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Cognitive Technologies, Social Science and the Three-Layered Leopard Skin of Change.

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Abstract: The current digitization of society brings a series of new issues which challenge social science. This paper describes the mechanism of digital projection (creation of a digital layer mirroring the physical world) by which the society digitizes. In the three-layered leopard skin model of change described in this paper (physical layer, representations and practice, institutions) , the physical layer (here, information technology) is changing much faster than the two other layers: representations and institutions. This situation calls for a new stand of social research in these evolutions, which is illustrated by the series of papers of this issue, summarized in this article. A closer link to technology and different relation with stakeholders seem to emerge as a new action-research approach in the field.

Résumé: La numérisation de la société pose une série de questions urgentes aux sciences sociales. Ce papier décrit le mécanisme de projection numérique (création d'une image numérique en miroir du monde réel) par lequel la société se numérise. Suivant le modèle du changement en peau de léopard à trois couches présenté ici (couche physique, représentations et pratiques, institutions), la couche de l'environnement physique (la technologie) change bien plus vite que la couche des représentations et celle des institutions. Cette situation appelle un nouveau positionnement des sciences sociales dans l'évolution sociétale en cours, qui est illustrée par les papiers rassemblés dans ce numéro, qui sont résumés dans cet article. Un nouveau courant de recherche-action semble émerger dans le domaine, en liaison étroite avec la technologie et les parties prenantes.

The story goes that when André Malraux, in August 1965, asked Zhou Enlai what he thought about the impact of the French revolution, the latter answered that "it was too early to tell"[1]. We always tend to believe we live major changes in our own lifetime, but of course only history can tell; good analysis requires distance. Adopting this distanced, critical attitude seems a commendable standpoint for Social Science: it is uneasy to grasp the whole picture when one is still involved in the phenomenon. Taking part in the process as a scientist is a risky and dubious challenge, so why should academics get involved?

This is a long-debated issue among philosophers and scientists. Today we must face it again urgently with the so-called "digital revolution". Revolution or not, something big is happening to societies with the diffusion of Cognitive Technologies (computers, sensors, software, mobile communication devices, the Internet etc.), that is changing our everyday lives fast. What stand can Social Science take in this evolution?

This issue collects a selection of papers that were presented over the last two years in international symposia of the "Cognitive Technologies" ("TECOG") program[2] at Fondation Maison des Sciences de l'Homme in Paris: "Digital ethnography"[3], "Perceiving and Being Perceived in digital environments"[4] ; "Geolocation: psychological and social impacts"[5], and one in the webinar series that TECOG co-organized in 2006-2007 with the RUFAE[6] network and CNRS-EHESS Center for Transdisciplinary Studies.

We launched the TECOG research program in 1998 at the Foundation Maison des

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[1] Interestingly, on the Internet, this anecdote is most often quoted as a dialog in 1971 (or 1972) between Henri Kissinger and Mao Zedong (but also sometimes between Kissinger/Malraux and Zhou, Ho-Chi-Minh, etc). So much for trusting the Internet as a source.

[2] This program is co-funded by EDF R&D and Foundation Maison des Sciences de l'Homme, with the support of Association Française de la Recherche Cognitive.

[3] ; December 11, 2006, with Alain d'Iribarne (FMSH); Saadi Lahlou (EDF R&D, Paris, FR);Christian Licoppe (ENST, Paris, FR); Valery Nosulenko (Russian Academy of Sciences, RU) Yuri Alexandrov (Russian Academy of Sciences, RU); Siegfried Frey (Duisburg-Essen University, DE); Edwin Hutchins, Saeko Nomura and Jim Hollan (UC San Diego, USA), Roy Pea and Joe Rosen (Stanford University, USA).

[4] June 12, 2007, with Jean-Luc Lory (FMSH); Saadi Lahlou(EDF R&D, Paris); Roel Vertegaal (Queens University, CA) ; Paul Bach-y-Rita (University of Wisconsin, USA; Charles Lenay (Compiègne University of Technology, FR); Ezequiel Di Paolo (University of Sussex, Brighton, UK (Valery Nosulenko, Russian Academy of Science, RU).

[5] November 12, 2007. with Alain D'Iribarne and Jean-Luc Lory (FMSH, Paris); Jun Rekimoto, (The University of Tokyo / Sony Computer Science Laboratories, Inc., JP) Andy Crabtree (University of Nottingham, UK), Peter Joore, (TNO, Eindhoven, NL),John Krumm, (Microsoft Research, Redmond, USA); Saadi Lahlou, (CNRS-EHESS, Paris, FR), Pierre Nguyen (EDF R&D, FR); Aaron V. Cicourel, (UC San Diego, USA) ; Charles Lenay, (Université de Technologie de Compiègne; FR), Valery Nosulenko (Russian Academy of Science, RU) ; François Jegou, (SDS, Brussels, BE).

[6] Research Network on User-Friendly Augmented Environments : www.rufae.net

Sciences de l'Homme to evaluate the potential impact of these cognitive technologies on society, and to organize discussion between social scientists, technology experts and stakeholders in the societal changes. Ten years later, a quick comparison of the state of the art then and now will remind us the scale of the changes.

1 Looking ten years back

Ten years ago, Google (founded November 1998) did not exist. Now it processes 200 million queries a day. In 1998, there was no Wifi, no fiber, no DSL[7], no power line network, no Bluetooth, no Wimax, no GPRS. Today half of the population in Western Europe has high bandwidth access to the Internet, and Wifi network is becoming ubiquitous. The possession of mobile phones grew sharply (in France, from 8.5% in 1997 to 84% in 2007), and Internet access too (for French households it was multiplied by 100). There are 800 million Bluetooth devices worldwide (the system was launched in 1998). E-bay (founded 1995) has 200 million users and over 7 billion dollars turnover. Wikipedia (founded 2001) has 10 million articles, and 200 million visits per month, in more than 250 languages. A flash memory card of 2 Gigabytes costs less than 10 Euros. Today's standard PC would have been in the world's top 500 ten years ago. 1.3 billion RFID tags were sold in 2006. And before the paper I write today will be even published, these figures will be obsolete. E.g. today's forecast of sales for RFID tags are of 600 billion in 2016.

