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How can we capture the subject's perspective? An evidence-based approach for the social scientist

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Abstract

This paper addresses the methodological gap that impedes the collection of empirical data on subjective experience. It describes a new family of methods for social science research (Subjective Evidence-Based Ethnography: SEBE). The methods are based on: first-person audio-visual recording with a miniature video-camera worn at eye-level ('subcam'); confronting subjects with these first-person recordings to collect their subjective experience; formulating the findings and discussing the final interpretation with the subjects. These procedures enable subjects to reconstruct and describe their psychological state at the moment of action, especially their goals, by reviewing films of their own activity recorded from their own perspective with subcams. These films provide situated records of actual activity in natural environments, without the need of an external observer. This approach, by providing both detailed records of actual activity and evidence-based accounts of the subject's own mental processes, supports grounded progress in ethnography, psychology, ergonomics, sociology and the social sciences in general. There are also applications for training and cross-cultural contacts. The techniques are described in sufficient detail for the reader to make use of them. Examples of applications are provided and limitations are discussed.

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Résumé

Cet article décrit une nouvelle famille de méthodes pour le recueil de données empiriques individuelles et leur analyse dans la recherche en sciences sociales (ethnographie à base de traces objectives). Ces méthodes sont fondées sur:

- l'enregistrement audio-visuel à la première personne avec une caméra vidéo miniature portée au niveau des yeux ('subcam');

- l'auto-confrontation des sujets avec leurs enregistrements pour recueillir leur expérience subjective;

- l'analyse et la discussion de l'interprétation finale avec les sujets au vu des enregistrements.

Ces méthodes permettent aux sujets de se remémorer et décrire leur état mental au moment des faits, en particulier leurs buts, lors de la confrontation avec l'enregistrement de leur activité obtenu avec la subcam. En outre les films fournissent une description réaliste de l'activité 'située', en milieu naturel et sans intervention d'un observateur extérieur. Ces méthodes, en fournissant des enregistrements détaillés de l'activité réelle et des comptes rendus de l'activité mentale des sujets fondés sur des éléments objectifs, apportent un changement profond dans l'ethnographie, la psychologie, l'ergonomie, la sociologie et les sciences sociales en général. Elles ont également des applications dans la formation et les contacts interculturels.

Les techniques sont décrites en détail pour permettre au lecteur de les utiliser. Des exemples d'application sont fournis et les limites discutées.

Mots-clés

abduction, auto-confrontation, biais d'interprétation, buts, cognition, débrief, emic, enthéasie, etic, expérience, interprétation, intersubjectivité, observation, phénoménologie, subcam, subjectivité, théorie de l'activité, vidéo

1. Introduction: Damastes the subduer and Clever Hans the horse

Procrustes, also called Damastes --- the subduer --- a famous Greek bandit, reputedly stretched his victims, or cut off their legs, so as to make them fit the size of an iron bed.

Unpleasant as this may seem, we scientists do the same to the phenomena we capture and analyse. This paper presents techniques which address the problem and should be of interest to all social scientists.

First we frame the issue; then we describe the techniques in enough pragmatic detail to make them transferrable to the reader; finally we give quick illustrations of their power.

As the first sections may appear very methodological, we suggest the reader takes a quick look at the pictures in section 6.1 (p. XX): they should motivate reading the whole piece.

'Damastism' (the influence of the observer/analyst in the construction of results) can happen when using rigid codification techniques, e.g. in questionnaires. Or by forcing our own interpretive perspective onto the phenomenon – an aspect of what Devereux calls 'counter-transference' in analogy with the impacts of the psychoanalyst's own unconscious processes in the analytic cure (Devereux 1967).

More generally, any interpretation is an abductive process in which the researcher gradually constructs some mapping between phenomena and a model, and in doing so she adapts *both* the model and the data (yes, I mean: *also* the data) to get some acceptable fit.

Damastism is a tough epistemological issue. It is not simply about biasing the data; it is about influencing their very construction, even in physics (Heisenberg 1927). This includes inducing (unconsciously) the phenomena themselves, and not only the data, to conform to the expectations of the researcher, a phenomenon well documented in social science (Rosenthal 1966). For example, in interaction, non-verbal cues given away by the researcher may influence subjects; the mere fact the subject is aware of being observed may also.

