Multiple Timescales of Joint Remembering in the Crafting of a Memory-Scaffolding Tool during Collaborative Design

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Abstract

Joint remembering relies on the successful interweaving of multiple cognitive, linguistic, bodily, social and material resources, anchored in specific cultural ecosystems. Such systems for joint remembering in social interactions are composed of processes unfolding over multiple but complementary timescales which we distinguish for analytic purposes with the terms 'coordination', 'collaboration', 'cooperation', and 'culture', so as better to study their interanimation in practice. As an illustrative example of the complementary timescales involved in joint remembering in a real-world activity, we present a micro-qualitative analysis of an interactional sequence in which two members of a four-person team of video designers crafted a memory- scaffolding tool. In order to find the temporal structure of the crafting of the memory-scaffolding tool, we used software for pattern recognition. The analysis suggests that coordination, collaboration, cooperation, and culture reveal complementary aspects of interacting to remember, which should be considered as complex phenomenon unfolding at multiple interanimating timescales.

Keywords: joint remembering; timescales; coordination, cooperation; collaboration; culture; t-pattern; ethnography; design studio

Introduction

Joint remembering involves people being engaged in recalling past experiences, which may themselves have been shared. So the information re-evoked during joint remembering can be the result of either shared or individual encodings of the same or similar original event (e.g. Harris, Barnier, & Sutton, 2013). Social interactions during joint remembering are complex phenomena unfolding over shorter and longer timescales, from milliseconds, seconds, and minutes to days, months, and years. Processes at shorter timescales are regulated by people's "ability to respond to actions and intentions, the turn-taking structure given by the reciprocity of roles (e.g. speaker-addressee, giver-taker), their alternation over time, and the expectation for an immediate response" (Levinson, 2006, p. 45-46). But this kind of 'human interaction engine' (Levinson, 2006) is supported by and in a range of cultural-cognitive ecosystems (Hutchins, 2014) evolving over longer timescales. Such cultural-cognitive ecosystems include the kinds of cultural practices in which particular social interactions occur, as well as their social and material histories and the histories of the participants engaged in them . When people jointly recall shared events in everyday situations (e.g. when senior members of expert teams collaboratively tell work-related past experiences to junior team members), perhaps trying to achieve a sharing of goals (e.g. to foster identification with the group and solidarity among team members), there are complex bodily, linguistic and cognitive processes unfolding in synchrony over a micro timescale, which we shall label for convenience t^1. People engaged in joint remembering tend to mimic each others' bodily movements and practices (e.g. eye-gaze, manual gestures, and body positions) in a sequential rather than in simultaneous fashion (Cienki, Bietti, & Kok, 2014). The temporal dynamics of nonverbal behavioral coordination seems to be determined by the sequential organization of the conversations in which joint remembering takes place. These processes typically occur over milliseconds and seconds. But remembering together in conversations also relies on processes which begin to expand or extend this micro timescale, such as the dynamics of verbal interactions reflected in cuing attempts, repetitions and turn-taking (e.g. Harris, Keil, Sutton, Barnier, & McIlwain, 2011; Meade, Nokes, & Morrow, 2009). While there are no sharp distinctions between processes operating over seconds to those operating over minutes, we can for analytic convenience identify a mid-range timescale t^2. At this timescale, in contrast to the cognitive processes that govern other collaborative activities (such as collaborative problem- solving and joint reasoning), remembering together involves re-evoking a shared or partially shared past distributed among interacting partners (Bietti, 2012; Hirst & Echterhoff, 2012; Sutton, Harris, Keil, & Barnier, 2010). Such re-evoking of past experiences involves the human capacity for mental time travel: the "faculty that allows humans to mentally project themselves backwards in time to re-live stages of their lives, or forward, to pre-live events" (Suddendorf & Corballis, 2007, p.299). The acts of mentally travelling back in time in social interactions as well as the performance outcomes of these activities are phenomena occurring at a slightly longer timescale t^2. They are influenced by how people coordinate verbal and nonverbal behaviors at a t^1, but do not fully depend on that. What goes on over t^2 has to be related to something that occurred in the past if we are using the term 'remembering' rather than talking about some other kind of cognitive activity. We relate such 'pastness' and outcomes of joint remembering to our second timescale in the model (see fig. 1). At this second timescale, we can apply the notion of collaboration in order to achieve something, rather than coordination, which is a phenomenon that need not depend on specific plans or goals.