These technical figures go with deep changes in our everyday behavior. In France, 20% of the income tax declarations were done through the internet in 2007; a situation that was unthinkable 10 years ago. We can hardly live without the Internet and our cell phone. We spend about one hour out of four at work processing our emails. Our children's sociability is made of SMS, blogs, chats and instant messaging. We scientists are now familiars with webinars, and PowerPoint presentation is almost compulsory in congresses (see Beaudouin, this issue).

This evolution has also deep impact on the world economy: information technology fostered globalization and the emergence of new finance and business models, corporate governance, labor division, etc. E-commerce is exploding. The economies of knowledge, of attention, are becoming a focus of interest and competition. Internet is now a major

[7] One of the authors in this issue, Beaudouin, supervised the social research on the first DSL high bandwidth field experiments at France Telecom R&D in 1997.

resource for scholars and education, information, and soon policies.

These are trivia. Now here is the issue. These systems are developed mostly “tech-down”, that is by technologists and suppliers. Of course users seize the systems and try to adapt those to their own needs and desires. But there is very little oversight of the emerging effects of these technologies, and when there is, it is hardly taken into account at design stage. Teenager sociability was not the main scope of the developers of instant messaging techniques. A more worrying aspect of the current evolution is that it obviously brings a series of social problems. We shall not discuss here the globalization issues, which do not come from Information technology alone; but an issue like Privacy is obviously raised by this new Information Society (and at least three papers in this issue address this problem). Such social issues cannot be left to be dealt with by technologists alone.

In the last decade we saw the rise of interdisciplinary communities including social scientists who try to help the process of development of these Information and Communication Technologies (ICT) technologies to make them more user-friendly, more reliable and secure. The ACM (Association for Computing Machinery) hosts several. These communities, which include with ICT experts mostly sociologists, ergonomists, cognitive scientists, anthropologists, linguists and psychologists, are often presented as the “Human Factors” side of the ICT research community. Not only did their work contribute to the research effort in ICT, but it brought back from this field very interesting theoretical and methodological insight from the analysis of interaction with computers which feeds social science in general. In this field have also been applied and developed new approaches of action research and participative design involving users and stakeholders.

The papers presented here are an advanced sample of how social science research can contribute to the current evolution. One paper has a more neuroscience approach and aims at clarifying an issue which becomes fundamental with the virtualization on the digital world: how do we perceive the objects-of-the-world? Before describing the content of these papers, let us give, in the next two sections, a global vision to understand the process of the digitization of society, and a theoretical framework analyze this cultural change.

2 The digital projection of society

The past ten years enabled us to validate a new grid, which allows to sort out substantive

currents from surface effects. “Automation” is the economic drive to the diffusion of IT; the principle of “digital projection” guides their technical implementation locally. We will examine these two points in this section. Finally, the diffusion of this digital projection follows a three-layered leopard skin pattern –which we will see in the following section.

2.1 Automation.

The development of productive structures goes through successive stages which follow this automation principle: transferring human work toward specialized machines. For a well defined repetitive task, a specifically designed agent is more cost-effective than unspecialized operators, such as humans. In the past industrial revolutions, physical human work had already been transferred to machinery. In current organizations most of the human work had become tertiary (working with people, information, or machine interface; but not directly transforming matter).

Information Technology (IT) has opened a new domain of automation for production: information processing. Henceforth, any repetitive task, including cognitive, which can be explicitly modeled in the form of a procedure tends, in an economic process, to be transferred to automatons. On this basis, all processes, particularly in the service sector, are currently being reviewed and optimized to take advantage of the new possibilities offered by IT.

The automation of cognitive tasks is the economic drive for the diffusion of cognitive technologies. The automation of cognitive work remains partial though, because Humans remain the best operators for human relations, a task for which they are specialized by nature. The pressure to the economic rationalization leads first to computerize the "informational" fractions of the activity. This is what we observe for example in the large “call centers” where information processing is done by digital automatons (computers, programs and the like), but where relation is still performed by humans.

In this framework, the input of Human Sciences becomes crucial for system design. As Lomov [1963, p. 23] stated: “(…) a man remains a man even when he enters the role of a link in the control system”. We need humans in the loop of complex systems since Man is more plastic than machines with regard to information input, processing, execution, and is able to “grasp” improbable events [Lomov, 1963, p. 21]. This is why “the greater the development of technology the more acute becomes the need for a detailed and thorough

study of the peculiarities of Man" [Lomov, p. 9].

To predict future developments of the digitization of society, it is therefore necessary to distinguish the "relational work" to which man is gradually relegated, from the "informational processing" undergoing industrial transformation. How is this transformation happening in practice?

2.2 Digital projection

The process of this digitization follows the principle of "digital projection". Each individual object or process of the actual World is assigned its own digital representation. This digital image of the material world enables computing operations on objects in the digital space (with workflows, programs, web-services…). For example, the machines of an industrial plant, or financial flows of the various entities of the company, its customers etc. are modeled, monitored and represented through computer interface to the Humans in charge. The operations on those interfaces (acknowledgment, correction, command…) trigger the action of physical automatons. In the more mundane areas of life, where economic pressure is less strong or inexistent, the drive for comfort and easiness brings a similar tendency for delegating to automatons various tasks (storing, searching, etc.). But the creation of digital projections of everyday objects also brings new affordances (in gaming, creation, interpersonal relations) which create a demand of their own, therefore fueling demand.

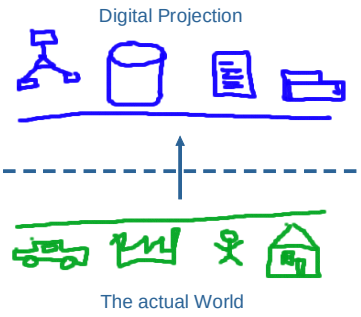

Fig. 1: The Digital Projection: a digital world mirroring the actual World. Each object of the World has its representation in the digital world.

The structuring vision that we must have in mind is that of the gradual establishment of a digital world mirroring the physical world (the "digital projection" of the physical world. In the future, almost any object involved in a transaction will, eventually, have its projection in the digital world (Fig. 1).

We are moving towards this new framework, it is already adopted by many service companies (bankinsurance, vehicle rental, etc.): A central database, digital representation of the organization operations domain (external and internal), is connected to functional workflows, with workers overseeing relational interfaces with clients. Around this digital channel is organized the production and activity of staff and customers.

