

Considering an Organization's Memory

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ABSTRACT

The term *organizational memory* is due for an overhaul. Memory appears to be everywhere in organizations; yet, the term has been limited to a few uses. In this paper we examine what memory in an organization really is. Based on an ethnographic study of a telephone hotline group, this paper presents a micro-level analysis of a hotline call, the work activity surrounding the call, and the memory used in the work activity. We do this analysis from the viewpoint of distributed cognition theory, finding it fruitful for an understanding of an organization's memory.

Keywords

Organizational memory, knowledge management, collective memory, group memory, information sharing, distributed cognition, CSCW, computer-supported cooperative work

INTRODUCTION

The term *organizational memory* has been overworked and confused. Burdened with the requirement to reuse experience, the term organizational memory obscures and ignores critical functions of the organization's memory. Instead, only some forms of memory have been considered. Unfortunately, while these forms have been most visible, they are also the most likely to be corrupted by the extension of the metaphor from cognitive science's physical-symbol-system model (also called the information processing model) to social groupings.

In this paper we wish to address this failure. We are therefore primarily interested in exploring where memory exists within an organizational setting, rather than focusing on particular memory augmentations. To do this we present a micro-level analysis of a domain that we find to be overflowing with organizational memory -- a telephone helpline for personnel issues. We take an ethnographic based approach for data collection and base our analysis in

distributed cognition theory [9, 13, 17].

The paper begins with a brief overview of the organizational memory literature. We follow this with a description of the field site and data collection. Before beginning the detailed analysis, the next section provides a brief overview of distributed cognition theory. This is followed with a detailed analysis of a hotline call, progressively describing the call, the work activity surrounding the call, and the memory used in the work activity. The paper concludes with a discussion of the implications for organizational memory research.

EXAMINING MEMORY IN AN ORGANIZATION

Organizational memory, as a literature, has been rife with varying, and occasionally competing, definitions and elaborations. Little of the literature rests on empirical examinations of organizational memory within a context of use. Walsh and Ungson, in their review article [22], note that:

Despite the general use of the term organizational memory, it is not clear that we have understood the concept or its implications for the management of organizations. To date, a myriad of unexamined conjectures has defined a concept that has even served as a basis for prescriptive management advice. (pp. 84-85)

Indeed, the need for systematic work to examine organizational memory is even more pressing than for many other organizational concepts. Organizational memory as a concept, especially at a grand level, has a number of theoretical problems. For example, an organization is hardly a single, unified entity, as the metaphor implies. An organization's memory must be socially constructed, maintained, and directed.

Generally, papers theorizing about organizational memory often theorize at a very grand scale, not relying on empirical data. Walsh and Ungson do distinguish a number of general components of organizational memory. They include people, archives, organizational procedures, organizational structures, and culture. (We assume here that their omission of internal archives, such as computer data-

bases and paper files, was an oversight.) Walsh and Ungson's paper is not empirical, and does not cite any empirical studies.

Other theoretical studies also lack an empirical base. Huber [11] argues that support for organizational learning and memory would be useful, but does not distinguish clearly what concretely constitutes organizational memory. Stein and Zwass [21], while acknowledging the need for empirical studies, nonetheless rely on an information-processing model of the organization, again at a very grand scale. Smith [19] uses a similar model.

Most studies of organization memory have largely focused on the technology systems designed to replace human and paper-based memory systems. While many of these studies (e.g., [1], [15], [5]) have examined memory systems in use, the studies have nonetheless been limited. They often rely on narrow definitions of organizational memory or organizational tasks, and more importantly, they have been limited to particular, usually prototype, systems in use.

This paper does not argue for abandoning or ignoring organizational memory as a concept. Despite the conceptual problems, there is something arresting about the idea or metaphor of organizational memory, as Bannon and Kuutti state:

...that such a concept is appealed to across a wide range of studies, even if its definition is disputed, is testimony to the fact that even if people cannot agree on what exactly the term means, there must be some set of issues that can be subsumed under its umbrella that people feel are important and worth discussing. ([4], pp. 156-157)

Instead, as we have above, this paper argues for resting an analysis of organizational memory on an empirically derived analysis. It is important that this analysis result from a study within an organizational field setting; that is, within a context of everyday use. As Bannon and Kuutti go on:

What is surprising is that there has been little focus among the various disciplinary groups concerned with organizational memory on the details of how organizations actually develop and use organizational memories.... ([4], p. 164)

Indeed, one might argue that system construction must be founded upon empirically determined insights about organizational memory – instead of just building blindly.

