Digitization and transmission of human experience

Article (Accepted version) (Refereed)

LAHLOU, S. (2010). Transferring Human Experience: Issues with Digitization. *Social Science Information*. Vol. 49, n°3, 2010. pp. 291-327. Sept 2010. Draft version.

Saadi Lahlou

Digitization and transmission of human experience.

Abstract: Transmission of human experience is essential for many purposes. It has two aspects: content and social relation. Digital technologies can solve some of the classic issues in capture and transmission of human experience.

Based on these new technical affordances, this article presents a framework to capture and describe human activity and experience based on video and cooperative explicitation of activity trajectories with the subject, using a transition model inspired from the formalism of dynamical systems. The article also introduces this special issue “Digitize and Transfer”, and gives an overview of its papers.

Key words: Activity theory --- Cognition --- Dynamical systems --- Experience --- Expert --- Explicitation interview --- Goals --- Information and communication technologies --- Knowledge --- Kommunikatsiya --- Novice --- Obschenie --- Observation --- Phenomenology --- Self-confrontation --- Subcam --- Transition

Résumé. La transmission de l’expérience humaine est un enjeu fondamental pour l’espèce. Elle a deux aspects: le contenu et la relation sociale. Les technologies numériques peuvent résoudre certains des problèmes classiques de la capture et la transmission de l’expérience humaine.

En s’appuyant sur ces nouvelles possibilités techniques, ce document présente un nouveau cadre pour capturer et décrire l’activité humaine et l’expérience. On utilise la vidéo et un entretien d’explicitation des trajectoires d’activité avec les sujets, en faisant appel au modèle des « transitions » inspiré du formalisme des systèmes dynamiques.

Ce document introduit également ce numéro spécial “Numérisation et transfert”, et donne un aperçu critique des articles qui le composent.

Mots-clés. Auto-confrontation --- Buts --- Cognition --- Connaissances --- Entretien d'explicitation --- Expérience subjective --- Experts --- Kommunikatsiya --- Modèle des transitions --- Novices --- Observation --- Obschenie --- Phénoménologie --- Subcam --- Technologies de l’information et de la communication Théorie de l'activité --- Théorie des systèmes dynamiques

1 Introduction

Sharing individual experience is at the basis of culture, and also of group belonging. We all learn from other people’s experience. This is a characteristic we share with other social animals: for example rats will observe their conspecifics and choose or avoid the same foods (Strupp & Levitsky, 1984). This way of learning through the transmission of other’s experience of course has adaptive value (in this case, avoiding poisonous foods). In fact

social animals have developed empathic competences, which enable them, to some degree, to make sense of the overt behaviour of conspecifics in terms of their own experience. Humans are capable of empathy (see (Hatfield, Rapson & Le, 2009) for a review); and, on the other hand, *Homo sapiens* has developed sophisticated innate signalling systems to express these emotions to conspecifics (Darwin, 1872), which all humans can decode (Eibl-Eibesfeldt, 1967). Recent research suggests that humans and some other primates have inbuilt cognitive systems ('mirror neurones') which enable them to *feel* the movements of other primates whom they see acting and to automatically infer the *intentions* behind these movements (Gallese et al., 1996; Rizzolatti et al., 1996; Rizzolatti & Craighero, 2004; Keysers & Gazzola, 2006). These capacities facilitate learning in presence and by imitation. They are powerful, but are somewhat limited by the fact those who share experience must be co-present during the event.

It must be noted here that this sharing of experience is crucial in the constitution of groups. In the short term, sharing experience (and especially emotions) is a strong constituent of *participation*. In the long term, what builds a community is the sharing of experience; and believing that this sharing is for the long term (hence the creation of a common mythical past and belief in a common destiny or project). Rituals are typically moments where this phenomenon of participation is strong and can guide our intuition as to what kind of 'sharing' feeling humans enjoy. In sum, transmission of experience has a social dimension that goes beyond the mere transmission of information --- we shall come back to this later in the section with the notion of *obschenie*.

However, *Homo Sapiens* has gone one step further and developed a symbolic system of representations which, precisely, goes beyond this limitation of *physical presence*. Language, and more generally *representation* (re-presentation*)*, enabled humans to transmit some of the experience of objects, situations, intentions, etc., and the potential actions they carry beyond the 'here and now' in the physical absence of the object. For example, the person who has been in contact with 'a tiger' can describe, explain, teach what 'a tiger' is, and what should be done when one is met; all this in the comfortable absence of a tiger.

This has a cost: representations are a projection of the original phenomenological experience of the individual into a conventional, social, typifying, symbolic system; which is why we use here the term 'experience' and not 'knowledge' or 'information'. The latter terms refer to culturally processed products, which have gained in social intelligibility but have lost some of the multidimensional aspects of primary, direct, bodily *experience*.

Representations are pervasive in our lives because our societies hold, construct, and are continuously reconstructed by these representations (Berger & Luckmann, 1967; Moscovici, 1976). Representation systems carry their own affordances, which may open new cognitive possibilities, as (Goody, 1977) showed for writing and Wells (in preparation) shows for literacy. But representations also carry biases: for example, the structure and vocabulary of a language may influence the way people experience the world (Whorf & Carroll, 1956). Therefore, changes in our capacity to represent and transfer human experience will have deep and pervasive consequences at the societal level.

Precisely, *digitization has suddenly and massively increased our capacity to represent and transfer human experience* by empowering us to represent new aspects which

were difficult to represent before (e.g. movements, space) and to provide new perspectives (e.g. bird's eye, first person, slow motion, acceleration, high magnification etc.); as well as by greatly increasing the scope and speed of diffusion of such representations (through the Internet, etc.) while decreasing the marginal cost of such diffusion to almost zero.

In addition, digitization, because of the pervasiveness of networks and of the user-friendly interfaces to the networks, now enables interactivity. Representations are continuously updated, amended, discussed, referred to in a collective-authorship process for which new instruments are growing: digital fora, wikis (Wikipedia being the most spectacular example), social media, etc. Academia and professional training are now starting to put into practice these new tools, as was predicted; but the evolution is slow because these institutions must change models that took centuries to construct with the previous techniques.

It is obvious that this change of representation systems will (and already has begun to) massively change our societies, as the printing press did in its time. It may be interesting therefore to search for the fundamental drives that are at stake and which will orient the evolution of a technology that could virtually, in this domain, do anything. We forward here the hypothesis that, because humans are social beings, *we wish to share experience more than we want to transmit knowledge*.

This statement refers us back to two aspects of communication: content and sharing. The distinction is not new: these aspects are explicitly separated in the Russian theory of communication: *kommunikatsiya*, which refers to the informational content --- content in the western tradition (Shannon & Weaver, 1949) --- and *obschenie*, which refers to the social, sharing aspects(Lomov, Belyaeva, et al.1985; Lomov, 1978, 1979; Nosulenko & Samoylenko 1997).

Indeed, this concept characterizes a specific area and sophisticated research in the Russian psychology. The term 'obschenie' incorporates several meanings of the term 'communication' as, for example, 'Human Relations', 'interaction between individuals', 'pooling' and finally 'sharing' in the spiritual sense …. In this perspective, communication is increasingly seen as not only a way to 'convey information', but also as social interaction and as a means of investigating the psychological characteristics of the other. (Nosulenko & Samoylenko 1998: 5)

Social aspects of communication, and the role of experience sharing in group participation mentioned earlier are obvious in the way Internet chat and other 'social' media (Facebook, etc.) are used. Although there is a lot of information transmission, a large amount of the direct 'communication' is made of 'phatic' statements (Malinowski, 1923) and of sharing moods with various devices or emoticons. In social media, the main goals of *obschenie* statements seem to be to signal that the individual is there, as a member of the group, and willing to share her/his experience ('I am doing this'; 'I just did that'; 'I am willing to display my experience'). In fact, even mobile-phone conversations often start with some statement of where the speakers are, which is usually irrelevant to the *kommunikatsiya* aspect of the conversation, but crucial for sharing experience.

As we provide humans with very open affordances for communication, their actual behaviour and choices among all the possible combinations reveal to us what is really important for them: *attending to the group*; and this grounds our hypothesis. In digital mediated communication, as in real

life, the relation seems to be more important than the content. This does not mean that there is no *kommunikatsiya* in the social media*,* but it usually comes with *obschenie*. Furthermore, this is precisely the reason for the success of the social media and their future business model as (social) sources of (commercial) information. Humans prefer to learn with someone rather than from some document, as has been made clear by the success of training by peers over using manuals in information technology. In fact, the preferred information is the one that comes from –and with- a 'good' group or source.

The interplay of *kommunikatsiya* and *obschenie* is complex because, more often than not, being a good information provider (providing snappy answers in fora, having the good Web links first) is a strategy to gain social status: in the end, the social motive takes over and instruments all others. Here we see applied in the Web a theory that was worked out by Dessalles for the development of conversation and the origin of language: displaying skills in managing information and transmitting experience to others is valued as a positive selective trait for the skilful individual, since it signals him (her) as a good coalition partner (Dessalles, 2007).

Digital technologies are better at affording *obschenie* than conventional symbolic communication techniques because of their quick reaction time and interactivity, and this feeds their growth. It is likely they will be used in the future for other aspects of experience sharing, to transfer more and more multimodal, intimate aspects of individual experience; and to build communities, at the same time as they grow as communication systems in the sense of *kommunikatsiya*.

In this context, this article will first introduce this special issue with a quick overview of the papers, and how they fit in the problematic of the impact of digital technologies on the transmission of knowledge; and then suggest a model for transferring human experiencen using the affordances of these information technologies.

Section 2 introduces the papers in this issue. Section 3 addresses the difficulties in the transmission of human experience, due to its nature. Section 4 shows how digital technologies enable us to resolve some of these issues, but reminds us that these new solutions also raise new issues. Section 5 proposes a new 'transition' model to structure the capture and description of human experience using the affordances of these information technologies.