This affects functions as diverse as Customer Relation Management (CRM), human resources, procurement, logistics, reporting, planning, design… The digital projections are at present rather simple, and interconnections primitive. For example digital projection of a client begins with a name, address, registration number, a means of payment. But projections are enriched quickly. After several years of CRM, digital projection contains a customer's technical specifications, preferences, habits, his history of relation with the company, even data on his possessions, contracts, etc.

In summary: the automation principle guides the evolution of productive organizations. IT open new domains to automation, especially in the service sector. Automation happens by digital projection mirroring the material world. The digital world where transactions run is now spreading rapidly in scope and precision.

We can forecast that what shall prevail increasingly is not what is "real" in the physical world, but its representation in the digital space, because there lies the register of transactions, especially financial or legal. This shift will have important consequence on society.

Of course, we are all ware of these changes, even if we may not share this vision of digital projection. Now, what is the path of evolution to this digital society? At present, we see many local changes, and at different levels: many new devices and services, some new regulations, changes in behaviors, but the whole picture is yet far from clear. Can we get a better sense of the social logics of this change, if there is any? And can Social Science help us to monitor those changes; for a better world or at least to minimize the undesired effects?

3 Changing societies: the three layered leopard skin

Going beyond mere description, critical analysis or modeling, actually *using* science in *designing* real-world systems is a tough reality test for any science. Among the problems immediately encountered is the trans-disciplinary aspect of reality. A real system does not only have social aspects, but also psychological, technical, economical etc. E.g. the

causes for the wide dissemination of ICT in the last decades are not only functional: the fact that, at identical cost every two years the power of electronic chips doubles while their size gets smaller (the so-called Moore's law) plays a major role. Hence, in explanation, and in design as well, the researcher must take into account not only the human aspects but the technical aspects as well. Conversely, the technologist must consider human factors. *It is a well known fact among stakeholders in the domain that the major causes for success or failure of a new ICT system are "non-technical" (understand: linked to user reception).*

Here is a small simple model to clear things up, the triple-determination model.

3.1 Three layers of determination of human behavior

At a given moment, the World can be considered as an "installation" (in the artistic sense of assembling patterns in space to modify the way we experience this situation). This installation guides subjects into their activity track, at three levels: physical, mental, institutional.

The physical level refers to material reality and artifacts; it provides *affordances* [Gibson, 1967, 1982] for activity: which activities can be supported by the objects. For example, ladders afford climbing; e-mail affords asynchronous text communication; houses afford shelter. This is the first level of determination. One can only do what is afforded by the present environment.

At human level, *representations and practice* provide possible interpretations of the situation, and enable subjects to elaborate and plan behaviors. Mere affordances are not sufficient. This is the second level of determination: people can use mental representations to interpret affordances into support for their activities. Jakob von Uexküll [1956] provides a famous example with ladders. He had come to Dar es Salaam with a smart young African who had never been in town or seen a ladder in his life. When Uexküll showed him a ladder, the young man could only see "sticks and holes"; but as soon as he saw someone climbing the ladder, the artifact made sense to him, and he was able to climb too.

Representations and objects follow a co-evolution process: representations are constructed by the practice people have of objects. Conversely, objects are made after the pattern of their representation: ladders are made to look like ladders; firemen are trained to behave as firemen; e-mail software are built after the representation of e-mail. And this

is the reason why representations match with objects. So if we want new ICT systems to be usable and sustainable, we have to work also on their representations among users and designers.

At a social level, the co-evolution of objects and representations is monitored by domain-local communities of interest (users, providers, public authority, etc.) who set the patterns of objects, the rules of practice etc. Because these stakeholders know the field, objects, representations and rules are adapted to behaviors. These stakeholders create institutions, which are both sets of rules to be applied to keep order and cooperation, and communities of interest aware that they play in the same game. *In this framework scientists have a crucial role: they create new patterns of representation, make effects and trends explicit and understandable, set measurement and evaluation techniques, legitimize or criticize, and in general feed stakeholders and mass media with future visions and new ideas to monitor the change.*

Knowing how to use the affordances is not always sufficient to execute adequate behavior. Some people might do wrong and provoke (by ignorance, personal interest…) negative externalities for themselves or others. Institutions are a social answer: they create and enforce rules to control these potential misuses or abuses; they set common conventions which enable cooperation (e.g. people should all drive on the same side of the road; they should use netiquette in their digital communication, etc.). Many of these rules are already contained in the mental representations, which are by nature normative. But institutions bring a *physical* control layer to these norms. They enforce them with special personnel. Also, every loyal member of the community tends to serve as a rule-enforcer and bring back mavericks on track. Often these rules are made formal and explicit (regulations, laws, etc.) but they may stay informal rules of good practice, tricks of the trade or traditions. As these rules are the result of compromise between local interests, they vary from place to place. One only needs to look at the differences between regional architectures for concrete illustration. The fact that the rules are created and enforced by and between institutions which represent communities of interests, results in rules reflecting *rapports de force* between these communities, vested interests, and current practice in the real world. *The co-evolution between artifacts and representations is done under continuous monitoring and control of stakeholder communities, which use institutions as social and economics tools to safeguard their interests.* This is one more factor of stability of this normative framework. So much for this third, social, level of

determination of behavior.

The resources and constraints provided at these three levels guide our social life and make it possible and fluid. Subjects rely on them simultaneously and alternatively. They are compatible and somewhat redundant which makes this triple-determination system pretty robust and stable.

This triple determination explains how we behave at a given moment in time. This works because representations of objects match their actual shape and affordance, and because rules prescribe behaviors which are indeed feasible in the state-of-the art. Now, as stated earlier, this matching comes from a co-evolution between objects and representations; in a chicken-and-egg continuous reconstruction and slow evolution.

For our problem –digitization of society- we must keep in mind these three levels to understand the evolution of the World. For example, to use an email, we must learn how to use the interface (representation level), and also learn the conversation rules that go with it, finally we may need some instituted authority to refrain spammers.

Evolving towards a stable and sustainable state of the system means making changes at three levels: physical (technical system ICT framework, from digital networks to software and business models); representational (the ideas people have of what “living in a digital society” means); institutional (rules of good practice accepted and enforced by stakeholders of the domain).