So far, there is still something missing if we want to understand how people remember together. Joint activities in which people remember together are also anchored in longer-term cooperative and accumulative group dynamics between people with a history of interaction, which we can

characterize as typically operating at a timescale t^3 of hours and days. But this timescale stretches, because these processes typically involve a constant interaction between internal cognitive resources (such individual biological memory resources) and external cognitive resources (such as other people and technology) (e.g. Donald, 1993; Malafouris, 2013; Sterelny, 2012). Such interactions lead to an accumulation of knowledge and skills in ontogenetic time. The knowledge and skills involved are partly transmitted culturally and historically and learnt throughout complex communication chains, which play a key role in the formation and transmission of collective memories within mnemonic communities (Wertsch, 2002). Studying the transmission of knowledge and skills that enable the formation of collective memories takes us into consideration of a macro cultural timescale or t^4 (fig. 1).

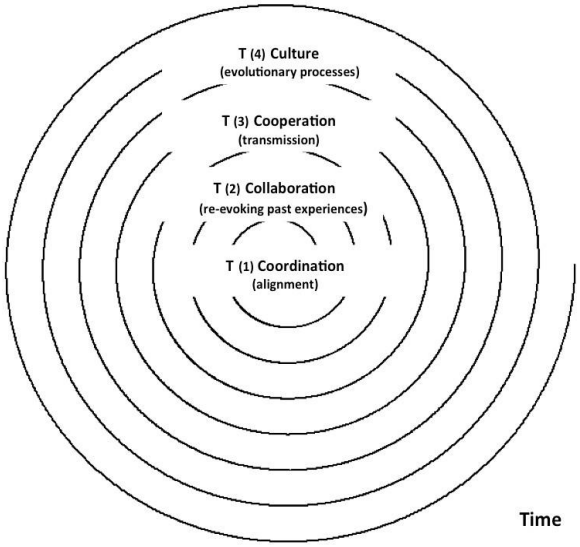

Figure 1: Multiple timescales of joint remembering

As figure 1 shows, the long-term processes unfolding over t^4 are also affected (and partly constituted) by shorter processes occurring over t^1, t^2 and t^3. That is, the way collective memories emerge and are transmitted over longer, cultural timescales partly depends on the human ability to coordinate verbal and nonverbal behaviors over t^1, the human capacity to mentally travel back in time jointly in collaborative social interactions over t^2, and on the diachronic processes of cooperation by which enduring groups form and function t^3. Purely for analytic convenience, we adopt these four terms to describe processes operating at each timescale. Below the level of longer-term cultural processes, we can treat 'cooperation' as labeling the most inclusive, general, and enduring processes by which groups engage in the diachronic management and negotiation of the shared past. At shorter timescales, 'collaboration' is a useful term for the active and often deliberate sharing of actions and experiences for mutual benefit, while in turn the processes of 'coordination' can include faster and more dynamic interactions of which participants need not be explicitly aware (compare Sterelny 2012; Sutton, 2013, p.30).

In this paper we attempt to illustrate how processes operating across these distinct timescales interact with and complement each other in joint remembering (Bietti & Sutton, in press).

The real-world context we selected to show how these processes interact with each other was a video design studio. Our data comes from an ethnographic study we conducted in a video design studio in Barcelona in February 2014. The micro-qualitative analysis focuses on an interactional sequence in which two members of a four- person team of video designers crafted a memory- scaffolding tool. This collaborative activity involved writing a list of the tasks that had been already done by the team of designers as well as the tasks they were to have done by the end of the day. To do so, designers used multiple distributed resources, including linguistic, bodily, and material resources acting in synchrony. In order to find the temporal structure of the crafting of the memory- scaffolding tool, we used software for pattern recognition. The micro-qualitative analysis suggests that coordination, collaboration, cooperation, and culture reveal complementary aspects of interacting to remember, which should be considered as complex phenomenon unfolding at multiple interanimating timescales.

The Design Studio as Cultural EcoSystem

New phases of collaborative design projects are built upon previous ones (e.g. storyboarding => modelling), transforming creative processes as temporally distributed activities (e.g. Wiltschnig, Christensen, & Ball, 2013). The temporal distribution of collaborative design depends on successfully recalling relevant aspects of previous phases of the project. Several methods have been developed to store design knowledge and decisions about design projects. One such method is exemplified by 'design rationale systems', which provide documentation of the evolution of the design project attempting to capture the reasons why the design is the way forward and its justifications (e.g. Burge, Carroll, McCall & Mistrik, 2008). Although design rationales embody shared design project memory, they cannot incorporate all aspects that may be viewed as relevant at future stages of the project development. We therefore argue that their existence does not obviate the need for interactive contextualization and negotiation of meaning of design elements, as represented in the rationale. In that case, it is important to understand the contexts and the processes by which past design decisions are interactively recreated, or "jointly remembered". In other terms, joint remembering, as an interactive phenomenon, both goes beyond design rationales and will always be a potential necessity for design teams, given evolving contexts that require new meanings to be co-created.