2 Digitize and transfer

This issue of the Journal is taking a closer, grounded, look at how the process of capture and transmission of human experience and knowledge will change with the advent of new digital media.

The core functional question of culture from an evolutionary perspective is: How can the species foster the outcome of experiencing the world so that the next generation behaves more efficiently? Trial and error was the biological way of natural selection: the fittest survived and reproduced (Darwin, 1859). Culture uses a dual selection process, where artefacts are selected by trial-and-error reality test (in society, on the market, etc.), while their representations are selected by *thought* experiments and discussions, under institutional

monitoring and control (Lahlou, 2008a). Now, with the diffusion of digital technologies, institutions have started indeed reflecting on how to put to use these new affordances; they have begun their social-monitoring process of these technologies.

Science is exploring what these new media make it possible to transfer: see in this issue (Barabanschikov 2010), on the transmission of digitized faces, and Cordelois (Cordelois, 2010) on new ethnographic techniques. It also creates and tests new media, like *Mobltz*, to make the best of the new affordances and create new types of multimedia narratives (Lewis, Pea & Rosen, 2010). Smaller institutions concerned with production develop new solutions to capture and transfer their cognitive capital. Industrial corporations are interested in the transmission of professional know-how (Le Bellu, Lahlou & Nosulenko, 2010); while research centres and academia are trying to archive research data and results (Habert & Huc, 2010). Will new forms of narratives succeed in fulfilling the function that stories have always had in society (Garcia-Lorenzo, 2010)? The effect will certainly be global, but, at this point, it is unclear whether the result will be a liberation or a nightmare --- maybe both --- since, as Ganascia points out, we can already see massive positive and negative effects of what is clearly a change of societal paradigm caused by the digital projection (Lahlou, 2008a) of all elements of the 'classic' world into its continuously updated digital representation.

2.1 Framing uncertainty: Narratives, change and digital technologies.

Lucia Garcia-Lorenzo traces a broad cultural analysis of narratives, from developmental aspects to organizational studies. While the roles of narratives in the transmission of knowledge has always been recognized, their role as instruments of community building, ensuring permanence of the group, and of reassurance of its members in the face of uncertainty is less often described. Illustrations are taken from three empirical case studies in the corporate world by Garcia-Lorenzo (the take-over of a national company by a multinational corporation; a British-Swedish merger; and a virtual project team whose members are distributed around the globe).

Reading Garcia-Lorenzo, it becomes clear that narratives are social-psychological processes, of which the manifest content (the story) is only one part, the activity of storytelling being a crucial aspect. In moments of uncertainty, when the organization must find psychological and social resources to face change, (re)creating and telling narratives provides group members with resources to manage emotions constructively, link with the past and provide a framework for self-development. Garcia-Lorenzo shows with empirical illustrations how people create narratives to make sense of their world and especially by making boundaries.

She also shows that the relation of storytelling with digitization is complex. On one hand, traditional storytelling is challenged, and new technologies produce a fragmentation and plurivocity in the organization. On the other hand, these technologies provide affordances for a new networking culture and new forms of circulation of stories.

2.2 Beyond participation to co-creation of meaning: mobile social media in generative learning communities

Sarah Lewis, Roy Pea and Joseph Rosen describe a new system for sharing experience between individuals, with Mobltz, an amazing hybrid of blogs, social networks and video-streaming. Beyond the technological revolution of enabling seamless mixes of text and video, Mobltz is remarkable in its interface target: the mobile phone. This goes hand in hand with the growing trend of being 'always on' and closely connected to the digital network by reporting actions and thoughts, and contributing to a collective construction online and on the fly. This system gives a preview of a future society where communication of experience with fellow humans is continuous and mediated by the Internet in a multimodal format that encompasses all senses. The authors' ambitious reflexion, grounded in activity theory, on new modes of online presence and discussion sheds new light on the social-media hype. The public sphere described by Habermas, at a time where language was the main vehicle for discussion and when publication was a long and usually reflexive process, is now becoming a multimedia arena where anyone can contribute at anytime with very low entry barriers.

2.3 Capture and transfer the knowledge embodied in a professional gesture

Sophie Le Bellu, Saadi Lahlou and Valery Nosulenko present a systematic attempt to capture and model professional gestures (here, in the context of operating machines in power plants), to transfer them from expert to novice. While they use the Subcam, as well as more-classic recording equipment, it soon becomes clear that cooperation with the professionals who are filmed is a critical aspect of their technique, in order to capture the goals and sub-goals as well as the local decision-making process. Their article, which presents the state of the art, while giving a clear and exciting vision of what is obviously the future of professional training, shows that we are far from having solved all the theoretical and technical difficulties of 'how to get there at low cost'. It also points to a rising new paradigm of collaborative construction of knowledge, where the distinction between author, subject, critic and user gets blurred. Indeed the construction, maintenance and use process of the new information tools seem to involve inputs from all the stake-holders in continuous work in progress, in sharp contrast to the former 'book-publication' mode.

2.4 Using digital technology for collective ethnographic observation: an experiment on 'coming home'

Antoine Cordelois describes a collective process where individuals are empowered to collectively reflect on the action of one of them, by sharing the subjective view of his actions as recorded by the Subcam. While this is a first attempt, and is only used at this point for research purposes, one can think that such a process may generalize to other collective situations: learning, training, but perhaps also trials, entertainment, decision-making support, etc. While we usually tend to consider each technological innovation separately to evaluate

its impacts, Cordelois' article provides food for thought by showing how the combination of two techniques (here: the subjective-recording with a Subcam, and collaborative online editing with Diver) can generate ground-breaking innovations in a classic process (here, the ethnographic analysis).

2.5 What does the transmitted image of human face tell an observer about personality traits

Using the experimental techniques of psychology, Vladimir Barabanschikov studies what subjects are able to infer from the psychological traits of other humans by looking at their photo. Are the judgments based on photos correct? To ascertain this, he uses Cattel's scale of 16 personality factors (e.g. emotionality, reliability, self-reliance, etc.), and compares these assessments with the direct assessments of the photographed persons themselves (approximately 40% of the traits are estimated correctly; there are some differences in the results based on gender, and also on the viewer's own personality). On that basis, which gives us an idea of the interpretation capacities of humans, we can now evaluate the impact of partial transmission.

When the face is partially masked, there is little difference in accuracy when the left- or right-hand sides of the face are showed alone; but when only the top part is showed, there is a marked decrease, and even more if only the lower part is shown. What this means for the issue of digitization is that (a) what is perceived from an image is different from what the person thinks of herself and also probably different from 'reality'; (b) the capacity to transmit accurate information about the other's personality depends on the integrity of the medium. Although this may seem a 'half-full-glass' result, it does suggest that transmitting better images will produce better understanding of the Other.

2.6 Building together digital archives for research in social sciences and humanities

Benoît Habert and Claude Huc describe a recent institutional attempt, by the French national research agency, to create a digital archive of a scientific domain. In this case, spoken data (which 'mainly consist in dialogs or monologs recorded for linguistics research') were used as a pilot domain. In contrast with Garcia-Lorenzo's paper on narratives, this project, inspired by similar initiatives in physics, shows a computer-science approach to the issue of transmission. The project explored how systematic digital conservation could be applied to the field of social sciences and humanities, using a standard abstract model for archival information systems.

This article, which includes reflection on the nature of archiving and patrimonial strategies, is especially valuable because it provides an insider view, having been written by two main leaders of the project --- it is exceptional that project leaders make the effort to reflect on their practice as builders of a new socio-technical system. The analysis shows how institutional and technical logics can influence process, and the importance of administration and project management, as attested by the number of acronyms representing institutions and systems involved. This contribution is interesting as an example of a deep reflexive exercise by the engineers of the new institutional digital system. It gives food for thought on

how to organize in the future such large conservation projects and how to involve the relevant communities.

2.7 The generalized 'sousveillance' society

Jean-Gabriel Ganascia addresses one major consequence of the generalized transmission of experience through digital means, which he describes as the birth of a 'Catopticon', which makes everybody capable of communicating with everybody. This new situation, introduced by the internet and the generalization of both surveillance and 'sousveillance' (where the citizens themselves observe the system) by electronic means, contrasts with the previous situation and the model of the Panopticon (where one powerful watchman could watch all the inmates at all times). Ganascia explores the consequences of this emerging paradigm in terms of power and democracy.

This post-Foucaldian analysis is illustrated by a series of recent societal cases, and, among other seminal thoughts, shows how this Catopticon, on one hand, gives increased power and agency to single individuals (for example, a single individual can victoriously fight a powerful corporation) and, simultaneously, captures them all in the pervasive control system of a net which never forgets. In describing the emergence of this new power entity, which is distributed, overwhelming and uncontrollable, Ganascia shows us that new issues are emerging, such as the desire for visibility in a world of information overload, the right of access to information, the construction of cognitive authority and new rules for the political game.

As we can see from these very diverse papers, new societal questions are emerging with the changes introduced by these new technologies. Some of these questions would have not been imaginable twenty years ago, and this is a sign that a change of paradigm is taking place, prompted by new techniques of capture and transfer, which are changing the contents and formats of relations between humans, which are the very fabric of our societies.

3 Transmitting human experience

Human experience is difficult to capture and transmit because it is multimodal, embodied and situated, passive and active; because sense making is subjective; because action is distributed; because observation may modify behaviour.

If the hypothesis that we ventured in Section 1 (*'we wish to share experience more than we want to transmit knowledge'*) is correct*,* the future will see an increased demand, and offer, to share human experience by means of digital technologies.

In this context, there arise the questions of what exactly is human experience and how it can best be transmitted. Progress on these questions may help individuals capture and transmit their own experience. It may also help systems designers, industry, policy makers and (let's face it) business. It is precisely for this last reason that we should be aware of what is intimate and must be preserved in this transmission, and as soon as possible set

some ethical principles before a technological *fait accompli* presents us with almost irreversible situations (cf. Facebook and its privatisation of personal data of millions of youth who wanted to share their experience).