This study, then, is an empirical examination of memory in an organizational setting. Because of the state of the literature, and the circumstances of the setting, we believe that a descriptive examination that allows both a micro-scale analysis alongside a more comprehensive overview will be most useful. We have necessarily restricted our examination to a very small scale of operation in order to more clearly explore the nature of organizational memory, and we used distributed cognition theory as a theoretical framework that is useful for examining small-scale social activities and arrangements.

SETTING AND DATA COLLECTION

The following analysis is based on field observations of a telephone hotline group (here called HLG) at a well-established company, CyberCorp, headquartered in Silicon Valley. The study took place over a period of 18 months, and included a variety of data collection methods including direct observation, video, semi-structured interviews, and social network analyses. Originally, the field study was concerned with the design and use of an organizational memory system and HLG was merely the user group. However, HLG was noticeably interesting in its own right, and the study quickly turned to an examination of HLG itself.

HLG specializes in answering human resource questions, primarily about benefits and personnel policies for the company's thousands of employees. Here we describe and analyze one of the calls captured on video. This call involves Joan¹, one of the hotline representatives. Joan is a full-time agent. She had been at CyberCorp for five years and at HLG for one year.

Joan, like all of the agents, works in a cubicle that is open to a central corridor (figure 1). Like many control room settings (e.g., [18]), the cubicles are close enough to easily hear the activities of other agents. Her chair, like the other agents, faces away from the corridor between the cubicles and towards the windows.

Joan faces two monitors, where she uses a number of software packages. The telephone to the right of her monitors is another computational system that plays a role in Joan's

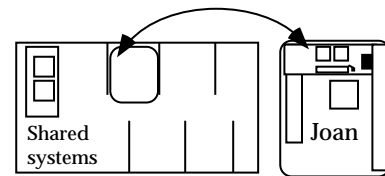


Figure 1: Joan's workplace. The left-hand portion shows how the cubicles are related to each other, as well as the shared terminals. The right is a larger picture of Joan's office.

work. These computational systems and software will be discussed at length below.

HLG, and telephone hotlines in general, are good places to study memory in an organization, because their operation is so information intensive. HLG agents must start forming their answer within 45 to 60 seconds after the start of the call, while simultaneously listening to the caller's elaborations and information. Many answers came directly from the hotline member's memory; hotline questions tend to be repetitive. Yet, there is also a great need for external memory sources: Facts must be double-checked, new

¹All participants and their individual attributes have been disguised for publication.

questions arise, some questions recur only sporadically or seasonally, while some answers become obsolete with new conditions.

We believe that the distributed cognition framework [6, 9, 10, 13, 17] provides several advantages for studying phenomena of this kind. The next section provides a brief overview of distributed cognition theory and its utility for analyzing organizational memory.

DISTRIBUTED COGNITION

Given the acknowledged range of components which comprise organizational memory [22], it would be useful to have a theoretical framework that allows us to examine how all those components work in concert. Distributed cognition provides both the framework and the theoretical language to analyze this system.

First of all, distributed cognition theory frames the problem in terms of examining a functional system as a cognitive system. The first task in a distributed cognition analysis is to identify how a functional system works, good and bad [17]. Functional operation is decomposed into smaller units of analysis that make sense with respect to the particular system. In some cases this may be a straightforward task decomposition, while other systems may call for a more event driven segmentation. Once this smaller unit is observed and detailed with respect to a particular task, distributed cognition provides a theoretical language to analyze how that function is achieved. This language addresses artifacts, human actors, and organizational and social structures on an equal theoretical footing. With this we can begin to understand how technologies currently fit a system's operation. By extension we can speculate about how changes in technologies might affect future operations. We believe that looking at the phenomena of organizational memory is well supported by taking this essentially cognitive view of a system, and in our interpretation, giving it a certain social twist.

What distributed cognition shares with other cognitive models is an identification of the informational input entering a system. Whether a computational or cognitive system, we want to know how information is represented and how these representations are transformed, combined and propagated through that system in order to produce the system's observable behavior. (See figure 2.)

Once the function of a system has been analyzed into its component representational states and processes, the analyst uses that information to reconstruct a story of the functioning of the system. This allows an analysis with respect to the context of use within an organization. For example, our study of HLG shows a plethora of *information* is both available and necessary. In some cases the required information is easily accessible, while in others it must be located or uncovered. In any case, information must be monitored, managed, and communicated in order to do the job. In the next section we try to give the sense of how such a description is built out of the more detailed

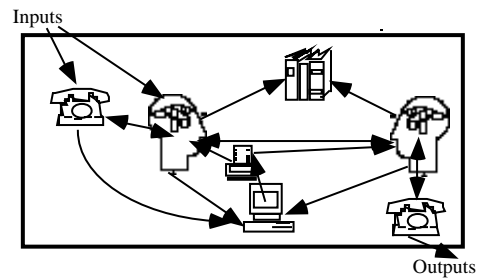


Figure 2. The components in the system are analyzed as media in a particular state that is interpreted by some agent. The heavy lines between the components represent the *processes* that progress the mapping.

analysis. Then in the remainder of the paper we will discuss the analysis at the higher level.