This is true even with animal subjects. The famous case of 'Clever Hans' (a horse said to be able to count, and gave the results of additions by tapping the floor with its hoof) was finally elucidated when Oskar Pfungst noticed that the horse sensed the non-verbal reaction of spectators to its tapping and adjusted its 'answers' accordingly (Pfungst 1911).

Influence of the researcher's subculture on the data has been vastly discussed in gender or intercultural studies and by post-modernism, especially regarding the influence of Western, male, and dominant culture; but Damastism is an epistemological issue even before it is a political one.

Although such effects are unavoidable in research, new technical possibilities of recording from the subjects' perspective and involving them in the analysis somewhat change the nature of the relation between observer and observee. They open amazing avenues for social science and technological progress recently made this technique accessible at low cost.

This paper is about that major step forward and presents a general method of subjective evidence-based ethnography, based on:
- first person audio-visual recording with a miniature video-camera worn at eye-level;
- confronting subjects with the first person recordings to collect their subjective experience;
- formulating the findings and discussing the final interpretation with the subjects.
Section 2 will address the issue of capturing and translating individual perspective on activity. Section 3 shows how the method enables going beyond the current limitations. Section 4 details the equipment, the protocols for capture and analysis. Section 5 shows what the techniques teaches us about the perspective of the other. Section 6 gives quick but thought provoking illustration of why the method is revolutionary. Section 7 highlights the limitations.

2. Capture and translation: catching the fish and canning the fish

The problem is twofold. First, understanding how the situation is lived from the *perspective of the subject* (catching the fish). Then translating and publishing this experience into some understandable, transferrable, description (canning the fish); while avoiding as much as possible to project inadequate preconceptions of the observer on the phenomenon.

2.1. Catching the fish

Social sciences have developed and perfected over the years various methods to collect empirical data about individual experience (activity, thoughts, beliefs, attitudes, etc.) which are described in classic manuals (Bauer and Gaskell 2000; Evans 2010; Flick 2006). Quantitative techniques are often stigmatized as being narrow-sighted and simplistic (because they overlook what is not planned in the collection process), or 'Damastic' for such purpose because they force all the data into a single rigid format. Qualitative techniques are open in their approach but suffer from similar pitfalls, although in a more subtle way. Data collection is usually the result of some interaction between the researcher and the data source, and in this process the data collected undergo a construction process which may heavily depend upon the position and skills of the researcher. For this reason, qualitative techniques are often criticized as having some 'black-box' character by the advocates of quantitative techniques (the black box being the researcher).
This dispute has now somewhat cooled off with both sides publicly admitting that all techniques have something to bring in. Also, it should be noted that opposing quantitative and qualitative is simplistic, since in the detail most methods tend to include both aspects to some degree, and in many cases combine them with some experimental design. But, as Claude Bernard noted, there is not an essential difference between observations and experiments: the

difference is that in experiments the experimenter creates some specific conditions for observation, in order to better control for them (Bernard 1865: 44-54). Therefore the problems of observation remain even there.

'The ultimate goal of qualitative research is to understand those being studied from their perspective" (Gorman, Clayton, Rice-Lively and Gorman 1997: 23). Social sciences, and especially Psychology, Sociology and Anthropology are interested in understanding other people's perspective, modelling it, and making these findings explicit. Various techniques to elicit expression of 'natural' thought, through free association (Freud and Breuer 1895), non-directive or semi-directive interview, life stories, etc. have been used, and most come in the form of 'verbal reports' (Ericsson and Simon 1980).

These techniques suffer from a series of biases. Confirmation bias (Nickerson, 1998) whereby the researcher tends to find (only) what she's looking for, is the most prominent, but many others have been documented in the literature – see e.g. (Droz 1984) for a list.

Introspection is a somewhat specific case, because it is, as Boring notes (Boring 1953), implicitly at the root of all verbal protocols where the subject is asked to describe internal states, from attitudes to representations or feelings. Therefore it deserves our special attention. Introspection is 'looking into our own minds and reporting what we there discover' (James 1890, vol. I, p. 185). But, as James describes it well, the stream of consciousness is a continuous flow, elusive, constantly changing, and situation-dependent; and hence transcribing it into 'observations' is not a trivial task.