'What is human experience?' This is a difficult question if it is not asked with a specific purpose. We decided to leave aside the difficult philosophical issues of phenomenology and relativism, to cautiously ignore post-modernist critical stance and to avoid getting into detailed ethnomethodological discussions. Our approach will instead be to explore how we can share this human experience *in practice*. In doing so, we will venture an imperfect model, which owes a lot to activity theory, distributed cognition and functionalist perspectives in anthropology; a model which we hope will fuel a constructive discussion among theorists and practitioners.

Let us start by examining some characteristics of human experience and how these impact the issue of capture and transmission.

3.1 Human experience is multimodal and situated

Human experience is multimodal because we exist on several levels simultaneously. The most obvious factor of multimodality is the diversity of our sensory organs: we see, hear, taste, smell, touch and act. In fact, talking about five senses is a strong reduction. Kinaesthesia involves all muscles. We see, hear, and smell in stereo. Taste involves several receptor systems. A more detailed analysis shows that we are constantly aware, at some level, of a considerable array of variables, from temperature to muscle tension and hormone levels. And of course, we have a mental and emotional life. All these parameters participate in our experience of the life-world; they contribute to explain why we behave as we do and how we make sense of situations. And these different types of input are irretrievably integrated into one single multimodal experience in the mind: mono-modal aspects cannot be, even at the neurone level, separated from this holistic experience. This is why, for example, a white wine coloured with a red (and otherwise neutral and tasteless) colouring will 'taste' like a red wine (Brochet, 2000).

Because perceptions are embodied, experience is situated: we live it from our point of view in space and time and in our lived body. Only recently (Suchman, 1987) has science realized the implications for our cognition of the fact that we must *in practice*, continuously react on the fly, as we are carried along by the flow of events; in contrast to the distantiated and un-involved *theoretical* perspective. If we want to understand experience, we must seize it 'in the wild' (Hutchins, 1995a), in the flow of life, and not by a mere account *ex-post facto*, which, as we know, is a reconstruction, as are theories based on introspection alone. It is the difference between practice and theory.

This calls for a capture of experience *in situ*: from the perspective of the actor, in its very body. This is easier said than done. For example, as we discovered through experiment, filming from the exact perspective of the retina produces a different effect than from, e.g. a camera attached to the forehead. The latter provides the perspective of someone slightly taller, and does not match with the subject's own perception. Alignments and occlusions are

not rendered correctly, neither is eye contact; and the respective height of subjects, which is an important factor in interpersonal relations, is lost.

And of course, situated means both in place *and* time. This means that experience must be recorded as it emerges on the fly. As a consequence, the decision to wear a capture device must be made in advance of the event to be observed.

3.2 Human experience is both passion and action

Strangely enough, philosophy has focused mainly on experience as a passion with the description of perception and emotions; but its motor aspect (action) is just as important. First, even perception is an activity because it results from an exploratory action with the sensory organs (Gibson, 1963; Leont'ev, 1976; Lenay, 2008). *Attention* is the behaviour by which we orient our sensory systems to the environment; in doing so, we select some specific aspects and scotomize the rest. Many psychological experiments on the 'priming' effect, where the attention of the subject is selectively tuned to some aspects by providing her some cues prior to the stimuli, show how powerful this selection is. One can be in a situation and remain completely unaware of the aspects to which one is not 'paying attention'. This phenomenon, called 'inattentional blindness' (Mack & Rock, 1988), has led to many a spectacular experiment of which the most famous is probably the 'gorilla' experiment (Simons & Chabris, 1999), in which subjects are shown a video of two basketball teams (one dressed in black, the other in white) and asked to count the number of times the white team passes the ball. In the middle of the film, a man dressed in a black gorilla suit slowly passes through the group and waves at the camera; but half of the subjects do *not* notice this when they see the film. When watching a second time after being warned about the gorilla, they all notice it and can hardly believe it is the same film they already saw.

While the orientation of sensing in a specific direction is fairly easy to render with mechanical sensors (e.g. directional microphones), it is less easy to render the interpretive selection mechanism operated by the mind on the raw data (e.g. the capacity to tune in to a specific conversation in the noisy environment of a cocktail party). The only access we can have at this point seems to be to ask the subjects what their interpretations were.

3.3 Sense making

There is no perception *per se*, we always perceive 'something', that is, an object. What we *experience* are objects, intentions, situations, and not a series of perceptions. Therefore, simply capturing a flow of physical parameters will not be appropriate; we must capture the *meaning* of the experience. And to be understood, this meaning must find anchoring (Moscovici, 1961) in the representations of the receiver. Therefore, in this case more than ever, we should apply the postulate of adequacy:

> Postulate of adequacy. It may be formulated as follows: each term used in a scientific system referring to human action must be so constructed that a human act performed within the life-world by an individual actor in the way indicated by the

> typical construction would be reasonable and understandable himself as well as for his fellow man. (Schütz, 1976: 19)

3.4 Action is distributed

Human action is distributed. For example, in a scene happening in a restaurant, many local actions are relevant: what happens at the tables, but also what the waiters are doing in the dining room, what they are doing backstage, and what the cooks are doing because all these are connected in a functional chain. And indeed each stake-holder to some extent takes into account what the others are doing in order to act properly. Therefore, a full explanation for the sake of education or transmission should provide the whole picture, and the way to construct the whole picture in a methodical and systematic way is the job of the scientist, who should not *only* rely on what his informers tell him.

> We would certainly be surprised if we found a cartographer in mapping a town restricting himself to collecting information from the natives. Nevertheless, social scientists frequently choose this strange method. They forget that their scientific work is done on a level of representation and understanding different from the people in daily life. (Schütz, 1942: 67)

A representation of the whole situation, as the state of things and beings that surround us, is necessary to understand what was at stake in the experience that is being transmitted. While Schütz (Schütz, 1942) is quite right that the scientist should not limit herself to what the subject says, this part is still essential to understand what is at stake, and what are the values of the stakes; and in fact later in the same paper, Schütz writes, commenting on the example of a businessman who runs to catch the same train he takes every morning, in order, this specific day, not to loose an important contract: ‘Let us assume that an observer watches this man rushing for the train “as usual” (so he thinks). Is this behaviour planned, and if so, what is the plan? Only the actor can give the answer because he alone knows the span of his plans and projects’ (ibid.: 76).

Indeed the actual components of the activity may not be obvious for an external observer. Sometimes the operator will use a proxy to evaluate the situation of an invisible element, e.g. the wheels of a vehicle: in the Pantanal (a wetland region in Mato Grosso) our guide Douglas Trent, as he drove his Volkswagen minibus over approximate bridges made of a couple of raw tree trunks, used to say (once the bridge was crossed) with the smile of the successful expert: ‘It’s good to know where your wheels are!’ How could we transfer his actual experience of crossing a bridge without accessing his internal representation of the situation and how risky he felt it was, knowing what he knew about bridges, wheels, minibuses, crocodiles and piranhas?

This is why the description may need to go beyond a mere film of what a given subject ‘sees’. As we said, the subject’s attention focuses on specific aspects of the situation. But this does not preclude the subject’s taking into account other aspects of the situation. The aircraft pilot is aware of the position of the undercarriage; the train driver is aware of his

passengers --- even though he does not see them; and in fact these are important elements in their decisions.

We believe that this context as viewed by the subject should be described in a 'naive realistic' manner. First, even if every experience is subjective and situated, common sense assumes realism: the subject believes that the context is 'out there'. Therefore, for the sake of communication in practice, we shall do 'as if' it was indeed 'out there', and provide an 'objective' description of the scene, sticking to common sense.. This is not always satisfying in theory, but is handy in practice. [2].

3.5 Observation may modify behaviour

If the subject is aware of being observed, observation may modify the behaviour. This is especially obvious when the observer is present in situations where private interactions take place.

When observed, subjects tend to stick to the rules of the group. In fact, what matters is less the presence of the observer herself than the group she represents. This is why it is still possible to get good observations when the subject is promised confidentiality ('only the observer will know'). If the subject does not fear being seen misbehaving by the members of his in-group (e.g. the viewers are from another group; or the subject thinks his behaviour is acceptable, or has a status such that it does not matter, etc.), then the effect of observation is minor.

There are also possible implications of the fact that the subject knows that his behaviour will be traced by automatic instruments. Nosulenko, Pavard, Rognin, & Samoylenko (1993) provide an interesting example of such a case, in which operators in a space-mission control centre had to go away from the official –and traced- communication system to solve a problem in an unconventional manner, and then denied having done so.

Finally, as observation is also the result of attentional focus, the way the recording is done by the observer may modify *the representation of* behaviour. Depending on the camera angle or when the film starts, interpretation can be completely reversed. For example, during our conversations about activity recording with British police, one stated that one time his attempt to help a very agitated drunk person was mistaken for an aggression, based on a video-tape made by a witness; hence he was put into serious trouble. Fortunately a video-camera on a pole had captured the whole scene from the beginning and from another angle, which enabled him to prove that the witness's interpretation was wrong, and saved the policeman's day.

More generally, observers from outside the community tend to have an ignorance bias and fail to capture elements that are critical to understanding the situation, while inside observers tend to ignore element that are inconsistent with the image they want to have of their community (Cicourel & Lahlou, 2005).

As we see, human experience is a complex phenomenon to capture, and to transfer. There are still more issues in capturing and transferring human experience: some crucial elements

are tacit, holographic (distributed in communities) and transient: Garcia-Lorenzo addresses some of these problems in her paper in this issue.

Nevertheless, even if it seems very difficult to capture and transfer human experience in theory, we manage to do it in practice on an everyday basis. And digitization will now enable us to solve some of these issues and make the process easier, as we shall see in the next section.