Applying distributed cognition to HLG

A functional human system such as HLG has the property that many of the system properties are directly observable. We can bound the portion of the system to be analyzed, based on the observed function. Within this unit we expose information about the task, its resources and organization.

In the case of HLG, the cognitive system's purpose is to answer or solve the caller's problem. The caller can be seen as the input to this system, and her question is a representational state traveling via the material media of the phone to one of the HLG agents. For each call the unit of consideration may vary. Figure 3 shows how we might initially *bound* the system to include the caller, Joan, the telephone, and other materials (or *resources*) available to Joan.

While her use of the telephone is an indicator of where the process is occurring, it does not completely define the limits of the task. In general, the functional system is observed to be bounded by physical, resource, and temporal limits.

Jumping back to a higher level, an examination of Joan's cubicle shows there are many other available resources. Depending on the type of query Joan can use a variety of on-line resources. In addition there are a myriad of yellow post-it notes stuck to every possible surface, and as our call

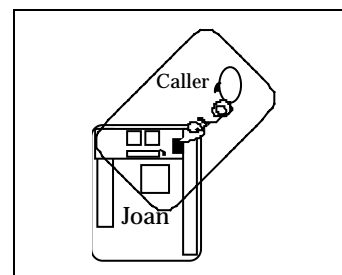


Figure 3. The unit of analysis for a particular call can be roughly bounded based on the trajectory identified by the telephone as a mediating device between Joan and the caller.

example shows, the resources of other people should not be ignored. In addition, her employee benefits book, this day, lies atop assorted papers on her right "shelf." Pages of quickly required information, such as telephone numbers, are tacked to her left wall, and neatly stacked project files, color coded, for her spare moments are on the left "shelf."

Delving further we can observe much of the system processing as it involves transitions between humans and artifacts. We are able to record the representational state, the material media on which it is instantiated, as well as the processes that transform it. An advantage of the distributed cognition framework, to be drawn upon below, is its commitment to a unit of analysis defined in relation to the complex phenomena being observed. As Hutchins shows in *Cognition in the Wild* (1995), the information processing in a navigation team varies with the context and circumstances. Solo watch standing involves the interaction of one individual with various artifacts, structured via well-established procedures and routines. In contrast, the high tempo activity of entering a harbor requires the effort of several people, again in coordination with specialized tools and with each other. While the overall "intelligent behavior" exhibited by the system is the same, the means change.

In the case of HLG, our analysis shows how the work of the system is organized and reorganized to meet changing needs. An important part of understanding this is knowing all the possible resources and following their use through a variety of situations.

Our analysis shows the agent's similarity and differences with respect to other agents. Some are more dependent on the employee handbook, notebooks of frequently needed information, and other collections of materials. HLG members used a variety of information systems, including multiple databases and electronic documents. They also consulted a number of paper documents, manuals, post-it notes, telephone lists, scribbled messages, and the like. Very critically, they also used one another as information sources, bridging social and cognitive worlds, as well as technical and domain understanding. We adopted Hutchins' distributed cognition framework precisely because it provides a mechanism that can be used to bridge these worlds.

CORRECTING A DATABASE ENTRY

Below is a transcript from videotape of an HLG call. A walkthrough of this call will use distributed cognition to unpack the working of organizational memory. We reproduce and discuss the beginning of this call at length; later we will summarize sections of the call to be more concise. Because of privacy reasons, only one side of the exchange was taped.

Answering the Phone

The first four turns of the call are routine, but even so they demonstrate critical aspects of the organization's memory. The call begins with Joan's standard opening. Turn 1 consists of Joan greeting the caller, and acknowledging that the caller was forced to hold for some period of time.

While the telephone system automatically routed a call to her as soon as she finished the previous call, the caller was forced to wait for an available agent. Turn 2 acknowledges the caller's request. In this case an employee has called because a benefits provider does not show her as receiving their benefit. This benefits provider, Eye and Vision Associates (EVA), will not process the employee's claim (or rather, allow the employee to purchase eyeglasses at a discount) until this is corrected.

1	HR Helpline. This is Joan. Thanks for holding. (Joan nods slowly to herself.)
2	You called EVA directly? I'll find out what our system shows for you. Oh I see. Oh, so right, right...yeah.... (Encouragingly) Let me do this. (In an aside tone) The system is being very slow, so it'll take a second to get a new record up for you.