To date, since introspection is limited to one's own perspective, we have no empirical direct access to the individual experience of the Other. Some even argue it is impossible (Nisbett and Wilson 1977). The seminal discussion by Wundt, who introduced the introspection process in psychological investigation (*Selbstbeobachtung: self-observation*), is illuminating in this respect:

> The endeavour to observe oneself must inevitably introduce changes into the course of mental events, - changes which could not have occurred without it, and whose usual consequence is that the very process which was to have been observed disappears from consciousness. (Wundt 1904, p. 5)

Therefore, Wundt advocates for an *experimental* introspection, which is at the root of modern experimental psychology; for him only the experimental method can make scientific introspection possible.

> The psychological experiment (…) creates external conditions that look towards the introduction of a determinate mental process at a given moment. In the second place, it makes the observer so far master of the general situation, that the state of consciousness accompanying this process remains approximately unchanged. The great importance of

> the experimental method, therefore, lies not simply in the fact that, here as in the physical realm, it enables us arbitrarily to vary the conditions of our observations, *but also and essentially in the further fact that it makes observation itself possible for us.* (Wundt 1904, p. 5, italics mine)

As we see, the problem is framed upon the assumption that 'endeavour to observe oneself must inevitably introduce changes into the course of mental events'. Reflexivity takes time and attention indeed, which would disturb the subject in the flow of action. What we argue here is: after the fact, provided with the relevant cues, the subject can clinically provide a detailed and grounded in evidence comment of her mental processes; without disturbing these since the action *already* has taken place. *This is precisely what new recording techniques enable.* We called 'entheaty' (from the Greek θεάομαι, 'to gaze at a spectacle', as in a theatre) the situation, recently enabled by technology but recent in Human history, where B observes a situation *recorded from A's perspective* (Lahlou, 2006). Self-entheaty is the situation where one observes his own actions on record. Reconciliation of internal and external views is the heart of the matter.

2.2. Emic and Etic

The issue of external vs. internal observer has been addressed mostly in anthropology, and especially ethnography, where the status of the observer is a crucial problem (DeAndrade 2000; Del Casino 2001; Eppley 2006; Young 2005). But set in cultural terms (what is it to be an insider?) it is aporetic because insider-outsider is a continuum: we do always share something as Human beings, and at the other end of the continuum, the very fact one is a researcher somehow excludes him from being a 'mere' insider even in his own in-group (Weaver-Zercher 2005).

The topic is usually debated by comparing 'emic' and 'etic' perspectives(Pike 1967). *Emic* refers to a description in terms of the actor, while *etic* refers to a description by an observer in culturally neutral terms (in practice: scientific). There has been some debate over the notions, with the founder (Pike, first edition of his book in 1954) and developers of the notion (mainly Harris and Goodenough) holding opposite views (Harris 1976; Headland, Pike and Harris 1990). See Headland's (1990) exhilarating history of the concept, which nevertheless sheds light on the nature of the concepts:

> (…) the terms are defined in the literature in many different and --- in my view --- usually inadequate ways. (…) Some authors equate emic and etic with verbal versus nonverbal, or as specific versus universal, or as interview versus observation, or as subjective knowledge versus scientific knowledge, or as good versus bad, or as ideal behaviour versus actual behaviour, or as description versus theory, or as private versus public, or as ethnographic (i.e., idiosyncratically incomparable) versus ethnological

(comparable cross-culturally). One linguistic dictionary (Ducrot and Todorov, 1979: 36) says emic interprets events according to their particular cultural function, while etic characterizes events only by spatio-temporal criteria. (Headland 1990)

The core of the problem is that we want to describe the experience of the insider, which is inevitably constructed from her own cultural and personal history, into an interpretation that could be transferrable into someone else's life world. The emic/etic refers initially to the difference between phonemics and phonetics. Phonemes are elementary units of sound distinguished *by the speakers* of a given language, while phonetics focuses on the *physical description of the sound* of human speech: the categories used for description are different.