For a period of five working days we recorded the activities of a group of graphic and animation designers while they developed a commercial video for Russian television. The setting for this real-world study was an animation and video production studio located in Barcelona, Spain. The stakeholders involved in the making of the commercial were the Russian subsidiary of an American multinational food manufacturing company (client), the Russian branch of a major international advertisement company, a Moscow-based film production studio, and a Barcelona-based animation and production studio, which was where we conducted our fieldwork in February 2014. The overall production of the

commercial lasted from late December 2013 to mid March 2014, when it was delivered to the Russian channels.

The team of designers in Barcelona included: i) a project leader (PL), who was directly in contact with the client in Moscow, and as project director, supervised the overall design process and progress to address client's requests; ii) a project manager (PM), who led the design process and kept track of the design progress in relation to the deadlines defined by the Moscow-based agency at the beginning of the project; and iii) two designers (D1 and D2) who worked on the 3D animation and had to respond the project leader and project manager's requests.

Our recordings at the design studio in Barcelona were made with six static (fixed) cameras (4 GoPro HERO 3+ Black, 1 Canon VIXIA HF S21, and 1 Drift HD Ghost), as well as with one head-mounted wearable video camera (Looxie LX2). Because of his leading role, we anticipated that PL would be involved in more interactional sequences compared to the other three members of the team. Hence, we asked him to wear the head-mounted video camera.

Figure 2: Angles from multiple video cameras

The audio and video recordings were transcribed in detail in ChronoviZ, (Fouse, Weibel, Hutchins & Hollan, 2011). The search for recurrent behavioral patterns in the data was done with the help of pattern recognition software (Theme™, see Magnusson, 2000). During the working week we spent at the video design studio we collected 45+ hours of video and audio recordings. In addition to this dataset, we were given copies of the documents (e.g. production timing and storyboard) that were used to coordinate efforts among the different stakeholders involved in the development of the commercial. First, we coded all the interactional sequences we found in the video and audio recordings, in which at least two of the designers involved in the making of the commercial was part of (n= 232). For pragmatic reasons, we defined interactional sequences (ISs) as instances in which at least two designers were interacting. These ISs ranged from greetings (2 seconds) to group meetings (37 minutes). Next, we wanted to know what the number of designers participating in ISs was. That is, whether they were two, three or the four of them working on the commercial for the Russian television. Here we found that the vast majority of interactional sequences were between two designers (.84), these were followed by sequences where three designers participated in (.13) and by only a small number of sequences in which the four of them were involved (.3). From among the most frequent ISs, we selected an example we believe best illustrates the interweaving of timescales during joint remembering. In this IS (IS370AD) designers PL and D2 were involved in a collaborative activity that involved creating a list (see fig. 3) of the tasks that had been already done by the team of designers as well as the tasks they were to have done by the end of the day. This IS occurred after having a Skype meeting with the Moscow-based film production agency; it lasted 12:14.5 minutes. In the collaborative activity involved in the writing of the list, PL and D2 used multiple distributed resources, including linguistic, bodily, and material resources acting in synchrony.

The collaborative activity of drawing up the list was oriented to and guided by the past while at the same time aimed at providing guidelines for the goals for what remained of the day. In relation to the past, it was linked backed in time to the goals set by the 'production timing manifest' defined by the Moscow-based agency at the beginning of the project (see fig. 4). On the other hand, and in terms of what it set out for the future, after the IS PL used the list to remind the other team members (PM and D1) of the things that they were to have done by the end of the day. Thus, PL used the list to project the design process into the future, and thus, to make predictions and inferences that were useful for anticipating possible outcomes of design decisions. From among the most frequent ISs, we selected an example we believe best illustrates the interweaving of timescales during joint remembering. In this IS (IS370AD) designers PL and D2 were involved in a collaborative activity that involved creating a list (see fig. 3) of the tasks that had been already done by the team of designers as well as the tasks they were to have done by the end of the day. This IS occurred after having a Skype meeting with the Moscow-based film production agency; it lasted 12:14.5 minutes. In the collaborative activity involved in the writing of the list, PL and D2 used multiple distributed resources, including linguistic, bodily, and material resources acting in synchrony.