The employee says that she called EVA directly and that EVA did not show her as having coverage. Joan must then check whether the employee, Michelle, actually showed coverage within the CARL database: This database, built from payroll data, shows the employee benefits for each employee in CyberCorp.

At the end of turn 2, Joan starts a new call-tracking record in the CAT (Call Tracking) system for the new call, closing out the old one that she had not quite finished. Turn 3 is more complex, as Joan does several things simultaneously. She asks for the relevant information, namely the caller's employee number. Joan has now opened a new CAT record for the call and checked the employee phone list for the caller. She double-checks the employee's social security number for later use with the CARL database. As she is confirming the employee information with the caller, Michelle, she is also typing the information into the call-tracking record. She also writes Michelle's social security number on a piece of scrap paper, because she must go to the CARL terminal to look up the employee data. When she is finished obtaining and double-checking this information, she asks Michelle to hold, knowing that the next step will take a minute or two.

3	I'm sorry. Oh what a shame. Well you know, these funny things. (More officially) What is your employee number?
4	Okay, what I'm going to do is, I'm going to check the, uh, the CARL. Is this Michelle? Let me check your social security number is the one I have, 1-8-2-4-zero-7-3-5-5. Okay, what I'm going to do is to check the system and find out what your coverage is, and if it's not showing...coverage on CARL, uh, then we'll, hmm, we'll have to do something else, okay? Hold just a second, Michelle

At the end of turn 4, Joan goes to the CARL terminal, which is physically in another location behind her cubicle. (There are separate terminals for two different employee databases, and part of Joan's routine is selecting the correct database.) She types, looking at the piece of scrap paper, and pulls up the appropriate record. This takes 23 seconds. After obtaining the data, she visibly pauses and stares abstractedly at the ceiling.

Many Small Memories

We will proceed with the rest of the call below, but even the first four turns show many cognitive, social, and institutional arrangements in the organization's memory. In her execution Joan uses not one monolithic memory, as many technocentric models would have it. Instead, she uses many small memories.

To recap, the call was triggered by the telephone system's short-term memory of the group's activity. The system state shows that Joan's station is free, and the call falls to her. Hearing the caller's information, Joan uses her own short-term memory as she then types that information into the CAT record. (For convenience, other uses of Joan's short-term memory are omitted here.)

Joan then takes the information in CAT and reproduces it onto a piece of paper, creating a mobile form of memory. She appears not trust to her own memory, but resorts to something that can help her reconstruct the circumstances of the call. She then types the information from the paper into the CARL system. CARL is a typical type of organizational memory, a corporate database with employee records. Joan places the CARL output onto the paper again.

Within just these three turns, Joan has used three separate software systems (CAT, the employee phone list, and CARL), the telephone system, and scratch paper, all of which maintain representational state for Joan, the group, or both. Figure 4 below graphically displays the order of processing of those memories; it consists largely of transferring information from memory to memory in order to answer the query. Within what is so far a very structured process, Joan's cognitive work consists largely in knowing which memories to trigger. Little processing is done on the actual information.

Although we present the flow of representations in Figure 4 as an individual process, there are actually multiple group and organizational processes occurring. In distrib-

uted cognition theory, expanding the boundaries of the analysis is required as we enlarge the relevant task in order to understand a memory's use in its full organizational context. This will become clearer at the end of the call, when Joan indexes the call-tracking record and changes the telephone state, but at this point, Joan is already embedded within these processes. For example, Joan uses CAT, the call-tracking system, seemingly as a short-term memory aid. Its major use, however, is to provide other agents with the ability to reconstruct the history of a caller's problem. In addition to maintaining a history of calls for the group, the CAT program also creates transformed, longer-term memory in the form of statistics, based on the indexing done by the agent (later) during her wrap-up period. These statistics are used by management to govern the group's future behavior, as has been typical in organizations since the late nineteenth century [23, 24]. The telephone system, in addition to being a primitive form of group memory that coordinates and paces the HLG agents' activities, also creates summary statistics for the group and the organization as a whole.

To recap, even within these four turns, Joan uses many discrete memories. Sometimes the memory used is individual and private; sometimes it is group and public. But all of these memories must be used together seamlessly (or nearly so) to create an organizational product (the product being not only the solution to the call but all of the institutional arrangements surrounding it). The density and connectedness of memories used as resources in this environment are remarkable.

The call, of course, continues past Joan's finding the employee's record. Next Joan must determine what to do with the facts she has uncovered.