4 Digital technologies, capture and transmission

Digital technologies, and especially digital video, have already brought considerable changes in the social sciences. The use of image had brought a first revolution in qualitative research by providing a whole set of new investigation techniques (Bauer & Gaskell, 2000). The technological progress of digital video, streaming, automatic indexing, online editing and analysis, and computer-supported collaborative work have taken it a step further (Pea,1994, Pea 2006; Cordelois, 2010).

Digital ethnography enables both better study of 'classic' interaction and study of IT-augmented environments (Hollan & Hutchins, 2009). This is welcome, since, because of the 'digital projection' (Lahlou, 2008a) of activity, many of the new interactions are happening in digital space (e.g. on the computer screen), where classic observation systems could hardly follow. As we said earlier, digitization brings new affordances and relaxes some constraints.

4.1 Digitization relaxes some constraints

As Pink points out:

> Recently, uses of video in ethnographic research have developed in tandem with new technologies, innovations and theoretical perspectives. Shifts from a realist approach to video as 'objective' reality to the idea of video as representation shaped by specific standpoints of its producers and viewers have encouraged the development of collaborative approaches to the production and interpretation of video images. The introduction of digital video and computer-based techniques seems particularly appropriate for the development of these methods and is forming the basis of future development in video research. (Pink, 2007: 116)

Situated and multimodal capture has now become possible. Wearable sensors can capture most of the biological parameters of the human body. Unfortunately, for most of them the replay does not re-present the experience adequately: seeing electric signals of blood pressure or brain scans does not enable us to re-live something of the experience. This is a problem of representation format. But at least for image and sound, and also to some degree for haptics and smell, we have found ways of re-presenting the experience: when we see films, they make sense and we can understand the situation. This is a direction for research, and some amazing results lead us to expect future progress in multimodality replay, since subjects can learn to use other neural pathways to the brain for the input of sensory

information (Bach-y-Rita et al., 2005). But at least for the time being, we can rely on video-cameras and audio.

Especially interesting is the possibility of getting a ‘subjective’ recording of activity. To understand the nature of situated cognition and activity, Lahlou set up in 1998 a method to capture a situated first-person audio-visual recording (‘subfilm’), using the Subcam --- a miniature video-camera with wide-angle worn at eye level --- and the interpretation by the subject itself of the films (especially the goals and emotions), obtained by asking the subject to comment their own subfilms (Lahlou 2006, 2009; Le Bellu, Lahlou & Le Blanc, 2009).

Figure 1 : A frame extracted from a subfilm (filmed with a Subcam)

Unobtrusive, wearable sensors. Using wearables, as the subject becomes her/his own observer, partly solves the problem of modification of behaviour by the observation. The subject feels like an observer as well as an ‘observed’. This seems to make the subject feel more in control of her data, especially if, as we do in our protocols (Lahlou, 2006), the subject sees the data first and only hands them over to the researcher if (s)he is satisfied with their content.

A subject recording her/his own experience with the Subcam is called a ‘subcamer’. The resulting ‘subfilms’ can be used for research, and be shown to others, enabling them to share the subjective experience of the subcamer as passengers in her/his head (Figure 1). Because the Subcam has a wide angle, it captures not only what the subject sees but also what s(he) does, at least with the hands; and what s(he) hears and says. We therefore capture a good view of the action itself, from a first-person perspective, with the correct eye--

hand synchronisation. Since the subject tends systematically to look at what (s)he is doing, the Subcam enables us, and this is not trivial, to capture the *focus of attention*.

Interestingly, as viewers are taken into the perception--action loop of the subcamer ('entheasy': sharing the contemplation of action), an identification process emerges and empathy occurs, based on *sharing similar phenomenological experience*. Although we do not get a fully multimodal recording, because experience is united in a single bundle, it seems that the elements recorded on tape are enough to elicit in the viewer an experience similar to the subject's. To what degree this is deceptive is difficult to know: in theory, this facilitated reconstruction effect is a double-edged sword, since my reconstructed experience of e.g. driving a car or eating macaroni will be phenomenologically different from yours, as they are the result of each of our total life-experiences. Once again, theory and practice diverge here. Experience shows that entheasy is quite different from empathy. As viewers, we precisely feel the small differences in the way the subcamer does things 'differently'. In fact, we get a feeling of detachment even when watching our own tapes. The result is an awareness of what the subcamer is doing (because we identify immediately the typified situations, and correctly infer typified goals), but there is still a feeling of strangeness. More research on this phenomenon is needed.

Moreover, confronted with their own subfilms, subcamers themselves show a remarkable capacity for remembering their actual mental states during activity (emotions, goals) (Lahlou, 2006). As they are re-immersed in the past episode with the same perspective from which they lived it, they gain direct access to their 'episodic memory' (Tulving, 1972, 2002). This is one of the most important features of our subjective recording methodology because it yields access to the cognitive aspects of activity.

The fact that reviewing images of the day is a powerful memory aid has been used by Steve Hodge and his colleagues: their SenseCam (Hodges et al., 2006) helps Alzheimer patients to remember their day and share memories with their partner.

Another line of development of wearables, pioneered by Steve Mann, is the continuous recording of one's own history with wearable cameras, to 'help us remember and see better, provide us with personal safety through crime reduction, and facilitate new forms of communication through collective connected humanistic intelligence' (Mann, 1998). This has also led to a democratic project to combat surveillance by keeping records of one's own perspective and therefore being able to oppose this individual perspective to the surveillance recordings: Mann coined the term 'sousveillance' for this inverse form of surveillance (Mann, 2004).

Sensors in the context, for example passive sensors at doors, access log-ins, and more generally any system keeping a trace of the subject's activity, as in the 'disappearing computing' systems which will be embedded in most home and office automation systems (Streitz et al., 2007), can contribute to creating a 'lifelog' that is a continuous trace of what the subject does (Gemmell et al., 2002). On one hand, this answers the issue of distributed activity (Section 0). But on the other hand, lifelogging, because it can be done without the observed subject's awareness, can cause massive privacy problems (Lahlou, 2008b).

In sum, wearables and distributed sensors provide silent, unobtrusive and continuous observation. Situated recordings enable explicitation of the mental states accompanying

activity by using self-confrontation of the subjects with the data. These techniques are employed by other authors in this issue (Le Bellu, Lahlou et Le Blanc, 2009; Cordelois, 2010). Unless they are used with the informed consent of the subjects, however, such techniques carry risks for privacy and freedom of action. Nevertheless, the Subcam and similar techniques of *subjective recording* open unprecedented access to human experience and insight into mental states. Not only can we get a realistic visual and auditory account of the situated individual experience of the Other, but also we can get detailed comments 'from the horse's mouth' on how this Other interpreted the events, what emotions were felt and what were the intentions behind the actions. The SHEOS project underway at the Institute of Social Psychology at the London School of Economics and Political Science is a global attempt to use these techniques to constitute a historical compendium of human experience for research purposes (SHEOS, 2010).

As such systematic transmission projects grow, it will become necessary to formulate some guidelines for the formats in which to capture human experience.

5 A new model for the description of human experience: 'transition' trajectories.

In the present issue, Lucia Garcia-Lorenzo gives an account of the history of stories and how they can be used in practice. Stories (or narratives) have always been a privileged mode of transmission of human experience. And this may be why all humans like stories, from their youngest age.

But why are narratives a privileged form of transmission of experience? Because from the perspective of the subject, the World appears continuously in the form of a 'story' of which the subject is the hero, in which the (s)he moves, acts, and meets objects and characters. This story is necessarily experienced in the form of temporal succession, and is focused on the conduct of the course of a single hero (the subject,) who imposes his vantage point. In other words, narration is not a specific mode of description, it is *the* archetypal mode of a subject's experience of the world. We tend to identify with the hero of the story because in our real-life story *we* are always the hero.

The narrative categories of temporal succession, places, scenes, characters, etc. correspond to the naive categories that the common man uses to describe the states of things in his subjective experience. It is not surprising that the theatrical metaphor used by Goffman works so well for describing everyday life (Goffman, 1959): the very narrative structure of drama is based on the categories by which humans make sense of their life.

Narratives are very powerful because they typify the story. The use of language, which is 'the medium of typification par excellence' (Schütz, 1951), ensures that listeners will be able to interpret what the narrative is about. When we say 'Albert sat on a chair and took his hammer'; the words 'chair', 'hammer', as well as the use of the verb 'to sit', refer to typified elements of activity that we can readily understand. Whereas getting, for example, Albert's brain electric signals, as captured by brain electrodes, would mean nothing to us. In other words, the narrative applies Schütz's postulate of adequacy (cf. above, 3.3).

The classic narrative created a 'narrative world' (Eco, 1979), made of typifications (objects, characters, props, etc.), where the hero would progress in a succession of actions

and solve problems within the framework of this narrative world in accordance with his motives. Therefore we, as spectators, would understand what happened by identifying with the hero.

Classic narratives were a great solution when direct, situated, subjective recording of experience was not available. Now that we have this new possibility, can we imagine a better format for the transfer of experience? This is what the following section attempts to do.

5.1 A systemic description of activity

Human experience is about experience of activity, so we need to describe activity. Activity is about transition between successive states of the life-world.

Dynamical-systems formalism is relevant for our problem because it provides a clean description of successive states of complex system. A dynamical system is a model to describe the evolution over time of a set of interacting objects, with the following conventions (Katok & Hasselblatt 1996; Daucé 2010):

--- A representation of state, which is, for each state of the system, the list of the ***m*** values of variables describing this given state. The space of all possible states is a manifold **M** of dimension ***m***, called 'phase space'. One specific state is represented as a point $\boldsymbol{x = (a_1, a_2, \ldots a_m)}$ of this space.