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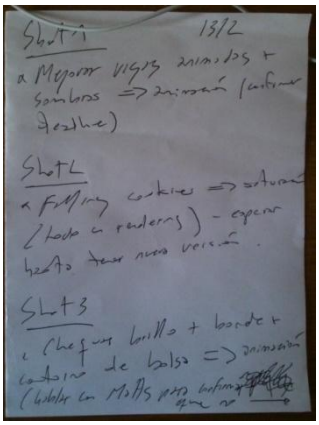
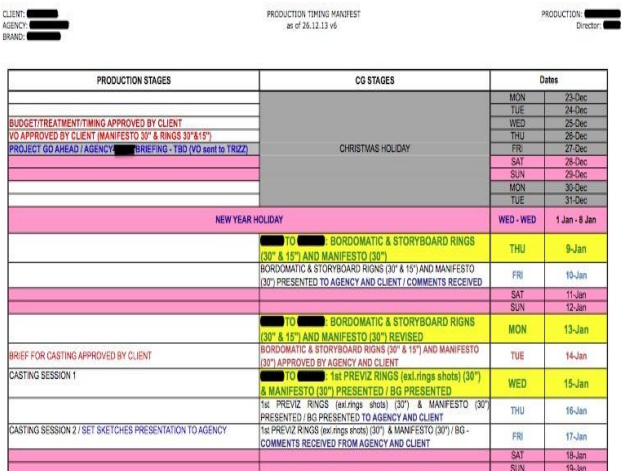


Figure 3: Fragment of the list created by PL and D2

Video and audio recordings were coded for linguistic and bodily behaviors, including speech, manual gesture, pointing, writing, typing and mouse-clicking, eye-gaze, head-nodding and shoulder shrugs. These categories emerged from the corpus rather than from the researchers' prior predictions. The minimum unit of time used for coding the IS was 100ms. For all time points, a binary value was assigned to each behavior of PL and D2 indicating whether they performed that behavior at the particular moment in time.



PRODUCTION TIMING MANIFEST
as of 26.12.13 v6

PRODUCTION STAGES	CG STAGES	Dates	
		MON	23-Dec
		TUE	24-Dec
BUDGET/TREATMENT/TIMING APPROVED BY CLIENT		WED	25-Dec
VO APPROVED BY CLIENT (MANIFESTO 30" & RINGS 30"&15")		THU	26-Dec
PROJECT GO AHEAD / AGENCY [redacted] BRIEFING - TBD (VO sent to TRIZZ)	CHRISTMAS HOLIDAY	FRI	27-Dec
		SAT	28-Dec
		SUN	29-Dec
		MON	30-Dec
		TUE	31-Dec
NEW YEAR HOLIDAY		WED - WED	1 Jan - 8 Jan
	[redacted] TO [redacted]: BORDOMATIC & STORYBOARD RINGS (30" & 15") AND MANIFESTO (30")	THU	9-Jan
	BORDOMATIC & STORYBOARD RIGNS (30" & 15") AND MANIFESTO (30") PRESENTED TO AGENCY AND CLIENT / COMMENTS RECEIVED	FRI	10-Jan
		SAT	11-Jan
		SUN	12-Jan
	[redacted] TO [redacted]: BORDOMATIC & STORYBOARD RIGNS (30" & 15") AND MANIFESTO (30") REVISED	MON	13-Jan
BRIEF FOR CASTING APPROVED BY CLIENT	BORDOMATIC & STORYBOARD RIGNS (30" & 15") AND MANIFESTO (30") APPROVED BY AGENCY AND CLIENT	TUE	14-Jan
CASTING SESSION 1	[redacted] TO [redacted]: 1st PREVIZ RINGS (excl.rings shots) (30") & MANIFESTO (30") PRESENTED / BG PRESENTED	WED	15-Jan
	1st PREVIZ RINGS (excl.rings shots) (30") & MANIFESTO (30") PRESENTED / BG PRESENTED TO AGENCY AND CLIENT	THU	16-Jan
CASTING SESSION 2 / SET SKETCHES PRESENTATION TO AGENCY	1st PREVIZ RINGS (excl.rings shots) (30") & MANIFESTO (30") / BG - COMMENTS RECEIVED FROM AGENCY AND CLIENT	FRI	17-Jan
		SAT	18-Jan
		SUN	19-Jan