3.2 The three-layered leopard skin

In historical cultural change, evolution is slow, because it needs *distributed* changes, in all three levels. For our problem here, changes must take place in all the physical systems (in millions of individual homes and offices, networks, machines), new global supply chains and business models dealing with non-material goods and virtual services, the introduction of new non-human actors in the social system (software agents, robots); the attitudes and practice of billions of individual and collective users, thousands of laws and regulations… This extensive aspect of the real World system is a challenge to general theories because the field displays considerable local variation, so what may work here may not apply there. And in each local point, the three layers must be coordinated so that physical objects are consistent with representations and practice, and adequate institutions are set up to monitor and control the domain. This coupling of the three layers is the result of complex negotiation between stakeholders, individuals, and the material

environment; it takes into account many a local specificity.

Therefore change in this complex and globalized system follows what could be described as a three layered leopard-skin process. This model differs from the simple geographical diffusion, in that here diffusion may not only happen by geographical contiguity but by rebounds through the three layers that were described in the triple-determination model. That is, local experiments create spots of change, which in some cases grow larger at community level. Possibly, the whole system finally changes when these locally grown experiments merge, or start being many enough to become the new norm. In this evolution, the role of institutions is absolutely crucial because they can actively propagate, reproduce or scale out a local innovation. Mass media (and Internet is one) is a new fast vehicle for the dissemination of social representations and practice

In this three-layered leopard skin model, the “spots” of innovation do not grow or spread in a steady and continuous manner, as water lilies covering a pond, but by complex interaction inside and between the three layers, which interactions are often explained mostly by local, historical or accidental opportunities seized by motivated actors. For example, the role of motivated individuals (techno-fans, evangelists, activists, enthusiast scientists etc.) in existing institutions often appears instrumental in seizing the windows of change to connect a layer to another and push their agenda. This distributed evolution model is difficult to understand, predict, and even more to monitor.

One main issue in the present ICT development is that the innovations are often “tech-down”; the physical level is constructed first. But there are not yet institutionalized ecologies in these domains; or rather the previous institutions are not adapted because the domain boundaries have changed fast and deeply. For example, the so-called “convergence” of the media, content and communication economic clusters has not even stabilized that it is being questioned by a new convergence with the ‘Internet of things” (cf. Lahlou, this issue). So users –and other stakeholders- are drowned in a mass of new digital affordances before the representations and the rules of use are constructed. The new affordances, by introducing novel forms of interaction, raise fundamental questions about the very nature of relations between humans (cf. Lenay, this issue). Not only users are disoriented, but on the supply side actors are still seeking sustainable business models and try to construct new organizations and institutions. Designers combine technologies and install in our everyday environment new systems: emails, videoconferencing, blogs, the Internet, but also networked sensors and robots, aware objects, etc. for which we do

not yet have clear representations or rules of the game.

Social science has a major role to play in the construction of the mental and institutional level. Psychology tells us that individuals are often reluctant to influence; sociology that societies and institutions have some tendency to resist change. This is true and is in fact the basic reason for which the world is livable: continuous change would only produce chaos. On the other hand, experience shows that when individuals are confronted to problems they cannot solve with their usual routines (and especially when confronted with novelty) they become more open to influence, and even eventually actively seek influence [Leppamaki & Lahlou, 2004]. This is also true of organizations: in fact a large part of the flourishing consulting business is based on this; so are many research programmes.

Therefore, if the digitization of society raises social issues, social scientists should get involved and propose solutions; otherwise solutions will be proposed by technologists mostly: Joore's paper in this issue shows precisely how this happens.

The Cognitive Technologies research program at Fondation Maison des Sciences de l'Homme, where the papers collected here were presented, explored the potential psychological and social consequences of the digital revolution introduced by ICT, in an attempt to connect together the different layers of the leopard skin.

It is a very diverse set of papers we have here, which reflects the diversity of issues raised in society by this technological wave. A common aspect of these papers is that they all include some part of technical description of the systems, because, as the reader will soon understand, they are a crucial aspect of the social problem. This display of technical proficiency in a non-social domain is somewhat unusual in social science (let alone statistics), but when we deal with a hybrid word these concrete issues cannot be left aside. In this sense these authors are representative of the current trend of social scientists in "digital ethnography" who actually get involved in the design of socio-technical systems in order to understand from the inside how social reality is constructed by its stakeholders. They acknowledged that a first hand experience of the nature and properties of technical systems is of great help to understand how they shape their social use.

4 A grounded approach to ethical issues in the digital society

This issue collects seven papers. Three (Joore; Vertegaal & Shell; Lahlou). deal with the augmented environments and privacy issues caused by the digital projection of Humans

and of their activity (position, attention, intention) In these papers the problem is how to create institutional rules considering the fact that the physical layer has changed as a *fait accompli* and now brings serious privacy threats. Two papers (Beaudouin, Pea et al.) deal with the impact of digital tools (PowerPoint, and video) on the way we process knowledge. They focus on the relation between the physical layer and the representations and practice layer. Three papers (Nosulenko, Lenay; Alexandrov) deal with some fundamental aspects of digitization: what is an 'object' (Alexandrov, Nosulenko), what is an 'Other Subject' (Lenay): these issues are crucial to understand before we design a digital projection. We shall see that Alexandrov and Lenay come with unexpected conclusions, and Nosulenko brings some constructive methodological propositions.

4.1 An overview of the papers in this issue

Peter Joore's paper on "Social aspects of location monitoring systems: the Guide Me and the My-SOS case" relates the design process of two new "location-based services" aiming at helping or protecting people.

"My SOS" is a very small box with two buttons. One sends an alarm message including the location of the device to a call centre. Pressing both buttons directly calls the Dutch police. A speech connection is being opened. The help desk tracks the location of the person and takes action when needed. This device, initially designed to prevent attacks on children, was also used in a security company for employees to carry in their rounds. "Guide-me" is technically similar, but designed to help family or caregivers locate Alzheimer patients in case they start wandering.