Handling an Exception

As mentioned, Joan pulled up Michelle's record within the CARL database. After this, Joan visibly paused and stared at the ceiling. As will be seen below, Michelle should have EVA coverage according to her CARL record; yet, EVA shows no such coverage. Presumably, Joan is trying to figure out what to do about this unusual discrepancy.

After five seconds, she begins a conversation with one of the senior telephone agents who had been wrapping up her call. In turns 5 through 15, Joan asks the senior agent, Nichole, how to proceed.

Joan appears in turns 5 through 15 to be trying to under-

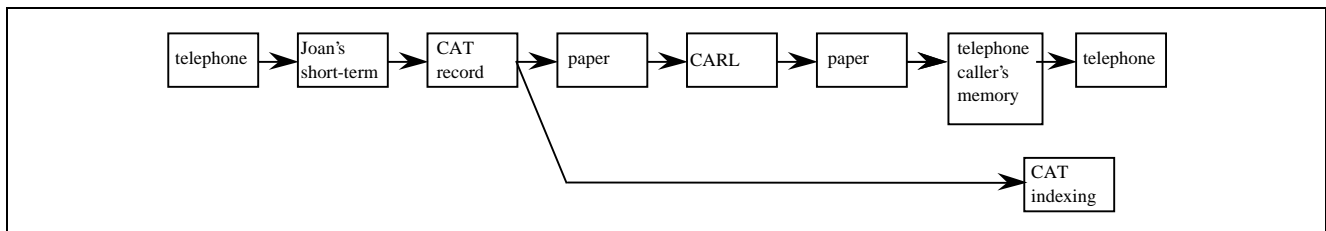


Figure 4. The flow of representational states in the first 4 turns of Joan's call.

stand whether to escalate the problem to the benefits group. Organizationally, the HRG is dependent on other groups to handle more complicated or complex situations; these are called *escalations*. The senior agent confirms that she should escalate, and tells her what information is necessary to properly create the escalation. (In the following, the angle brackets <> indicate a section of the tape that was indistinct. The slashes \ / and / \ indicate overlapping conversational areas on the tape; a = sign indicates that there was no appreciable pause between the two words.)

5	Joan	Nikki, can I get your...
6	Nichole	Uh, huh. (Nichole nods her head and walks towards Joan.)
7	Joan	If this employee, uh, called EVA and they say they show no coverage for her, but she's showing, showing active on CARL. She's has confirmed no problems, but what should I do as far as the referral?
8	Nichole	Call, call them [EVA] yourself and find out what they want.
9	Joan	Okay.
10	Nichole	Then escalate it to the <Benefits>. EVA is asking for this information on this (indistinguishable). (Official tone, as though acting out a scenario) We show it as having such-and-such. That way /we\
11	Joan	\Okay./ Okay, /I\
12	Nichole	\can/ tell <them>... what EVA is looking for.
13	Joan	I can tell the employee it's showing there's not, shouldn't be a problem, so=
14	Nichole	=we're trying to fix it.
15	Joan	I'm trying to get a <feel> for it. Thanks, Nik.

Nichole tells Joan, then, to escalate the problem to the Benefits group and to obtain from EVA what they need to resolve the problem. Joan walks away from Nichole at the end of this interaction, and returns to her seat.

Organizing the Work and Organizational Boundaries

We showed earlier how Joan's processing was dependent on many small memories, including her own. However, solving a problem may not be dependent solely on an individual's cognition and the artifacts (memory or otherwise) within the environment. These turns show how Joan's work is socially organized as well as the role of memory in

that organizing.

Unlike ship navigation [12, 13] or air traffic control [7-9] with their standard operating procedures, HLG has fewer pre-specified routines. Yet, as Pentland [16] observed in his study of a software hotline and as Katzenberg et al. [14] observed in hospital situations, the HLG group has developed a set of informal routines that can be combined flexibly to solve a large range of problems. Indeed, the HLG manager repeatedly mentioned during the study that he was trying to balance flexible diagnosis and service with transaction efficiency. There were numerous minor task reallocations during the study period as the group attempted to juggle the two demands and build their repertoire of small routines.

In this case, Joan has a routine to uncover a discrepancy between what an employee wishes to have for benefits and what he or she currently has – she looks it up. Joan can then explain that discrepancy as well as potential solutions to the employee. The discrepancy, however, between the internal CyberCorp databases and the benefit provider's database is not routine. Joan later demarked the situation as neither usual nor unusual, and as such, one without a given routine.