--- A transition function ***F***, which defines the state of the system at a given moment of time, from its states in the previous times. If the system is initially at a state ***x***, it will find itself after time ***t*** at a new state ***F(x, t).*** This function verifies: $\boldsymbol{F(x, 0) = x}$ and $\boldsymbol{F(F(x, t1), t2) = F(x, t1 + t2)}$.

The transition function can therefore describe the trajectory of the system in the phase space.

More precisely, the trajectory that has $\boldsymbol{x_0}$ for origin ($\boldsymbol{x_0}$ describes the initial conditions) will be defined by the application

$\mathbf{F_{x0}: T \rightarrow M}$ such that $\mathbf{F_{x0}(t) = F(x_0 , t)}$.

This associates a specific state of the system with each point in time. This function can be represented by a curve in the phase space, the trajectory formed by the points representing the successive state of the system, $\mathbf{F(x_0 , t)}$ as **t** varies.

These 'states' are constituents of activity in activity theory. A 'represented final state of the system' is a 'goal'. At any moment, the state of the system is 'the conditions given', which are the context in which the subject will try to achieve the goal. Therefore, trajectories in a phase space would map the actions (transition from one step to the next) or, rather, the results of actions as a modification of the state of the environment (external and internal).

In theory, a dynamical system is a very generic formalism that could describe any complex system, including the ones in which human experience takes place. In practice, in the current state of the art, we are only able to describe rather simple and limited systems of the real world, with a restricted number of variables (usually a few hundreds at most) connected by relatively straightforward relations (e.g. positive or negative feedback, etc.). This is too limited to describe the behaviour of an individual human in an open environment. Nevertheless, the basic principles of representation of dynamical systems can be used metaphorically to explain the subjects that an activity can be considered as "a trajectory in a state space", and therefore provide them with some guidelines as how to describe it. The interest of such an approach is that we ask the subject to describe his activity not simply as a

sequence of his own actions and decisions but *as the sequence of successive situations experienced in the course of activity*. This elicits descriptions that can be used by others to diagnose the situations and interpret them in terms of what can/should be done: their activity connotations (Von Uexküll, 1965). This is part of a functionalist approach to the transfer of human experience. Furthermore, such descriptions of situations facilitate the cognitive process of comparison (of situations). The cognitive mechanism of comparison is at the basis of the perceived-quality method (Nosulenko & Samoylenko, 2009) used to design operational changes based on user experience.

Put simply, without the mathematical apparatus: in a dynamical system, a state of the system is represented by a point in the mathematical space of all possible states; therefore an activity can be represented by a trajectory in this space. The trajectory starts with the initial situation. The subject in the initial situation has a goal, which is to find herself in another situation, hopefully the final state of the trajectory. Some points are intermediate goals, which the subjects anticipate as action steps in their activity trajectory.

Once this is understood, the subject should be able to describe the activity as anticipated ('thinking in the future perfect tense', to use Schütz's expression), even before starting it. Since a goal is 'a conscious description of this state to be reached', the subject is usually able to describe it, as well as the intermediate goals that are reached by action steps.

For example, if the initial situation is realizing that one has a flat tire while driving, a first action step might be to find a safe place to stop (sub-goal: 'park in a safe place'). Then another step will be to take off the wheel with the flat tire; another one to put on the spare wheel; another to get the flat tire repaired; etc.

Subjects will usually understand rather easily this idea of behavioural trajectory. When asked to describe their own trajectory and the 'action steps' they take, the idea of a trajectory will help them make their goals and decision points explicit (although they may tend to overemphasize the spatial aspect because of the trajectory metaphor).

Subjects can also be asked to describe the alternative trajectories that may be considered at decision steps. *For example, once safely parked, the subject may consider changing the tire herself, call the insurance to send someone to do it or use instant tire sealant.*

When the whole activity is developed, the result is some sort of tree of possible trajectories. It must be made quite clear that this tree does not necessarily exist *ex ante*; it develops as the subject progresses in the activity, and the alternatives, as well as their characteristics, unfold from what the subject finds in the situation itself. Experience shows that what happens is that the subject tends to follow routines, and only when the routine does not work as expected is the subject's awareness awakened and directed at the problem. In these moments, the subject tries to make sense of the situation, and the goal is often to find an alternative path to reach the initial goal. Figure 2 shows an example with the "flat tire", where a subject describes his story as a series of successive state (we took an example without video to make the discussion shorter).

A – Driving normally on the highway

B – Strange vibration in the steering wheel, car unstable, noise. Awareness that something is wrong.

B1. Hypothesis : road is damaged : visibly no

B2 Hypothesis : car is damaged (flat tire?) [alternative chosen]

C- Decision :

C1. continue driving (dangerous?)

C2. Stop immediately (dangerous if no parking space)

C3. Slow down and park as soon as safe place is available [alternative chosen]

D – Slow down and stop in rest area

E. Get out of car and check. Diagnosis : 'Flat tire'

– Decision :

E1. Fix tire with spare tire (big hassle: dirty, tiring, causes delay)

E2. Call insurance to send mechanic to change tire (unknown delay and cost)

E3. Fix tire with instant sealant (easy, fast, but damages tire and only transient solution) [alternative chosen/ done].

F. Drive slowly for 10 miles

G. Get to initial destination, but note that soon must go to garage to fix tire

Figure 2. The flat tire. Example of an activity trajectory described by steps, as a tree of possibilities (first and second level of branches only detailed).

Some of these trajectories lead into hazardous or unpleasant state zones, which the subject may be able to describe as state areas to avoid. For example, changing a tire on the side of a highway when the tire to be changed is on the highway side is a dangerous state area to be in.

The subject then can be asked to describe each sub-goal state as 'a situation', as if the subject 'was there' and was looking 'around and inside herself 360°' to describe the state of the various objects, and what affordances or risk may exist at this point. This is a subjective interpretation of the situation.

"This world, built around my own I, presents itself for interpretation to me, being living naïvely within it. From this standpoint everything has reference to my actual historical situation, or as we can also say, to my pragmatic interests which belong to the situation in which I find myself here and now" (Schütz, [1954], 1962 p. 134)

For example, in our 'flat tire' scenario, the situation when one is changing the tire on the road-side, with the cars passing just behind one, is indeed very uncomfortable. The 360° description of the situation will include both the aspects of the context (wearing the 'high viz' bright reflective jacket, park as far as possible off the road, etc.) and the internal goals (e.g. do things fast but methodically because the worst is to have to start over again; ask the children to leave the car and sit in a safe place, don't let the bolts roll under the car or onto the road etc.); but also the emotions (fear, frustration, determination etc.).

This technique of transmission of human experience, of course, can be applied purely verbally, as just shown, but we propose to use it in conjunction with a subjective recording methodology, like the Subcam protocol, in order to gather the cognitive elements needed to

understand the activity. The first step is to ask the subject to describe the activity, without looking at the film (step 1 below). This will train the subject to pay introspective attention to action steps and goals, and produce a tree of activity as in Figure 2.

Step 2 is to look at the film with the subject, and ask him to 'pause' the film [1] each time he wants to comment, and then to describe the elements of activity (objects, people, goals, feelings…) with the 360° exercise. This produces a series of commented clips, like the ones described by (Cordelois, 2010) or (Le Bellu et al., 2010). The format depends on the video software used. Figure 3 shows an extract of such analysis on a subfilm of a driver entering an underground parking lot, using the Diver software (Pea 2006). In this analysis, only the trajectory of the succession of the actual situations is shown, since the possible alternatives that were not chosen, of course, did not materialize.

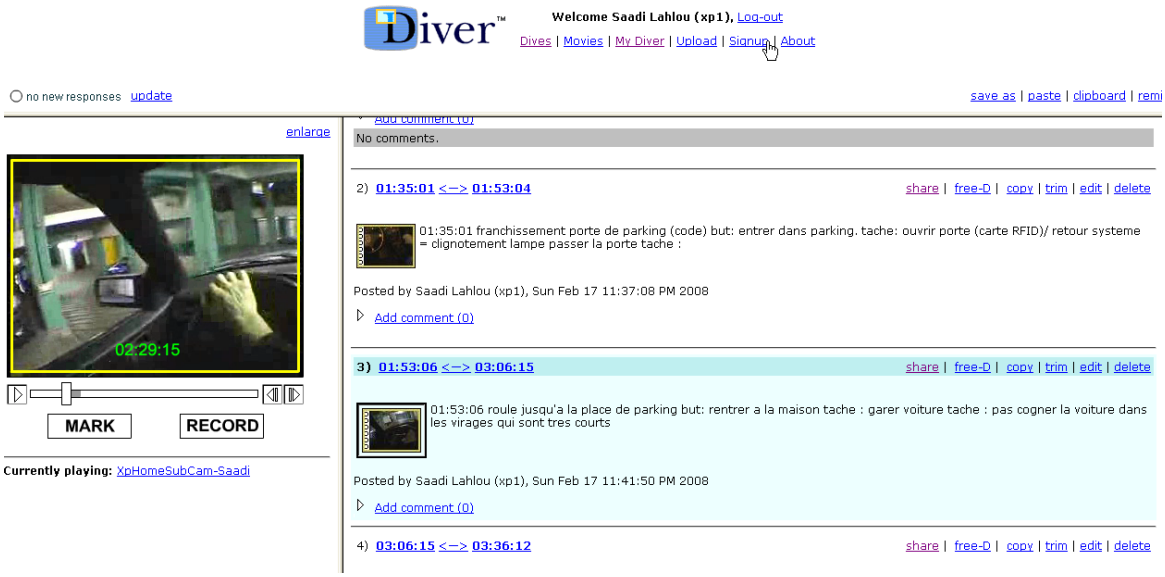

Figure 3: Example of analysis taken from step 2 using the Diver software

Comparison between the two steps, which will often be spontaneously done by the subject, is revealing of many important details or process. Here is an example of how to introduce verbally the subject to the exercise.

