence recollection occurring in private and in collective settings in which memories are shared and discussed; (3) whether memory distortions in children of different age groups differ in "collectivist" and "individualistic" cultures (including tribal societies where privacy is of limited social value). If such studies consistently show that memory distortions are more biased toward matching collective memories in the more collectivistic societies, it would be in line with the assumption that this was also the case in early (collectivistic) human societies, where mental time travel was always done with intimate social partners. Third, if the suggestion that the Pirahã language has evolved culturally to supress false memory and deceit is correct, studies of memory misattribution would be expected to reveal a far smaller number of memory distortions among the Pirahã people than in other linguistic groups. It would also be interesting to see how pretend-play develops in Pirahã children, and whether, to what extent, and in what manner the children's imagination is culturally and linguistically shaped. A comparative study of false memory in social groups with different memory terms (such as those explored by Ambereber 2007) and evidentiality structures (linguistic structures that encode the speaker's assessment of the evidence for his or her statement) may reveal nuanced differences between different linguistic communities in the control of false memory and deceit. Finally, a study of the new problems introduced by AM could be of great interest: the tendency to believe well-told stories, evident in the amazing spread of urban myths and the successful manipulations of expert liars, and in literate societies, the

uncritical belief in the written word, may be the price we pay (and have not yet managed to culturally contain) for the evolution of AM.

Acknowledgements I am grateful to the participants of the 2015 in the 29th Annual International Workshop on the History and Philosophy of Science, Israel, *Landscapes of collectively* and the ANU 2016 workshop on *The Evolution of Language* for their constructive comments, and to Simona Ginsburg, Zohar Bronfman, Daniel Dor and Dan Everett for critical comments on an earlier version of this paper. Special thanks are due to Marion Lamb who read and commented on the various versions of this paper.

References

Addis DR, Wong AT, Schacter DL (2007) Remembering the past and imagining the future: common and distinct neural substrates during event construction and elaboration. Neuropsychologia 45(7):1363–1377. https://doi.org/10.1016/j.neuropsychologia.2006.10.016

Allen TA, Fortin NJ (2013) The evolution of episodic memory. Proc Natl Acad Sci USA 110(Suppl. 2):10379–10386. https://doi.org/10.1073/pnas.1301199110

Ambereber M (ed) (2007) The language of memory in a crosslinguistic perspective. John Benjamin Publishing Company, Amsterdam

Bader O (in press) Being in a group—the emotional scaffolding of the evolution of collective intentionality. In: Gissis S, Lamm E, Shavit A (eds) Landscapes of collectivity in the life science, Vienna series in theoretical biology. MIT press, Cambridge

Basu LO (2011) Effects of collectivistic and individualistic cultures on imagination inflation in Eastern and Western cultures. Stud Pulse 3(2). http://www.studentpulse.com/articles/385/5/effects8of8collectivistic8and8individualistic8cultures8on8imagination8inflation8in8eastern8and8western8cultures

Burton FD (2009) Fire: the spark that ignited human evolution. University of New Mexico Press, Albuquerque

Cleveland ES, Reese E (2008) Children remember early childhood: long-term recall across the offset of childhood amnesia. Appl Cogn Psychol 22:127–142

Crystal JD (2009) Elements of episodic-like memory in animal models. Behav Processes 80:269–277

Csibra G, Gergely G (2011) Natural pedagogy as evolutionary adaptation. Philos Trans R Soc B 36:1149–1157. https://doi.org/10.1098/rstb.2010.0319

Dediu D, Levinson SC (2014) The time frame of the emergence pf modern language and its implications. In: Dor D, Knight C, Lewis J (eds) Social origins of language. Oxford University Press, Oxford, pp 184–195

Dor D (2015) The instruction of imagination: language as a social communication technology. Oxford University Press, Oxford

Dor D (2017) The role of the lie in the evolution of human language. Lang Sci 63:44–59

Dor D, Jablonka E (2010) Plasticity and canalization in the evolution of linguistic communication: an evolutionary developmental approach. In: Larson RK, Deprez V, Yamakido H (eds) The evolution of human language: biolinguistic perspectives. Cambridge University Press, Cambridge, pp 135–147

Dor D, Knight C, Lewis J (eds) (2014) The social origins of language. Oxford University Press, Oxford

Drummey AB, Newcombe NS (2002) Developmental changes in source memory. Dev Sci 5(4):502–513

Dunbar RIM (1996) Grooming, gossip and the evolution of language. Faber and Faber, London

Everett DL (2005) Cultural constraints on grammar and cognition in Pirahã. Curr Anthropol 46(4):621–646

Fivush R (2011) The development of autobiographical memory. Annu Rev Psychol 62:559–582

French L, Garry M, Mori K (2008) You say tomato? Collaborative remembering leads to more false memories for intimate couples than for strangers. Memory 16(3):262–273. https://doi.org/10.1080/09658210701801491

Ginsburg S, Jablonka E (2014) Memory, imagination and the evolution of modern language. In: Dor D, Knight C, Lewis J (eds) Social origins of language. Oxford University Press, Oxford, pp 317–324

Goren-Inbar N (2011) Culture and cognition in the Acheulian industry: a case study from Gesher Benot Ya'aqov. Philos Trans R Soc B 366:1038–1049. https://doi.org/10.1098/rstb.2010.0365