Instead, Joan relies on Nichole. Nichole was considered the "expert" on more obscure situations; HLG agents would often pose difficult questions to Nichole. Like Hutchins' Navy navigation crew, the HLG is organized such that the more senior agents have served in all simpler positions. (The HLG roles are less differentiated than are those for shipboard navigation, but the coverage of experts' knowledge over novices' tasks is the same.) In addition, Joan liked asking questions of other agents as a way of obtaining needed information, so this interaction suited her information seeking style. The intent of many organizational memory systems would be to replace Nichole but without losing the supposedly reusable information. Instead, many exceptions may be better serviced by task experts; this exchange is extremely short. We will discuss this trade-off space further below.

The production is divided not only among group members but among groups as well. Relaxing the boundaries of the task shows Joan's work is also connected organizationally across other group's processes. There are two larger tasks that are invoked in these turns.

First, Joan and HLG are dependent on another organizational group to maintain the database used to verify an employee's benefits. Considering the call more broadly demonstrates the important set of organizing arrangements required to imbue and inscribe the memory with authenticity and veracity [3]. The HLG agent relies on the payroll group for the correctness of the information, when they create and maintain an employee record, which serves as a boundary object [20]. Joan knows none of the details of the record's creation or maintenance; almost all of the context has been lost. She does not know whether there are problems with the employee's employment or whether

there are extenuating circumstances. Indeed, it is assumed that the CARL database is more authoritatively correct than the employee database (maintained by the accounting department), since CARL is more authoritative for deducted benefits.

In addition, escalations are problematic organizationally because there is a fine line between taking action inappropriately or incorrectly and between wasting the other group's time. In fact, there was a fair amount of tension between the Benefits group and HLG. HLG felt that Benefits looked down on them for not knowing the Human Resources (HR) subject area sufficiently, and HLG agents wished to be regarded as professionals. Indeed, HLG perceived themselves as the future of the HR profession, as did the CyberCorp management. But this was a future unwanted by most of Benefits, since hotline work was perceived by the Benefits professionals as leading to HR deskilling in CyberCorp. Therefore, inappropriate escalations sometimes furthered political tensions. Since escalations were always to some extent problematic, the procedures around them often shifted during the study, thus the need for the question to Nichole.

Playing a Hunch

In the next segment of the call, Joan returns to her chair, reconnects her telephone headset, and begins to speak with Michelle again. Procedurally, all Joan must do is to tell Michelle that she will call EVA and escalate the problem. However, this is derailed by a side discussion over Michelle's incorrect telephone number.

16	Michelle, when you spoke with the folks at EVA, what, what is it that they said to you?
17	Okay, because you do in mine. ...So I don't know what the situation is.
	[Segment of the call deleted; Joan is dealing with Michelle's phone number.]

In the omitted portion of the transcript, Michelle reports that she cannot seem to correct her telephone number in the employee phone list, even though she has tried many times. She discusses this at some length with Joan, asking her to change it. At first analysis, the incorrect telephone number appeared to be extraneous to this call, but it is an interesting side conversation. The employee, having found someone to correct her employee records, now asks Joan to correct her telephone number in all CyberCorp databases. We believe that to Michelle, it appears that she has found the person that is in charge of correcting the appropriate memory, whether it is her telephone number or her benefits status. Joan cannot, because the responsibility for changing something so seemingly mundane as a telephone number lies with another group. In the actual production, there are distinct organizational boundaries to the memories. To the organizational member, however, these boundaries are arbitrary and frustrating.

Joan continues with her explanation of the escalating process (as it needs to be seen by the employee). However, this is derailed several times by a side discussion about obtaining an electronic form for EVA. This side discussion triggers off a recollection and hunch in Joan.

24	Okay, what we'll do is, I'm going to call EVA (voice rising in question tone) directly and find out what the situation is, and, uh, it's possible they might need some other information that the benefits department can provide for them, but either way, you'll get a call back from somebody by the end of the day tomorrow and let you know what the status is, uh, go ahead...
25	Oh. (surprised) I can request a form for you, but the, the thing is if I request the form and for some reason they don't have coverage for you they're going to reject it. So what I'll do is I'll do two things. Uh, EVA, did you, did you call the 800 number? Did you call, did the hotline direct you to that number?
26	Right
27	Oh, I see. Well, you know what? I think I remember this happening once before, Michelle, and since my system showed that, that the employee that called was covered, they said, okay, I'll put that in the system and we'll go ahead and send the form out ... so who knows? Did...
	[Segment of the call deleted; Joan and Michelle discuss Michelle's address for the EVA form.]

Finally, Joan ends the call with the employee. Interestingly, Joan has formulated a plan of action that attempts to solve the problem, rather than following Nichole's advice literally. In this, she uses Nichole's statements as advice to formulate her own activity, rather than a requirement.