Phase 1: verbal description without self-confrontation with the film

I will ask you to describe your activity as a journey through different phases, just as you would describe a trajectory on a map. Think of the initial point as the situation where you start from, and as the end point of a situation at which you want to arrive (your goal).

We speak in terms of changes of situation; this does not mean that you move in geographical space, but rather in the space of situations. Can you describe the situation you want to reach --- your goal? To describe it, imagine yourself there: look around and inside yourself 360°, and describe what there is (what should be there).

Can you do the same for the situation you started from?

Now let us consider your journey step by step. What are the important action steps and the intermediate states you want to reach?

For each of them, explain if this is a decision-making point and what the alternatives are.

Phase 2: verbal comment of the film during self-confrontation

Please comment on the video as it plays; do not hesitate to pause when you wish to give a detailed explanation. Please also pause at each important step or decision-making moment to explain what your thoughts were at that moment and what were the important aspects in the situation. Use with the 360° look-around-and-inside method.

It is very important that these exchanges have some *obschenie* aspect: the subject should have a clear social motivation for explicating his activity and experience. If the subject is providing his description for a group he likes, then sharing will be a pleasure. The interviewer should therefore in some way represent or impersonate a community of liked recipients.

When the dynamical-system approach can be used more fully to draw some phase space this can provide great insight. It is difficult to get more than very crude 2-dimensional maps of such phase spaces, but even these can prove useful for exploring the psychological experience and the rationale of decision-making. Figure 4 shows such a crude 2-dimensional map, resulting from a discussion and several scribble attempts at drafting the domains the subject tried to avoid during the flat-tire experience described in Figure 2 (see explanation below). Note that this phase space did not exist as a mental representation before the explicitation exercise, and is instead a result of it. Still, it is interesting, and the subject can comment on some of its dimensions, e.g. here the fact that on the left side the ‘upset’ feeling grows, while to the right the ‘scared’ feeling grows; and that the ‘lower’ zones are more stressful than the ‘upper’ ones. Such maps can be used to position other events (e.g. here: ‘a collision’ in the BIG DANGER zone; ‘a major mechanical breakdown’, like the gear box, in the BIG HASSLE zone). It can also help subjects verbalize their feelings. Interestingly, the feelings can be attributed to the whole situation, and not to the subject’s own body. For example, in case of mechanical damage to their car (with no human physically harmed), some subjects still express the idea that it (the damage to the car) hurts them in their own body.

Figure 4: A crude phase space constructed around the ‘flat tire’ experience. The trajectory of experience (fat curve) and its steps refer back to the indexing of steps in Figure 2.

The phase space distinguishes the normal state of driving without incident, which is the staring state (ALL OK), step A.

Then, with the awareness of a strange noise and vibration, the subject reaches a zone of NOT OK. This is where step B (strange vibration in the steering wheel, car unstable, noise. Awareness that something is wrong) occurs.

Then the subject moves on to step C, which is a decision-making point (continue driving fast/ Stop immediately/ Slow down and park as soon as safe place is available). The first two options would lead into a HIGH DANGER zone, and the subject chooses the third (slow down until safe parking available), which moves the situation into a SMALL DANGER zone. Step D (slow down and stop in rest area) is on the border between SMALL DANGER and a new zone, SMALL HASSLE.

As the subject goes around the car and diagnoses the flat tire, he moves to E, which is a decision step (between E1. Fix tire with spare / E2. Call insurance to send mechanic to change tire / E3. Fix tire with instant sealant).

E is on the border between SMALL HASSLE and BIG HASSLE, because E1 is a big hassle (dirty, effortful and delaying); E3 is a small hassle (easy, fast, but damages tire and only transient solution), and E2 is borderline because the consequences are unknown (small or big hassle?).

As subject chooses E3, fixes the tire and restarts driving (slowlyat first to let the sealant dry evenly) he transits slowly through the SMALL HASSLE zone and finally, as he resumes driving at normal speed, goes back into the NOT OK zone, where something is wrong but where the solution is still acceptable: waiting for a definitive fix.

The model is not perfect (why would state F and state B be in the same NOT OK zone? Should we not distinguish two different subzones? Etc. But it gives a different insight into the subject's experience than the mere tree of Figure 2.

Finally, the dynamical-systems approach is useful because it enables us to describe a phenomenon we frequently observe: in some areas of the phase space, the subjects tend to get captured by 'cognitive attractors', that is the automatically, and almost against their will, get sidetracked into performing some other activity. A typical instance of this is 'doing email': when the subject opens her mailbox for a specific reason, she will tend to do a complete processing of all new emails. It seems that 'the situation has a momentum of its own'. These phenomena, which have been described elsewhere (Lahlou, 2000, 2009), are frequent to the point that we suspect a large part of ordinary activity is simply chaining execution of such 'attractors' as the subjects get into the situations proposed by their environment. Technically, in dynamical-systems formalism, an attractor is a compact set of the phase space, into which all nearby trajectories converge. The basin of attraction is the set of points whose trajectories converge to the attractor: in other words, a basin of attraction is a set of initial conditions that lead towards this attractor. When the phase space contains several attractors, each attractor has its own 'basin of attraction'. The separating varieties that mark the border between two basins are places of bifurcation, where the system can switch from one attractor to another.

The intuition behind the use of activity phase space as a metaphor to describe human experience is therefore very similar to the one that was at the basis of Kurt Lewin's dynamic psychology, and more particularly his field theory (Lewin, 1951), where the behaviour depends on the position of the individual in a life-world, characterized by force fields (although Lewin used different mathematical conventions, based on the physics of his time).

In practice, as we said, it is difficult to describe in a comprehensive way the phase space corresponding to the behaviour of a subject. So the concept of attractor, for example, will likely wait several decades before we can make quantified applications; nevertheless it remains usable in principle. An activity is a path in the lived world, a phenomenological tunnel of perception-action. It unfolds in time. At a given moment, it corresponds to a certain arrangement of objects around it and to the internal conditions of the subject (e.g. 'sitting at my computer, typing on the keyboard with my email open). When the subject is cruising her phase space, if her trajectory accidentally or deliberately crosses a basin of attraction, this action will tend to be executed. E.g. 'sitting at my computer, typing on my keyboard with email open' will most probably trigger an email session. As subjects are to some extent aware of this phenomenon, and of the 'autonomous momentum' that certain zones of the phase space carry, they can label these zones in terms of activity and of what states they will probably lead into (e.g. danger zones, etc.).

Once again, it is the job of the interviewer top make this latent knowledge that the subjects have of their life-word and own experience made explicit in the interview.

As the reader can see, our approach is very open and flexible. We suggest adapting it to the situation at hand. The important elements are to collect the goals, decision-making processes and other mental psychological aspects of activity, in order to give as an account of experience complete as possible. The trajectory metaphor is used loosely to help the subjects structure their explicitation both hierarchically and sequentially, that is along the two main dimensions of the organization of goal-directed activity (Cranach, Mächler & Steiner, 1985). The spatial metaphor also helps the subject to highlight as stages the loci of possible bifurcation, which are usually the most interesting moments.

Given that this explicitation takes the form of a semi-directive interview, it is not so important that the subject himself does or does not fully understand what a dynamical system is, and what “activity theory” is --- as long as the researcher who conducts the explicitation does. If this is the case, the researcher will know what kind of explicitation she needs from the subject, and adapt accordingly.

5.2 Limitations

At this point, one may wonder why we are using such a vague and flexible protocol for data collection. The sad truth is that, in the current state of the art, we (at least our group) know too little to be able to recommend very precise guidelines, since the situations of data collection are complex, and one-size-fits-all methodology does not seem commendable.

Behind this is a problem of fuzziness at the theoretical level: human experience is a complex phenomenon, as was shown in Section 2. Brilliant scholars have tackled the problem, following Husserl. Alfred Schütz wrote sharp and deep pages on this issue and made the effort to analyze the issue of mental planning and reconstruction of activity by the subject himself in the perspectives provided by Husserl, Dewey, Bergson and Leibniz (Schütz, 1951).While his discussion is fascinating, its practical implications for our purpose remain limited, since Schütz leaves the question somewhat open.

In general, there seems to be a gap between theoretical discussions and practical applications to everyday research. Being very theoretical was also to some extent the problem for activity theory (Rubinstein, 1957; Leont'ev, 1978; Nosulenko & Rabardel, 2007), at least until recent developments in ‘perceived quality’ (Nosulenko, Parizet & Samoylenko, 1998; Nosulenko & Samoylenko, 2001) proposed methodology which has passed the test of real-life applications.

Because there is still discussion on the very nature of the cognitive correlates of behaviour, it is not surprising that the categories used to describe them in empirical research remain problematic. Let us take, for example, Von Cranach’s school of ‘goal-directed action’ theory (Ginsburg, Brenner, & Cranach, 1985), which is certainly one of the best attempts to tackle the issue with a clear formalism. But its tenants come up with so many theoretical dimensions and distinctions that the theory becomes hardly usable in practice. On the other hand, ‘simple’ theories do not pass the reality test.

The renewal of activity theory (Engeström, 1990; Kaptelinin, Kuutti, & Bannon, 1995; Kuutti, 1996; Nardi, 1996) has brought progress in the theoretical aspects. There is a growing body of applied research that revolves around the issue of analysing activity, more

and more with the use of video. Each group tends to propose their own methodology, a sign of the domain's methodological immaturity (see (Le Bellu et al., 2010; Sonntag et al., 2002) for reviews). But similarities emerge, which is all the more remarkable seeing that the authors start from very different theoretical perspectives.

The general and indeed rather vague instructions proposed here are in the same vein of empowering the subject with some communication framework (narration, explanation to colleague, description for a novice, etc.) in order to facilitate the process of introspection and translation of personal experience into typified, understandable communication. For this, a format of social communication that makes sense for the subject is necessary. Therefore here, as in most techniques, communication combines the content and sharing (*kommunikatsiya* and *obschenie)* aspects by providing a partner and an audience in the person of the researcher and the community of friendly fellow men s(he) should impersonate.