Joore raises on very concrete grounds social and ethical issues, regarding the tradeoff between safety and liberty. He shows how these ethical issues are closely connected with technical and design issues, e.g. whether the device signals the user when she is observed, the precision of location, etc. His accounts show how power relations intervene; and how diverse may be the attitudes of different stakeholders: some patients think they do not need the device, while caretakers think it would be a good idea to implant it under the skin so that patients do not forget to wear it, or to implement electronic "barriers" to limit the patients errands ("geofencing"). But Joore's analysis also uncovers unexpected issues raised by these new devices, namely the problem of a new responsibility for the watchers. E.g. the Guide Me device, while on one hand making caretakers' task easier, on the other hand creates a new continuous obligation and responsibility for them because of their

awareness, finally making their work heavier.

Peter Joore's discussion, building on Bentham and Foucault, but also on interviews with users, makes explicit the difficulty to create new rules and practice, as well as highlights how dependent these social constructions are of minute and apparently benign technical design choices. His paper is prototypical because he shows that ITC concretely raises issues for which society has not yet found consensual answers; while the services he describes are already been launched on the market.

In the leopard skin model, we see how the three layers try to adapt to each other "vertically" on a local basis for the "Guide me". We also see that the three layers for the "Guide-me" system cannot be transferred without modification to another local domain (for the security company or the elderly care), even if some features of the physical layer (the device) remain similar: this is precisely why the system must have three layers.

Roel Vertegaal and Jeffrey S. Shell describe a new technique for making objects aware of human attention, by enabling them to identify the direction of human gaze. Their technology uses simple and affordable video cameras, by coupling them with the automatic analysis of the reflection of infrared light on human eyes, to "know" if human eyes (whose pupils reflect infrared) are in sight, and whether they are or not looking at the camera. With their paper, we understand how fare "aware" environments are becoming a reality. Such attentive interfaces enable more natural communication with objects, since humans can then address devices by looking at them. In other words, devices become able of eye-contact, a fundamental event in inter-subjective communication or reciprocal awareness and a crucial meta-signal in the management of turn-taking in conversation and inter-personal communication in general.

Of course this new affordance is of great added value for human machine –and even human-human communication (Vertegaal et al. also made gaze-aware glasses which can signal us whether we are looked at). The paper describes an experience where his system is used to customize work environments in order to support better communication or privacy. Beyond this, these "attentive user interfaces" are capable to monitor human attention, which is now becoming a scarce resource and a commercial stake; and this raises a new series of issues.

Vertegaal and Shell discuss potential privacy implications in ubiquitous aware

environments, and whether we could counterbalance surveillance with Steve Mann's "sousveillance" notion, where the subject continuously monitors the environment that watches him/her.

"Attentive objects" are obviously introducing a major change in our environment, since objects which until now were thought as passive now become able of one of the most elaborate capacities of humans, namely to be aware of other's attention, especially in the case of objects able to make eye-contact, as created by Vertegaal. It is still unknown what will be the consequences of connecting these aware objects with the virtually unlimited memory and reasoning capacity of networked computers. But here again, these technologies are already commercially available (I can testify, as we have some in our lab, among the multiple automatic tracking devices, biometric contactless authentication systems and the like which we use to test augmented environments: once again, social scientists should be aware of what is already out there).

In the leopard skin model, typically we see here that the physical layer (the device) is in phase advance to the rest of the system. We also see that is necessary for designers to think about the institutional aspects of their systems; and indeed so do Vertegaal and Shell.

As Joore points out, designers mostly focus on the positive aspects of their systems and tend to neglect the potential social issues. Lahlou's paper addresses this issue by attempting to build guidelines for designers in order to make the ICT systems respectful of privacy. The question addressed here is what may happen to real humans as a result of data mining in their digital projection.

Saadi Lahlou's paper "Identity, Status, Privacy and Face-Keeping in Digital Society", starts with providing the non-technical reader an overview of what the digital future will be like, when what is presently at test stage in industry labs will be on the market, and showing with some geolocation experiments how far these systems can reveal of intimate individual activity. Ambient intelligence, by recording all events and transactions, captures behavioral trajectories which enable to be aware of present and past activity, but also to some extent to predict what subjects will do in the next moments. His account of Krumm's work (protection by encryption, pseudonymy and other computer techniques, can usually be overcome with state-of-the art algorithms) shows that solutions cannot be

only at the technical level: mental attitude and institutions must change also. His presentation of the privacy dilemma suggests that the core reason of the privacy problems lays in the social nature of transactions: one needs to disclose personal elements to perform successful relation.

The paper proposes a new definition of privacy as “face keeping”. We all have many faces (combinations of role and status), but each one is used only in some settings. Privacy breach, Lahlou argues, is being presented with a “wrong” face, one that is not consistent with the situation (e.g. be seen at work in a family role). Systems should support users to wear exactly the face they want to show in the domain at hand (and nothing more: “privacy razor”).

This perspective is constructive in that it gives a positive goal to designers: tailoring the system to a very specific set of roles and statuses for the user; instead of vague instructions for avoiding potential problem. The paper includes in annex the complete set of European Privacy Design Guidelines by Lahlou & Jegou [2003], which were built upon this psycho-social analysis. This is an attempt to answer the question of the role of social scientists: feeding the institutions and the communities of interest with usable guidelines for their activity.

ICT changes the practice of formal communication, in science and in business. Valerie Beaudouin’s paper “PowerPoint, speech and text: Procustes’ bed revisited” studies one of the most remarkable evolution which occurred in the last ten years and blew up hundreds of years of rhetorical tradition. In 2001, according to Yates and Orlikowski [2006], 95% of public oral presentations were equipped with PowerPoint; a tool that did not even exist two decades before. This brings deep change in the nature and content of discourse. Beaudouin traces the historical evolution of the presentation format, from pure oral discourse, to read aloud written discourse, to discourse with graphic aids, and presently computed supported discourse with memory aids (PowerPoints) shared on the network. She lists the classic critics: PowerPoint decks are a Procustean “compromise” between long argumentative texts and short memory cues. Most often, intelligibility is lost because of the lack of global structure and because the hierarchy & list format forced by the software tends to destroy logical links and argumentation; while during presentation the text on the slides often distracts the audience.

Beaudouin goes further based on her series of ethnographic observation of presentations

and conferences. She shows how PowerPoint presentations disorient the audience when there is no *alignment* between the speaker, his talk, and the slides. This typically happens when slides contain lots of text; which is the case when slides are also intended to stay as a written document for the audience, and not only as aides to the discourse. This is a problem since one reason for using PowerPoint, on the production side (for speakers) is precisely that the same support will be used as aide and report, therefore saving the burden to write a text.