At the end of her conversation with the employee, Joan turns to the camera and explains the call. In the time that it takes Joan to explain the situation, she pulls up EVA's telephone number (using a computerized rolodex program) and dials the call. In fact, she appears to end her explanation when the call is connected. In the final section of the call, Joan convinces the EVA agent that Michelle is a CyberCorp employee and that she should have EVA benefits. (This has been compressed for space reasons.)

	You don't [show her on your system]? No. Is it, is it possible for me to, to uh, verify she's on our (rising, questioning) system? And you can go ahead and send the form to her? Excellent. I have an address (rising, questioning), if that would help you?
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After finishing her call with the EVA agent, Joan wraps up by indexing the call in the CAT system and then signaling to the phone system that she is ready for a new call.

At the end of the call, one might surmise that Joan now has a new routine, calling EVA directly and getting an employee her benefits. She could assume that this kind of transaction is routine, since the EVA agent treats it as relatively straightforward. However, as Joan says: "I think I remember this happening once before." There is no reason to suppose that this will not be recreated again from a very hazy human memory.

We next turn to a discussion of the call as a whole and its implications for organizational memory.

CONTEXT VS. CONTEXTUALIZING

The term "context" is often used as a catchall to denote the wealth of organizational and cultural knowledge one effortlessly brings to bear in a given situation. Joan shows in this call that she has knowledge of how her world works and that this knowledge is necessary for getting her work done. Within the call, she displays an understanding of her limitations, the range of knowledge within HLG, Nichole's role, and the complex relationship of HLG to Benefits and to EVA.

If one were primarily interested in implementing a technocentric view of organizational memory or knowledge management, with their immediate emphasis on capture and reuse, one might assume that all Joan needs is more information, whether in a computer system or on paper. Instead, the story is more complex. We see Joan moving seamlessly through this real setting with its many process states, using the memories and other artifacts that she judges to be critical to finishing her task. To understand her use of memory resources in accomplishing this, however, it will be important to tease apart the concurrent use of contextualization, decontextualization, and recontextualization in obtaining a solution to the situation.

The Missing Bark

The need for context, and Joan's contextualization of the environment, is revealed in the order and access of various resources. As with Sherlock Holmes' famous hound, the interesting thing about this call is all of the things that did not happen. Joan did not stumble or falter, searching for her next step. She needed help in the face of a breakdown, but she carefully and quickly determined a resolution. In her selections, she showed an enormous understanding of her environment and the role of artifacts and people within it.

On the other hand, Joan did not use paper or on-line documents to formulate her plan of action for this situation. The key was not that detail was missing from the on-line sources. If this were so, the solution would be indeed to add even more information on-line. To the contrary, the key to Joan's lack of use is the overwhelming amount of detail available. Since an HLG agent must have an answer within 45-60 seconds, it is impossible to sift through

megabytes of information. A search with terms "EVA" or "enrollment" might turn up dozens of documents. Even if the retrieval is ranked (i.e., the search engine evaluates the likelihood of fit), the agent does not have the time to consider the retrieved materials.

The information use that does occur is situated. Joan does not view all sources equally. She went to Nichole, rather than to another agent. She avoided one database for another. She relied on her own memory. Like the other agents, Joan considers some sources as authoritative. Sources have different costs, psychological or financial, associated with their access. She selects and chooses resources in her environment, according to her immediate understanding of the situation.

Memories as Boundary Objects

In a distributed cognition view, an organization's memory consists of many states, instantiated by people and artifacts, all within a single system allowing the participants to get their work done. To solve Michelle's problem, the process apparently is losing contextual information in many places – from payroll to HLG, from Nichole to Joan, from HLG to Benefits, from Joan to Michelle (in explaining the process), from Joan to the EVA representative, and finally from Joan to the CAT record.

Some of these differentiations correspond to boundaries with respect to the propagation of representational state and its re-interpretation. These boundaries often correspond with organizational divisions. Three of the four individuals involved in the call are all employees of CyberCorp. However, their different roles imply different meanings for the same representations. For the caller Michelle, Joan is the expert at HLG who will solve her problem. Pushing the notion of social boundaries to its extreme, even though Joan and Nichole are in the same department, Nichole's acknowledged expertise creates a boundary, and thus different contextualizations between her and Joan. A comparison of these boundaries with the propagation of representations through the processing of the call illustrates how the cognition involved (i.e., the use of memory) is constrained by social arrangements.