The description of experience for its transmission (typically: in a training process, from expert to novice) requires a description in a format that enables one to understand the nature of the activity. This means that the main components of activity as it is experienced and performed must be evidenced in the format: this includes not only the performed actions (motor movements, acts of thought) but also the goals, motives and rationales for strategies. This is what we tried to provide with our explicitation technique based on subjective recording.

Activity theory teaches us that the behaviour we actually observe when a subject performs her task is not the activity itself but merely one possible path that was chosen in this specific situation to reach the goal in the conditions given. For example, when this subject takes a key and turns it clockwise four times to close the valve, the purpose of the activity is not to turn a key four times clockwise, but rather to regulate the flow so that it attains a desired value, which depends on the global situation of the system. Were the initial state of the system different, for the same purpose the subject might have to turn the key e.g. two times counter-clockwise. And in fact, the use of the key may be only an emergency procedure when the valve's motor is not working.

Therefore, what is important is to clarify the goal and the rationale for decision making; because these are what enable sense making of the subject's experience by another subject, as well as a profitable transfer of that experience. What matters is not so much the exact protocol that is used, but the fact that in the end we manage to capture the goals and other psychological aspects of activity. If the subject can provide them easily, fine. If not, the researcher must be creative and adapt the interview strategy to the case at hand.

6 Conclusions

Sharing human experience is essential for learning. It is also a crucial aspect of social life. The two aspects of communication (*kommunikatsiya* and *obschenie)* are always present together, and this must be kept in mind when considering the future impact of digital technologies.

This impact will be massive, as with any technique that changes the system of representation of human experience. By forwarding the hypothesis that '*we wish to share*

experience more than we want to transmit knowledge', we suggested that social media will in the future be used for experience sharing; to transfer more and more multimodal, intimate, aspects of individual experience; and to build communities, as the same time as they grow as communication systems.

The articles collected in this issue show some directions in which this is beginning to happen, with new techniques and systems of capture and transfer; with the creation of new narrative formats; with institutional initiatives to control or create reasoned frameworks for this emerging flow. They point at both the human capacity to adapt to digital representations, and the dangers of a globally connected system where these representations flow in sometimes-unexpected ways.

We proposed a format to describe human experience as a trajectory of *transitions* between states of the system. The format is based on the use of subjective recording of activity, enabled by digital technologies, and especially the Subcam. This recording is then explicated by the subject in a semi-directive process, which uses activity theory as a framework to structure the description of relevant elements. The protocol helps the subject to make his psychological processes explicit by proposing the description of activity as a step-by-step trajectory, in a space of possible states, a technique loosely inspired by dynamical systems theory. This provides descriptions of the local processes of *transition* from one state to the next. The method is designed to be vague and flexible enough to be adapted to local cases: this weakness of the method is also what makes it robust.

In the end, what matters is the transmission of experience from one human to another. The human (body and mind) is by design the best (and only) instrument that can decode and interpret human experience. Our efforts, as a species, and as researchers, are directed at finding the best proxies to transfer this experience from human body to human body. To the biological level of emotion decoding (which we share with social animals) human culture has added stories, using symbolic language and graphic representations. Now the art of narration will have at hand new powerful digital tools to transmit more aspects of human experience, and to transmit them on a large scale. This will augment the forms of connectedness and sharing. Whatever new forms of civilization emerge from this will certainly be interesting to watch.

Saadi Lahlou is Professor at the London School of Economics and Political Science, where he is the director of the Institute of Social Psychology. He is the scientific director of the Cognitive Technologies programme at the Foundation Maison des Sciences de l'Homme (Paris); and associate researcher at the Centre Edgar Morin (CNRS-EHESS UMR 8177). Previously he has directed the Consumer research department at Crédoc; and various research units at EDF R&D, where he founded the Laboratory of Design for Cognition. His current research interests are in the application of social sciences to the real world, and especially the design of human-friendly and sustainable socio-technical systems. *Author's address*: Director, Institute of Social Psychology, St Clement's Building, London School of Economics and Political Science, Houghton Street, London WC2A 2AE [*email*: s.lahlou@lse.ac.uk]

Notes

1. It is handy to use a system that enables each of the participants in the self-confrontation (researcher, subject, and other subjects if this is collective) to pause easily the video.
2. What we do here is very similar to the husserlian « phenomenological reduction » which enables to discuss the subjective experience while leaving aside the epistemic issues of realism and relativism. “The phenomenologist does not deny the existence of the outer world, but for his analytical purpose he makes up his mind to suspend belief in its existence –that is, to refrain intentionally and systematically from all judgements related directly or indirectly to the existence of the outer world. Borrowing from mathematical technique, Husserl called this procedure “putting the world in brackets” or “performing the phenomenological reduction”. There is nothing mysterious in these notions, which are merely names for the technical device of phenomenology for radicalizing the Cartesian method of philosophical doubt, in order to go beyond the natural attitude of man living within the world he accepts, be it reality or mere appearance.” (Schütz, [1944], 1962 p. 104)
3. “What remains after the performance of the transcendental reduction is nothing less than the universe of our conscious life, the stream of thought in its integrity, with all its activities and with all the cogitations and experiences (both terms being used in the broadest the Cartesian- sense, which also includes not only perceptions, conceptions, judgements, but also acts of will, feelings, dreams, fantasies etc.” (Schütz, [1944], 1962 p. 104)

References

Bach-y-Rita, P., Danilov, Y., Tyler, M. E. & Grimm, R. J. (2005) 'Late human brain plasticity: vestibular substitution with a tongue BrainPort human-machine interface', *Intellectica* 40(1): 115--22.

Bauer, M. & Gaskell, G., eds (2000) *Qualitative researching with text, image and sound --- a practical handbook.* London: Sage.

Berger, P. & Luckmann, T. (1967) *The social construction of reality*. New York: Doubleday.

Brochet, F. (2000) 'La dégustation. Étude des représentations des objets chimiques dans le champ de la conscience', Doctoral thesis, Université Victor-Segalen-Bordeaux-II, Bordeaux.

Cicourel, A. V. & Lahlou, S. (2005) 'External and internal observers: Comparing two kinds of ethnographic bias', Paper presented at the 9th international conference of the Pragmatics association.

Cranach, M. v., Mächler, E. & Steiner, V. (1985) 'The organisation of goal-directed action: A research report', pp. 19--61 in G. P. Ginsburg, M. Brenner & M. v. Cranach (eds) *Discovery strategies in the psychology of action*. London: Academic Press.

Darwin, C. (1859) *On the origin of species by means of natural selection, or the Preservation of favoured races in the struggle for life*. London: John Murray. (1st ed.)

Darwin, C. (1872) *The expression of the emotions in man and animals*. London: John Murray.

Daucé, E. (2010) Systèmes dynamiques: Propriétés générales et définitions. Retrieved 10 March, 2010, from http://emmanuel.dauce.free.fr/sdsc/node3.html

Dessalles, J.-L. (2007) *Why we talk --- The evolutionary origins of language*. Oxford: Oxford University Press. (2nd ed.)

Eco, U. (1985 [1979]) *Lector in fabula: le rôle du lecteur ou la coopération interprétative dans les textes narratifs*. Paris: Grasset.

Eibl-Eibesfeldt, I. (1967) *Ethologie --- Biologie du comportement*. Paris: Editions Scientifiques.

Engeström, Y. (1990) *Learning, working and imaging: Twelve studies in activity theory*. Helsinki: Orienta-Konsultit.

Gallese, V., Fadiga, L., Fogassi, L. & Rizzolatti, G. (1996) 'Action recognition in the premotor cortex', *Brain* 119: 593--609.

Gemmell, J., Bell, G., Lueder, R., Drucker, S. & Wong, C. (2002) 'MyLifeBits: Fulfilling the Memex vision', pp. 235--38 in *Proceedings of ACM multimedia'02*, Juan-les-Pins, France. http://portal.acm.org/citation.cfm?id=641007.641053

Gibson, J. J. (1963) 'The useful dimensions of sensitivity', *American psychologist* 18: 1--15.

Ginsburg, G. P., Brenner, M. & Cranach, M. v., eds (1985) *Discovery strategies in the psychology of action*. London: Academic Press.

Goffman, E. (1959) *The presentation of self in everyday life*. New York: Doubleday Anchor Books.

Goody, J. (1977) *The domestication of the savage mind*. Cambridge: Cambridge University Press.

Hatfield, E., Rapson, R. L. & Le, Y. L. (2009) 'Emotional contagion and empathy', pp. 19--31 in J. Decety & W. Ickes (eds) *The social neuroscience of empathy*. Boston: MIT Press.

Hodges, S., Williams, L., Berry, E., Izadi, S., Srinivasan, J. & Butler, A. (2006) 'SenseCam: A retrospective memory aid', pp. 117--93 in P*roceedings of the 8th international Conference on Ubiquitous Computing* (Orange County, CA, USA, September 17-21, 2006). Lecture Notes In Computer Science, vol. 4206. Springer-Verlag, London.

Hollan, J. D. & Hutchins, E. L. (2009) 'Opportunities and challenges for augmented environments: A distributed cognition perspective', pp. 269--89 in S. Lahlou (ed.) *Designing user-friendly augmented work environments. From meeting rooms to digital collaborative spaces.* London: Springer.

Hutchins, E. (1995a) *Cognition in the wild*. Cambridge, MA: MIT Press.

Hutchins, E. (1995b) 'How a cockpit remembers its speed', Cognitive science 19: 265--88.

Kaptelinin, V., Kuutti, K. & Bannon, L. (1995).Activity theory: Basic concepts and applications, 189-201 in: Human-Computer Interaction. 5th International Conference, EWHCI'95. Selected Papers. Editors: Blumenthal, B.; Gornostaev, J.; Unger, C. Berlin: Springer-Verlag, 1995.