Halbwachs M (1992) On collective memory (Coser LA (ed), Trans). University of Chicago Press, Chicago
Hrdy SB (2009) Mothers and others: the evolutionary origins of joint understanding. Harvard University Press, Cambridge
Jablonka E (in press) Remembering as a group: the evolutionary origins of autobiographical memory. In: Gissis S, Lamm E, Shavit A (eds) Landscapes of collectivity in the life sciences, Vienna series in theoretical biology. MIT Press, Cambridge
Jablonka E, Ginsburg S, Dor D (2012) The co-evolution of language and the emotions. Philos Trans R Soc B 367:2152–2159. https://doi.org/10.1098/rstb.2012.0117
Klein SB (2013) The temporal orientation of memory: it's time for a change of direction. J Appl Res Mem Cogn 2:222–234
Leichtman M, Wang Q, Pillemer DP (2003) Cultural variations in interdependence and autobiographical memory: lessons from Korea, China, India, and the United States. In: Fivush R, Haden C (eds) Autobiographical memory and the construction of a narrative self: developmental and cultural perspectives. Erlbaum, Hillsdale, pp 73–98
Loftus EF, Palmer JC (1974) Reconstruction of auto-mobile destruction: an example of the interaction between language and memory. J Verbal Learn Verbal Behav 13:585–589
Michaelian K, Sutton J (2017) Collective mental time travel: remembering the past and imagining the future together. Synthese. https://doi.org/10.1007/s11229-017-1449-1
Nelson K, Fivush R (2004) The emergence of autobiographical memory: a social cultural developmental theory. Psychol Rev 111(2):486–511
Perrin DS, Rousset S (2014) The episodicity of memory. Rev Philos Psychol 5:291–312
Principe GF, Schindewolf E (2012) Natural conversations as a source of false memories in children: implications for the testimony of young witnesses. Dev Rev 32(3):205–223. https://doi.org/10.1016/j.dr.2012.06.003
Renoult L, Tanguay A, Beaudry M, Tavakoli P, Rabipour S, Campbell K, Moscovitch M, Levine B, Davidson PS (2016) Personal semantics: Is it distinct from episodic and semantic memory? An electrophysiological study of memory for autobiographical facts and repeated events in honor of Shlomo Bentin. Neuropsychologia 83:242–256
Roberts RP, Wiebels K, Sumner RL, van Mulukom V, Grady CL, Schacter DL, Addis DR (2017) An fMRI investigation of the relationship between future imagination and cognitive flexibility. Neuropsychologia 95:156–172
Sansom B (2006) The brief reach of history and the limitation of recall in traditional Aboriginal societies and cultures. Oceania 76:150–172
Schacter DL, Guerin SA, St Jaques PL (2011) Memory distortion: an adaptive perspective. Trends Cogn Sci 15(10):467–474. https://doi.org/10.1016/j.tics.2011.08.004
Schacter DL, Benoit RG, De Brigard F, Szpunar KK (2014) Episodic future thinking and episodic counterfactual thinking: intersections between memory and decisions. Neurobiol Learn Mem 117:14–21. https://doi.org/10.1016/j.nlm.2013.12.008
Schacter DL, Addis DR, Szpunar KK (2017) Escaping the past: contributions of the hippocampus to future thinking and imagination. In: Hannula DE, Duff MC (eds) The hippocampus from cells to systems: Structure, connectivity, and functional contributions to memory and flexible cognition. Springer, New York, pp 439–465
Shipton CBK (2013) A million years of hominin sociality and cognition: Acheulean bifaces in the Hunsgi-Baichbal valley India. British archeological reports international series 2468. Archaeopress, Oxford
Sperber D, Clément F, Heintz C, Mascaro O, Mercier H, Origgi G, Wilson D (2010) Epistemic vigilance. Mind Lang 25(4):359–393
Sterelny K (2012) The evolved apprentice: how evolution made humans unique. MIT Press, Cambridge
Stone CB, Barnier AJ, Sutton J, Hirst W (2013) Forgetting our personal past: socially shared retrieval-induced forgetting of autobiographical memories. J Exp Psychol Gen 142(4):1084–1099
Stout D (2011) Stone toolmaking and the evolution of human culture and cognition. Philos Trans R Soc B 366:1050–1059. https://doi.org/10.1098/rstb.2010.0369
Sugiyama MS (2001) Food, foragers, and folklore: the role of narrative in human subsistence. Evol Human Behav 22(4):221–240
Szpunar PM, Szpunar KK (2016) Collective future thought: concept, function, and implications for collective memory studies. Mem Stud 9(4):376–389. https://doi.org/10.1177/1750698015615660
Tomasello M (2009) Why we cooperate. MIT Press, Cambridge

Tomasello M (2014) A natural history of human thinking. Harvard University Press, Cambridge
Tulving E (1983) Elements of episodic memory. Oxford University Press, New York
Tulving E (2002) Episodic memory: from mind to brain. Annu Rev Psychol 53:1–25
Vaesen K (2012) The cognitive bases of human tool use. Behav Brain Sci 35(4):203–218
Wang Q (2008) On the cultural constitution of collective memory. Memory 16(3):305–317. https://doi.org/10.1080/09658210701801467
Wang Q (2011) Autobiographical memory and culture. Online Read Psychol Cult 5:2. https://doi.org/10.9707/2307-0919.1047
Wheeler MA, Stuss DT, Tulving E (1997) Toward a theory of episodic memory: the frontal lobes and autonoetic consciousness. Psychol Bull 121:331–354
Wrangham R (2009) Catching fire: how cooking made us human. Basic Books, New York
Wright C (1873) Evolution of self-consciousness. N Am Rev 116(239):245–310