Beaudouin proposes a new hypothesis for the growing use of PowerPoint, based on the economics of attention. In a context of strong pressure to produce many presentations, PowerPoint "decks" make it easier for the presenters to prepare (by assembling and customizing old slides) and present (using the slides as a memory aide). On the demand side, for a public engaged in multiple tasks during the presentation, PowerPoint enables floating attention and re-synchronizing with the presentation.

Beyond this discussion on the reciprocal influence of format and institutional constraints, Beaudouin shows how much PowerPoint decks are difficult to interpret in the absence of the accompanying contents. She therefore warns that, as PowerPoint decks are increasingly replacing texts, this may create long term problems with knowledge construction and corporate memory.

In the leopard skin, we have here a good example of the co-evolution of tools and practice, and on their institutional consequences. Beaudouin's warning to organizations and communities (business and scientific) is also a call for them to adapt their rules in order to prevent to possible unwanted consequences of the change in progress.

ICT changes the practice of business and science. This aspect of digital science is also visible in the paper by Roy Pea, Robb Lindgren and Joseph Rosen: "Cognitive technologies for establishing, sharing and comparing perspectives on video over computer networks". Pea et al. address the issue of how cognitive technologies "shape who we are by *re-organizing* our activity systems". This question has been addressed in general and in a historical perspective, by authors such as Vygotsky or Bruner, and more specifically by Jack Goody [1977] on the influence of graphic technology on culture. But in this paper, it is the very creators of a new media technique who raise the issue of its impacts; which is a bit as if we had Gutenberg's reflections on his tool as he was

designing it.

And in fact the Diver and WebDiver system developed by Pea & al., at the Stanford Center for Innovations in Learning, around a new system of spatio-temporal indexing they invented, enables a novel use of video by making it an easily pointable and annotable material. WebDiver makes it possible to do with video what we were doing on text with a highlight marker and comments, by creating pointers in the video material. But most important is that WebDiver enables collaborative use of video. Pea et al. show that WebDiver makes video a media suitable for scientific and educational activities, by answering the seven core challenges associated with creating common ground in a workgroup: the problems of *reference*, *attentional alignment*, *creation of "immutable mobiles"*, *effective search retrieval and experience of collaborative work*, *access permissions*, *integrating the insights of a collaborative group*, and finally *establishing coherent multi-party video-anchored discourse in an activity system*. CSCVA (Computer Supported Collaborative Video Analysis) can now become a reality. For those who know how cumbersome it was until now to use video as a research or educational material within a group, this is good news: the technical bottleneck is now disappearing.

Beyond the reflection on the nature of collaborative media analysis, this paper exemplifies what can be "digital ethnography" and the use of ICT in research. ICT are not only changing the layman's life, but also the life of scientists and academics. The use of digital media for social science analysis will soon become more and more common in our fields. A few dozens of laboratories worldwide (including our own) are currently using WebDiver; we predict that such instruments will within a few years be part of the standard toolbox of social sciences labs and teaching. For example our students at Ecole des Hautes Etudes en Sciences Sociales in Paris now use it on an everyday basis and are enthusiastic.

In the same vein of proposing new tools to the scientific community, Valery Nosulenko's paper "Measuring activities in digital space by their subjective quality" addresses the issue of observing behaviors in augmented environments. Nosulenko provides two theoretical frameworks, and one methodology. The theoretical framework of Russian activity theory [Rubinstein, 1922, 1957; Leontiev, 1975; Nosulenko & Rabardel, 2007] developed since the 1930's but remained almost unknown in Western countries because

of a lack of translation, has recently started to gain considerable momentum in the communities of social scientists involved in ICT [e.g. Nardi, 1996]. And indeed, because it takes into account intentionality, and considers the situation from the subject's perspective, this framework is remarkably efficient to describe complex and opportunistic behaviors in rich environments; and also to support user-oriented design.

Nosulenko also describes the "perceived quality" approach, a theory he and his school have been developing over the last 20 years in the line of activity theory, primarily applied to acoustics, then cognitive engineering (in space programs and more recently in the car industry and interface design). In a nutshell, this psychological approach provides methodology to describe the subjective perception of objects from subjects' verbalizations and connecting it to the physical properties of artifacts and systems. Nosulenko and colleagues use this framework to determine what properties of objects are actually relevant for subjects in the situations, and therefore to determine specification of systems based on the activity the subjects try to perform.

Nosulenko gives two examples of how this framework was used to analyze user activity in augmented environments, when interacting with a PDA, and in user's reactions to the HelloWall, a video system designed to enhance communication and awareness of social ambiance in a distant location [Streitz & al, 2007]. The method provides operational guidance to connect the designers work to the user's perceptions, and hence gradually improve systems. These techniques have been used in an ambitious attempt to create life-size experiments where groups co-design new augmented environments in order to produce a better work and social experience, "experimental reality".

Charles Lenay's paper, "Technical mediation of perceptive interactions. Tactile encounters in shared digital environments" is an unusual and deep contribution to the understanding of the nature of social encounter. He describes an experiment that is an archetype of "encounter" of two beings equipped with simplest capacity of movement and sensation; and shows that the intelligent nature of "Other" vs. artifacts is recognized through the intentionality of movements in keeping contact.

In this experiment blinded subjects can sense with their finger the position of pixels on a computer screen. As they move their cursor with one hand, a Braille cell produces a tactile signal on their other hand. This system ("Tactos"), in the line of research opened

by Paul Bach-y-Rita [Bach y Rita et al; 1969], enables subjects to reconstruct a representation of “what” is there, and they soon build exploration strategies to identify patterns. Lenay uses this one-pixel system as an operationalization of “perception” to investigate the nature of “presence”. In a creative and original psychology experiment (or is this experimental philosophy?), he connects pairs of blinded subjects through the system: each subject can “sense” the other’s cursor through the system. Lenay, by tracing the movements of both cursors, their spatial and temporal interactions, uncovers the subject’s exploration strategies and analyzes how they manage to distinguish each other’s sensitive “digital body” from artifacts. The presence of Other is understood by the perception of Other’s intentional and focused exploration strategies. In practice, One perceives the contact of the Other trying to follow as One moves; and this perception of Other is possible only if One cooperates and also searches contact of Other, in what becomes a coupling of strategies where intentions can be shared.