Figure 4: Production timing manifest

The Temporal Structure of Crafting Memories in the Design Studio

The analysis of time structure of coded behaviors in the IS370AD was performed with the help of specialized software (Theme™, see Magnusson, 2000). Theme™ software provides useful indications for discovering sequential structures in behavior in time series dataset. Theme™ detects statistically significant sequences of event types tied by critical interval relationships. A critical interval designates the time window after the occurrence of an event type during which the occurrence of another event type is considered to be non random. Theme™ defines as 'T-patterns' those sequences of behaviors that are linked by a specific time interaction more often than expectable by chance. T-pattern search was set to using a minimum of 10 related actions and at a significance level of $p<.005$. It detected 893 significant patterns from all coded events (n=1144). Among the 893 t-patterns that were found in IS370AD, we selected the most recurrent (11 times) t- pattern with the greatest number of events (n=8) that included the beginning and end of at least two speech events, one from each of the designers:

T-pattern: ((d2,b,speech, (d2,e,speech pl,b,speech))
((pl,e,speech (pl,b,writing (pl,e,writing
pl,e,gazewl))) pl,b,gazes)) (see fig. 5)

The components of the t-pattern were coded using the following scheme: a) 'b' and 'e' indicate the beginning (b) and end (e) of events, that is, each instance of behavior was composed of two events; b) 'writing' refers to the action of writing down new items on the list (fig. 4); c) 'speech' signals the presence of spoken language; d) 'gazewl' indicates eye-gaze towards the list; and e) 'gazes' signals eye-gaze towards the computer screen.

As an example (fig. 6) to illustrate how PL and D2 remembered relevant information in the process of drawing up the list of things that had already been done related to shoot nine of the commercial, and those that they were to do, we selected one of the occurrences (occurrence #10) of the t-pattern with the lowest critical interval times between events. That is, occurrence #10 was taken from the most recurrent and longest t-pattern that included two completed speech events, one from each of the designers. Although occurrence #10 is an illustrative example, it is representative of the IS, but not of the entire dataset (45+ hours of audio and video recordings). In the first line, D2 explained to PL the changes that he would make to the 3D modeling. PL agreed with him and implied that these changes had already been done (L.2). Before the 2 sec pause in line 3, both designers were looking at the computer screen (fig. 6 a). However, immediately afterwards, PL lowered his gaze direction down towards the list he was writing (fig. 6 b). In line 4, PL completed the utterance initiated by D2 in the previous line, and added information about what was missing while writing it down on the list. During the 6 sec pause, after uttering while writing down 'animación' (animation), PL changed gaze direction towards the computer screen. In line 7, D2 completed the utterance initiated by PL the line before. As occurred in 3-4, in lines 6-7 PL and D2 collaborated to remember what had to be done by the end of the day. In the last turn, PL changed his gaze downwards and repeating the item just remembered by D2 'galletas' (cookies) he wrote it down on the list (L. 8).

Discussion

Joint remembering relies on the successful interweaving of multiple cognitive, bodily, social and material resources, anchored in specific cultural ecosystems. Such systems for joint remembering in social interactions are composed of processes unfolding over multiple but complementary time scales: (i) faster, lower-level *coordination processes*