Katok, A. & Hasselblatt, B. (1996) *Introduction to the modern theory of dynamical systems*. Cambridge: Cambridge University Press.

Keysers, C. & Gazzola, V. (2006) 'Towards a unifying neural theory of social cognition, *Progress in brain research* 156: 379--401.

Lahlou, S. (2000) 'Attracteurs cognitifs et travail de bureau', *Intellectica* 1(30): 75--113.

Lahlou, S. (2006) 'L'activité du point de vue de l'acteur et la question de l'inter-subjectivité: huit années d'expériences avec des caméras miniaturisées fixées au front des acteurs (subcam)', *Communications* 80: 209--34.

Lahlou, S. (2008a) 'Cognitive technologies, social science and the three-layered leopard skin of change', *Social science information* 47(3): 299--332.

Lahlou, S. (2008b) 'Identity, social status, privacy and face-keeping in digital society', *Social science information* 47(3): 227--52.

Lahlou, S. (2009) 'Experimental reality: Principles for the design of augmented environments', pp. 113--58 in S. Lahlou (ed.), *Designing user-friendly augmented work environments. From meeting rooms to digital collaborative spaces.* London: Springer.

Le Bellu, S., Lahlou, S. & Le Blanc, B. (2009) 'Comment capter le savoir incorporé dans un geste métier du point de vue de l'opérateur?', *Information sciences for decision making*. Retrieved 2010, from http://isdm.univ-tln.fr/PDF/isdm36/LE_BELLU-VF-05.07.09.pdf

Le Bellu, S., Lahlou, S. & Nosulenko, V. (in press) 'Capter et transférer le savoir incorporé dans un geste professionnel', *Social science information* 49(3).

Lenay, C. (2008) 'Médiations techniques des interactions perceptives: rencontres tactiles dans les environnements numériques partagés' *Social science information* 47(3): 331--52.

Leont'ev, A. N. (1976) *Le développement du psychisme. Problèmes*. Paris: Éditions Sociales.

Leont'ev, A. N. (1978) *Activity, consciousness, and personality*. Englewood Cliffs, NJ: Prentice-Hall.

Lomov, B. (1978) 'Psychological processes and communication', *Soviet psychology* 17(1): 3--22.

Lomov, B. (1979) 'Mental processes and communication', pp. 211--23 in L. K. Strikland (ed.) *Soviet and western perspectives in social psychology*. New York: Pergamon Press.

Lomov, B., Belyaeva, A. & Nosulenko, V., eds (1985) *Psykhologitcheskie issledovaniya obscheniya* [Psychological research in communication]. Moscow: Nauka.

Mack, A. & Rock, I. (1988) *Inattentional blindness*. Cambridge, MA: MIT Press.

Malinowski, B. (1923) 'The problem of meaning in primitive languages', pp. 146--52 in C. K. Ogden & I. A. Richards (eds) *The meaning of meaning*. London: Routledge.

Mann, S. (1998) 'Humanistic intelligence: WearComp as a new framework for intelligent signal processing', *Proceedings of the IEEE* 86(11): 2123--51

Mann, S. (2004)." 'Sousveillance": inverse surveillance in multimedia imaging', Paper presented at the 12th annual ACM international conference on Multimedia, New York. http://portal.acm.org/citation.cfm?id=1027527.1027673

Moscovici, S. (1976) *La psychanalyse, son image et son public*. Paris: Presses Universitaires de France.

Nardi, B., ed. (1996) *Context and consciousness: Activity theory and human--computer interaction*. Cambridge, MA: MIT Press.

Nosulenko, V. & Rabardel, P., eds. (2007) *Rubinstein aujourd'hui. Nouvelles figures de l'activité humaine.* Toulouse; Paris: Octarès; Éditions de la Maison des Sciences de l'Homme.

Nosulenko, V. & Samoylenko, E. (1997) 'Approche systémique de l'analyse des verbalisations dans le cadre de l'étude des processus perceptifs et cognitifs', *Social science information* 36(2): 223--61.

Nosulenko, V. & Samoylenko, E. (1998) 'Activité, cognition, interaction, communication : Certains aspects des approches élaborées en Russie' (Rapport de recherche dans le cadre du contrat entre l'EDF et l'ANVIE). Paris: EDF/ANVIE/MSH. (40 pages)

Nosulenko, V. & Samoylenko, E. (2001) 'Evaluation de la qualité perçue des produits et services: approche interdisciplinaire', *International journal of design and innovation research* 2(2): 35--60.

Nosulenko, V. & Samoylenko, E. (2009) 'Psychological methods for the study of augmented environments', pp. 213--36 in S. Lahlou (ed.), *Designing user-friendly augmented work environments. From meeting rooms to digital collaborative spaces.* London: Springer.

Nosulenko, V., Parizet, E. & Samoylenko, E. (1998) 'La méthode d'analyse des verbalisations libres: une application à la caractérisation des bruits de véhicules', *Social science information* 37(4): 593--611.

Nosulenko, V., Pavard, B., Rognin, L. & Samoylenko, E. (1993) *Analyse des processus de communication entre membres d'un équipage et spécialistes du centre de contrôle en vol de Russie (CCV)* (Rapport sur le projet MRE 'Approche interculturelle de la gestion de la fiabilité dans les grands systèmes: le cas des projets spatiaux et ses conséquences sur le transfert de technologie'). Paris-Toulouse: ARAMIIHS-CNRS & Fondation Maison des Sciences de l'Homme.

Parizet, E. & Nosulenko, V. (1999) 'Multi-dimensional listening test: Selection of sound descriptors and design of the experiment', *Noise control engineering journal* 47(6): 227--32.

Pea, R. D. (1994) 'Seeing what we build together: Distributed multimedia learning environments for transformative communications', *Journal of the learning sciences* 3(3): 285--99.

Pea, R. D. (2006) 'Video-as-data and digital video manipulation techniques for transforming learning sciences research, education and other cultural practices', pp. 1321--93 in J. Weiss, J. Nolan & P. P. Trifonas (eds) *International handbook of virtual learning environments*. Dordrecht: Kluwer Academic Publishing.

Pink, S. (2007) *Doing visual ethnography: images, media and representation in research*. London: Sage. (2nd ed.)

Rizzolatti, G. & Craighero, L. (2004) 'The mirror-neuron system', *Annual review of neuroscience* 27: 169--92.

Rizzolatti, G., Fadiga, L., Fogassi, L. & Gallese, V. (1996) 'Premotor cortex and the recognition of motor actions', *Cognitive brain research* 3: 131--41.

Rubinstein, S. L. (1957) *Bytie i soznanie* [Being and consciousness]. Moscow: USSR Academy of Sciences.

Schütz, A. (1964 [1942]) 'The problem of rationality in the social world', pp. 64--88 in A. Brodersen (ed.) *Collected papers*, Vol. 2 : *Studies in social theory*. The Hague: Martinus Nijhoff.

Schütz, A. (1962 [1944]) 'Some leading concepts of phenomenology', pp. 99--117 in M. Natanson (ed.) *Collected papers*, Vol. 1 : *The Problem of Social reality.* The Hague: Martinus Nijhoff.

Schütz, A. (1962 [1954]) 'Phenomenology and the social sciences', pp. 118--139 in M. Natanson (ed.) *Collected papers*, Vol. 1 : *The Problem of Social reality.* The Hague: Martinus Nijhoff.

Schütz, A. (1962 [1951]) 'Choosing among projects of action', pp. 67--96 in *Collected papers*, Vol. I: *The problem of social reality*. The Hague: Martinus Nijhoff.

Schütz, A. (1976) 'Social world and social action', pp. 3--19 in A. Brodersen (ed.) *Collected papers*, Vol. 2: *Studies in social theory*. The Hague: Martinus Nijhoff.

Shannon, C. E. & Weaver, W. (1949) *The mathematical theory of communication*. Urbana: University of Illinois Press.

SHEOS (2010) 'The subjective human experience observation system'. Retrieved March 10, 2010, from (http://www.psych.lse.ac.uk/research/sheos)

Simons, D. J. & Chabris, C. F. (1999) 'Gorillas in our midst: sustained inattentional blindness for dynamic events', *Perception* 28: 1059--74.

Sonntag, M., Rothier-Bautzer, E., Olry, P. & Marcel, J.-F. (2002) 'Les pratiques comme objet d'analyse', *Revue française de pédagogie* 138: 135--70

Streitz, N., Prante, T., Röcker, C., Van Alphen, D., Stenzel, R. & Magerkuth, C. (2007) 'Smart artefacts as affordances for awareness in distributed teams', pp. 3--29 in N. Streitz, A. Kameas & I. Mavrommati (eds) *The disappearing computer: Interaction design, system infrastructures and applications for smart environments.* Heidelberg: Springer.

Strupp, B. J. & Levitsky, D. A. (1984) 'Social transmission of food preferences in adult hooded rats (*Rattus norvegicus*)', *Journal of comparative psychology* 98 (3): 257--66.

Suchman, L. (1987) *Plans and situated actions. The problem of human--machine communication*. Cambridge: Cambridge University Press.

Tulving, E. (1972) 'Episodic and semantic memory', pp. 381--403 in E. T. W. Donaldson (ed.) *Organization of memory*. New York: Academic Press.

Tulving, E. (2002) 'Episodic memory: from mind to brain', *Annual review of psychology* 53: 1--25.

Von Uexküll, J. (1965 [1934]) *Mondes animaux et monde humain*. Paris: Médiations, Gonthier.

Whorf, B. L. & Carroll, J. B. (1956) *Language, thought, and reality: Selected writings of Benjamin Lee Whorf.* Cambridge, MA: Technology Press of Massachusetts Institute of Technology.