Lenay discovers new conditions for what he calls “perceptive crossings” through a digital system: availability of a body-image for other users; direct link between perceptive activity and the body-image; absence of self-perception of own body image. Some of his conclusions have deep philosophical implications, for example he suggests that subjects can co-construct a shared world only if they have different, situated views of it. If all subjects have a parallel, similar external view (like in television) the very notion of point-of-view disappears.

Lenay’s theoretical work has potential applications in digital communication systems; his novel approach may start a new experimental trend to tackle with difficult phenomenological issues. It is both an example of what Cognitive Technologies bring to scientific exploration of complex social issues, and a means through which scientific investigation may provide new insights to the development of digital communication systems.

Yuri Alexandrov’s paper “How we fragment the world: View from inside versus view from outside” addresses the fundamental issue of the nature of mental objects. In an augmented world where objects become virtual, we cannot rely any more on the naïve realist view of “objects” as material artifacts, since subjects deal with representations; and most objects in the digital world are symbolic representations. How do we conceive

objects, subjectively? How are they constructed in the brain? Alexandrov's paper is based on solid neuroscience, and, just as Lenay's paper uses an experimental approach to understand the nature of "presence", it uses sharp experiments to uncover the nature of "object". Alexandrov tackles with the difficult question of whether outward behavior unambiguously reflects the dynamics of processes in the subjective world and subject's brain. Behind this question lay tough issues about how far we can use classic observation of subject's behavior to analyze activity.

His experiments are conducted on animals, with very simple and classic conditioning and with more complex operant as well: rabbits or rats are trained to perform various tasks with objects (e.g. pushing a pedal to get food or avoid electric shock). Alexandrov, with cutting edge neuroscience techniques, monitors the brain activity at single cell level, a technique few labs worldwide have been able to master. The general theoretical background is that, at neuron level, achieving a behavioral result is accomplished by synchronizing the activity of the neurons in different brain structures. By analyzing the synchronization patterns of neurons, Alexandrov and his team are able to identify step by step the detail of brain structures' activity underlying a given behavior, from onset (e.g. stimulation by a flash of light) to execution (motor activity e.g. pressing the pedal).

His findings are somewhat destabilizing, on one hand; on the other hand they open a new path for our approach of human behavior, and the design of new objects. In a nutshell, what characterizes objects and behaviors are intentions rather than physical shape. Similar outward behaviors may be subserved by different brain activity if they have different goals; while outwardly different behaviors may have similar brain bases if they have the same goal. More precisely: *"an environment, although similar in physical parameters, is differently reflected in the activity of central and peripheral neurons depending on the goal of behavior.* (…) The sets of neurons activated in visual cortex are different during presentation of *identical* flashes that induce different types of behavior (e.g. food-acquisition and defense)." *Specializations of neurons are formed in relation to the systems, aimed at the achievement of specific results of both "overt" and "covert" behavior*."

Another finding is that "brain subserving of behavior reflects the history of its formation. Hence, the activation characteristics and sets of active neurons are different in outwardly similar forms of behavior with different history of forming". In other words, when a subject learns something, the brain organization depends on how it is learned: something

that was learned by trial and error will not have the same neural basis as would have an identical behavior learned by observation and imitation. Alexandrov also shows remembering is always a reconstruction, at neural level, and therefore every remembrance may modify the object. The structures that were involved in learning are activated when the subject performs what was learned, even if these structures are seemingly irrelevant to the task at hand. For example, visual structures of the brain may be involved in behavior without individual's visual contact with the environment.

The brain is a system where every new learning is built on existing structures, and modifies the previous organization. Therefore, *previously formed behavior is modified by forming a new behavior*.

This paper may seem far from the usual papers in this journal, and it sometimes needs attention to follow for those unfamiliar with neuroscience –which in Russian tradition has always stayed linked with social science-; but deep questions sometimes necessitate going beyond the usual boundaries of our own field. The consequences of Alexandrov's findings for our problem are clear, and massive. Augmented environments should be designed with in mind the fact that it is *goals* which count for the subject. Therefore, what should be stable in the pattern of virtual objects is "what they serve" rather than their physical shape. The ever-changing flow of technology tends to distract us from the real issues by focusing our attention on the technical artifacts, which are indeed fascinating. But society is about human intentions and desires, which are at the core of subjective life. In our analysis of the consequences of digitization of society, we should keep focused on the impact on the perceptions and intentions of subjects.

Alexandrov's findings about learning give food for thought for those who want to monitor the evolution of digital society. By training our children with digital learning techniques; by using them on an everyday basis, we are modifying, at neural level, the very way we perceive the world. Even "classic" objects take a new meaning in this new context of practice. Past structures do not completely disappear, but they are reconstructed in new networks, for better or worse.

What is true at neural level is also the case at the higher level of society, in institutions, representations, and material culture.

As we can see through all these papers, changes are currently taking place at the technology level faster than they do at representation level. Institutions have started

taking care of these issues of digital society, but they are often placed in front of a *fait accompli*. The lower, physical, layer of the leopard skin is full of large digitized spots but the other layers are still mostly in last century's fabric. For these reasons, it seems useful that social scientists take some active stand in this evolution.

Pea et al. and Nosulenko papers provided us with methodological tools. These last two papers by Lenay and Alexandrov give food for thought to our community and enable us to understand better what is at stake in the digitization of objects and people; they highlight what is important in their nature as seen from a human perspective. And indeed the social science community needs new theoretical frameworks as well as new tools to analyze the changes at hand.

5 Cognitive technologies and its social impacts

Ten years ago, in a special issue of *Intellectica*[8] collecting papers from the first series of our seminars of the Cognitive Technologies program at Fondation Maison des Sciences de l'Homme, we wrote that this era would probably be seen, later, as the Middle Ages or the Antiquity of Cognitive Technology, and that there was not yet a clear dominant scientific paradigm to make sense of the upcoming digital revolution [Lahlou, 2000]. The big issues were cognitive overflow, and the transformation of work and consumption processes.