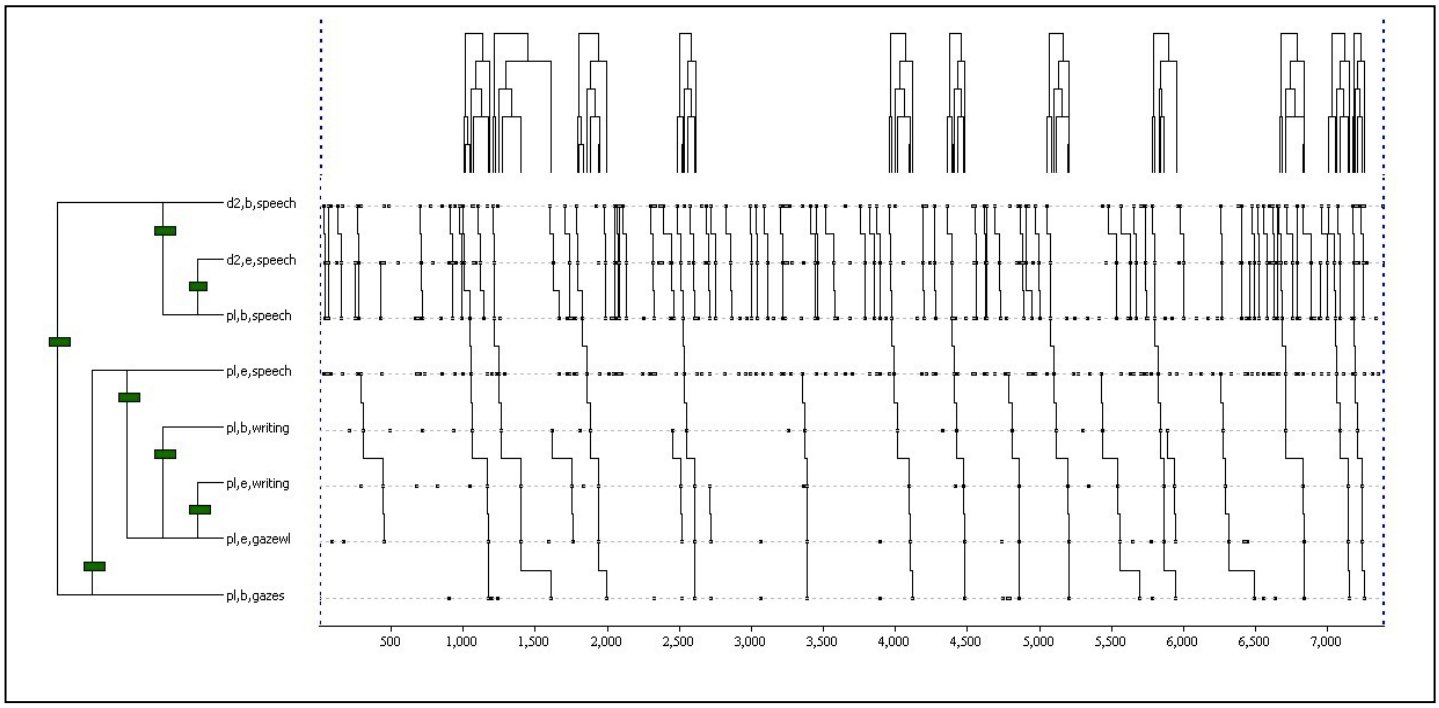


Figure 5: T-pattern diagram showing the distribution of most recurrent and longest pattern including two completed speech events, one coming from each of the designers

Figure 6: Crafting a memory-scaffolding tool during collaborative design

of behavioral matching and interactional synchrony occurring at timescale (t^1); (ii) mid-range *collaborative processes* which revoke past experiences in groups (t^2); (iii) *cooperative processes* involved in the transmission of memories over longer periods (t^3); and (iv) *cultural processes* and practices operating within cultural-cognitive ecosystems over evolutionary and historical timeframes (t^4).

The micro-qualitative analysis of occurrence #10 has shown how the coordination of linguistic (e.g. repetition of lexical items) and bodily resources (e.g. changes in gaze direction) supported collaborative processes during joint remembering between expert designers at the design studio.

The temporal structure of multimodal alignment between PL and D2 reflected the key role that the sequential organization of joint remembering played in determining the dynamics of events occurring over t^1. Joint remembering in the drawing up of the list involved not only the alignment of resources unfolding at t^1, but also collaborating to re-evoke what the team of designers had already done, and in the light of what they were still to do before the end of the day. The collaborative processes involved in the completion of the other's turns (lines 3-4; 6-7) illustrated one of the positive outcomes of the interaction: they could remember what was missing and add that information to the list over a t^2. The list

they were co-creating was used as a tool for the joint remembering of relevant information about the design project between team members in the future. The list was linked to the past too, in that it related back to the 'production timing manifest' set by the Moscow-based film production agency. Thus, the list, conceived as a tool for memory scaffolding also relates to a more macro timescale t^3 when compared to t^1 and t^2. However, as we could observe in occurrence #10, joint remembering in the drawing up of the list was also supported by external cognitive resources, transmitted and learnt through ontogeny, such as the creation of written records (list) and the interaction with computers over a macro cultural timescale t^4. The latter created the conditions for the emergence of specific cultural eco-systems, such as the video design studio. Further studies in memory research will need to bring controlled laboratory studies and ethnography together in the attempt to explain how multiple timescales and processes are integrated in a synergistic fashion during joint remembering.

Acknowledgments

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