As representational state propagates across individuals, inter-organizational, and intra-organizational boundaries, it must necessarily lose some of its context. As Star [20] points out, boundary objects in an organization work because they necessarily contain sufficient detail to be understandable by both parties, but at the same time, neither party must understand the full context of use by the other. As boundary objects, artifacts and other potential resources are given to other people or in this case, stored for later use by others. This requires the information to be decontextualized. Otherwise, the secondary users will drown in unnecessary, unhelpful, or conflicting data. (One may also wish to hide or obscure some institutional and social arrangements from the other group.) As an example, the payroll records are necessarily standardized and stripped of much informational content before they can be given to

groups such as HLG. Decontextualization, and perhaps commodification, must be expected by those who will try to use the memory.

To reuse a memory, the user must then recontextualize that information. The information, if not supplied by the same individual, must be reunderstood for the user's current purposes. Elsewhere we have written about the recontextualization problem in organizational memory systems [2], but the call shows that a difficulty, or even outright inability, in recontextualization, would make the memory useless or nearly so. For example, reused information must be imbued with attributes of veracity, authenticity, and even status [3]; it must be provided with everyday organizational context.

Joan understands that the CARL database record is authoritative; she knows enough of its meaning within HLG's context. Joan also knows she can ignore Nichole's advice, based on her understanding of HLG, Benefits, and EVA. Rather than adopt Nichole's advice – find out what EVA wants and then escalate – Joan proceeds to convince EVA herself that Michelle is an employee.

The Complexity of Reuse

Obviously reuse is possible. Joan's call showed many memories reused by Joan, other members of the group, and the organization as a whole. We have also shown that these memories can be rearranged and reused in different ways, depending on the production that is required.

The above sections, however, cautioned that the informational requirements for reuse are not trivial. For reuse, decontextualized information must be recontextualized sufficiently by the secondary user, according to his or her purposes. This is most likely to be done within a familiar process with little time lapse [2]. In distributed cognition terms, the cost of reuse is most likely to be borne where the traffic or the processing utility is highest – within heavily used or high payoff processes.

The problem with reuse, then, is the coexisting requirement for contextualization, decontextualization and recontextualization. To use information as a memory, one must remove the detail that provides context, making the information into a boundary object. However, at the same time one must consider how others will use it later as a resource in their processes; otherwise, subsequent users of the memory will not be able to properly recontextualize it.

On the other side, based on their understanding of their own situations, users of a memory must determine what contextual aspects of that memory are important and whether they have changed. This determination may be nearly impossible, given people's limited view of an organization as well as the decontextualization of the information. Users must then decide how their differing context should effect their use of the memory, and finally they must absorb the memory into their current situation. The simpler the memory, the more likely this all can occur.

CONCLUSIONS

This study has many limitations. Because of page restrictions, only a single call was presented here. The representativeness of HLG and its activities could be argued. Yet, within the limits of a single ethnographic record, we have tried to show that:

- There is no such thing as *an* organizational memory, as the metaphor attempts to invoke. We have tried to show how a supra-individual memory, using several people and many artifacts, works. This analysis also showed the utility of distributed cognition in understanding such a supra-individual memory.

This simple call and the distributed cognition analysis exposed a number of interesting aspects of this organization's memory. The procedure involved nine different memory states, and the human agent either translated among representational states or reconstructed memory states. We also showed that:

- Even this simple example was a not-so-very simple case of distributed memory. Memories were complexly distributed, interwoven, and occasionally overlaid. They were sometimes the province of the individual (e.g., Joan's scratch notes) or the group (e.g., the call-handling procedure embedded in the telephone system). But, often enough, the memory that served as individual memory also had a definition as a group and even an organizational memory.
- While knowledge management largely restricts itself to viewing organizational memory to repositories of experience "objects" that are magically reusable, we have tried to show in this paper that it is more fruitful to consider organizational memory as both object and process. Memory is both an artifact that holds its state and an artifact that is embedded in many organizational and individual processes.

The container metaphor is easier to consider computationally, but it is extremely limited organizationally. The distributed cognition view of a network of artifacts and people, of memory and of processing, bound by social arrangements, provides a deeper and ultimately more usable understanding of organizational life. It describes how memory as representational states can be both separated from organizational actors and necessarily bound to their actions and understandings.

- There is a tension in creating new memory artifacts between seamlessness and flexibility that cannot be easily resolved. In the last stage of the call, Michelle wants her phone number changed; she does not want to hear about the organizational boundaries that prevent Joan from doing so. On the other hand, we have argued here that small memories can be most easily decontextualized and recontextualized; they will serve most flexibility and may be of the most utility.
- Finally, there are many examples in this environment

demonstrating the reuse of memory. However, information to be used as memory is valuable only when it can be contextualized, decontextualized, and recontextualized at the proper time. Moreover, the proper context to capture is dependent on how the information will be used as a memory resource in the future and the ability of the users to recontextualize the information.

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