We are now in the next century; there are still no dominant paradigms, cognitive overflow is worse than ever, and we still hardly see where these transformations will lead us; the only thing for sure is that the technological wave announced by Toffler [1980] has amplified. At least, there is general awareness of the transformation, we gradually get more insight of the nature of the general evolution towards digital projection, of how it gets implemented in practice, and of the mechanisms of diffusion of this technically-driven cultural change. The issue is complex and needs cooperation of scientists, policy makers, and stakeholders.

The Cognitive Technology program tries to create a space for discussion between social scientists and the research community in ICT. The public of the seminars and symposia

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[8] *Intellectica*, 30, 2000/1. Papers by D. Kirsh, E. Hutchins, S. Lahlou, A.V. Cicourel, C. Heath P. Luff G. Nicholls D. vom Lehn, W.E. Mackay, M. Zacklad: 222 p.

from which these papers are extracted reflects the diversity of stakeholders in this transformation: scientists, industry, policy makers… and doctoral students who are the new generation of researchers in this field. The papers presented here are a sample of the large variety of social science research on the current transformation of society; but they all tend to take a constructive stand. Here social science does neither adopt an external and critical attitude towards technology, nor a consulting position to feed industry or commerce; but rather a cooperative attempt with technology stakeholders to construct a new installation of the common World, one that will be more sustainable and human-friendly, by raising awareness of the social impacts of technology. A common characteristic of the authors is that they make efforts to master the technological aspects, at least enough to be able to engage discussion with designers. They do not hesitate to use themselves these new technologies in their research; some of them even by getting involved in the very design of new technologies, at the risk of been considered as academic mavericks.

Obviously, this is still work-in-progress, but one conclusion we can already draw from this exercise is the necessity for trans-disciplinarity, between disciplines of human and social sciences, and even with life sciences and engineering. Another conclusion from these collected papers as well as in the vast corpus of research produced by the growing communities of social scientists working on ICT issues, is that new forms of action research, where social scientists join efforts with designers, are now emerging which may contribute to make the future digital world more human-friendly. This calls for more initiatives like this one supported by Foundation Maison des Sciences de l'Homme, which create space for constructive debates between research and the stakeholders of the social evolution in progress.

Bibliography:

BACH Y RITA Paul, COLLINS Carter C., SAUNDERS Frank A., WHITE Benjamin, SCADDEN Lawrence (1969). Vision Substitution by Tactile Image Projection. *Nature*, vol. 221, pp. 963-964, 1969.

GIBSON, James J. (1967). Notes on affordances. In: E . Reed & R. Jones (eds.) *Reasons for realism. Selected Essays of James J. Gibson*. London: Lawrence Erlbaum Associates, 1982, pp. 401-418.

GOODY, Jack (1977). *The domestication of the savage mind*. Cambridge University Press, 1977.

LAHLOU, Saadi (2000). La cognition au travail et ses outils : débordement, révolution, distribution. *Intellectica* 2000/1, n°30 : 7-17.

LAHLOU, Saadi, JEGOU, François. (2003) *European Disappearing Computer Privacy Design Guidelines V1 [EDC-PG 2003]*. Ambient Agoras IST-DC report D15.4. European Communities and EDF R&D/LDC, Oct. 2003. 8p. (www.rufae.net/privacy)

LEONTIEV, Alexis. N. (1975) *Activité, conscience, personnalité*. Moscou: Éditions du Progrès, 1975.

LEPPAMAKI, Sanna, LAHLOU, Saadi. *Approaching New Technologies: Representation, Anchoring, Action And Influence*. 7th International Conference on Social Representations. Guadalajara, Mexico, 10-14 sept. 2004. Clamart, EDF R&D. 19p.

LOMOV, Boris F. (1963). *Man and Technology* (Outlines in Engineering Psychology). Tr. JPRS 22300. US Dept of Commerce, Washington DC. Dec. 16, 1963. 307p.

NARDI Bonnie A. (Ed.), Context and Consciousness: Activity Theory and Human-Computer Interaction. Cambridge: The MIT Press.

NOSULENKO Valery; RABARDEL Pierre, (eds.). (2007) *Rubinstein aujourd'hui. Nouvelles figures de l'activité humaine*. Toulouse – Paris: Octarès - Maison des Sciences de l'Homme, 2007

RUBINSTEIN, Sergei. L. (1922) "Printsip tvorcheskoi samodeyatel'nosti (*Le principe de l'activité du sujet dans sa dimension créative*)" Uchenye zapiski Vysshei shkoly g. Odessy» (Notes scientifiques de l'école supérieure de la ville d'Odessa), tome 2: pp. 148 –154. Version française : Rubinstein, S.L. (2007) in V. Nosulenko et P. Rabardel (2007) pp. 129-140.

RUBINSTEIN, Sergei. L. (1957) Bytie i soznanie. O meste psikhicheskogo vo vseobshchei vzaimosviazi yavlenii material'nogo mira (*L'être et la conscience. De la place du psychologique dans les corrélations entre les phénomènes du monde matériel*). Moscou : Edition de l'Académie des Sciences de l'URSS, 327p.

STREITZ, Norbert, PRANTE, Thorsten, RÖCKER, Carsten, VAN ALPHEN Daniel, STENZEL Richard, MAGERKUTH Carsten, LAHLOU Saadi, NOSULENKO Valery, JEGOU François, SONDE Frank, Sonder, PLEWE Daniela (2007). Smart Artifacts as

Affordances for Awareness in Distributed Teams. In: Norbert Streitz, Achilles Kameas, Irene Mavrommati (Eds.) *The Disappearing Computer: Interaction Design, System Infrastructures and Applications for Smart Environments*. Heidelberg: Springer,. LNCS 4500, 2007. pp. 3-29.

TOFFLER, Alvin (1980). Third Wave. New York: Bantam Books.

UEXKÜLL, J. Von (1956) Streifzüge durch die Umwelten von Tieren und Menschen – Bedeutungslehre. Hamburg: Rowohlt Verlag., 1956.

YATES JoAnne., ORLIKOWSKI Wanda J. (2006). The PowerPoint Presentation and its Corollaries: How Genres Shape Communicative Action in Organizations. In: M. Zachry & C. Thralls, *The Cultural Turn: Communicative practices in Workplaces and the Professions*. Amityville, NY, Baywood Publishing, 2006.