An example of a phoneme is the /k/ sound in the words *kit* and *skill*. (In transcription, phonemes are placed between slashes, as here.) Even though most native speakers don't notice this, in most dialects, the k sounds in each of these words are actually pronounced differently: they are different speech sounds, or phones (which, in transcription, are placed in square brackets). In our example, the /k/ in *kit* is aspirated, [k^h], while the /k/ in *skill* is not, [k]. The reason why these different sounds are nonetheless considered to belong to the same phoneme in English is that if an English-speaker used one instead of the other, the meaning of the word would not change: using [k^h] in *skill* might sound odd, but the word would still be recognized. [Wikipedia, article 'phoneme', accessed 02/02/2010].

More generally, the categories used to describe phenomena in one's own culture may differ from those used in an external description, and this sends back to classical debates on how far language itself might frame how we perceive our world (Hunt and Agnoli 1991; Whorf and Carroll 1956). In practice, for our observation problem, this means that the observer may produce inadequate accounts of phenomena. An external observer could consider as different events what natives consider as insignificant variations of the same; and vice-versa [1]. Therefore, in theory the only way to know *what is relevant* from the subject's perspective in his own cultural context (emic perspective) requires to get an insider's view – which seems contradictory to accessing it as an external observer.

In fact, interpretation is an abductive [2] construction process whereby possible hypotheses are explored and confronted to the data by the researcher until some satisfying hypothesis is considered to be the valid 'explanation'. In this interpretive spiral, the researcher is usually alone (or discusses with colleagues only), every possible cognitive bias can play, and the subject's validation is rarely if ever sought.

We shall not replicate these debates, but rather show here how we can now go beyond classic limitations and provide a better grounded and deeper access to subjective perspective.

2.3. Subjective evidence-based ethnography

The method described infra, *subjective evidence-based ethnography* (SEBE), is typical of a new generation of investigation techniques which build on the affordances of Information Technology for recording, annotating and collectively processing data (Goldman 2007; Hollan and Hutchins 2009; Lahlou 2010; Lewis, Pea and Rosen 2010; Pea 1994, 2006) . 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)

SEBE is, as said earlier, based on the combination of three techniques:
- first person audio-visual recording with a miniature video-camera worn at eye-level
(subcam);
- confronting subjects with the first person recordings to collect their subjective *experience* through evidence-based, controlled, analytic reconstruction;
- formulating the findings; and discussing the final interpretation with the subjects.

In these techniques:
The subject records the events from his own situated perspective, in real situations, without needing extra mental load or attention in this process; in doing so provides us with the focus of her attention;
The subject analyses *ex post facto* the events with the researcher, when looking at the recordings in detail;
The subject checks the validity of the interpretations as reformulated etically by the researcher (this does not mean that the subject's interpretation should always be accepted; nevertheless to understand fully a subject's action one needs to be aware of the way the subject interprets its environment or how he accounts for it)
The last two steps are a 'triangulation', where two (or more) interpreters with different skills and knowledge confront their interpretation of the same material (the subfilm).
My colleagues and I have been developing this technique since the 1990's: the technical aspects of the capture devices, the methods for accessing the mental states from confrontation with the films and the theories for analysing the data. The focus of my research is to understand the multiple layers of determinants of human activity at fine-grained level, in real

context. We have used the method in a large variety of settings and research objectives: interpersonal relations, individual and group decision-making, collaborative design, meetings, workplace studies, experiments, knowledge transfer, counselling, and of course activity analysis, including using SEBE as one of the instruments to monitor the everyday activity of volunteer workers in a specially designed observation laboratory where natural work activity was continuously monitored, for 10 years by 30 cameras (Lahlou 2008, 2009; Nosulenko and Samoylenko 2009a). We have used these techniques alone or in association with other classic techniques, with sometimes subcams on several participants in the same scene. We have combined SEBE with classic filming by external cameras, with panoramic 360 video cameras, with SenseCams (Hodges, Williams, Berry et al. 2006), with remote cameras in videoconferences, with eye-tracking, with physiological monitoring (heart beat rate, blood pressure, skin resistivity…), and of course with more classic techniques such as interviews, critical incident, questionnaires and lab experiments. In most cases, SEBE proved to be a valuable complement, especially in the initial stages of exploring the problem in natural situations.

The first obvious outcome of SEBE is the amazing extent to which individual behaviour is framed by the context, and how everyday activity is mainly constituted of chaining automatic chunks of activity, often beyond the threshold of conscious decision-making, The material have led to develop models describing these phenomena: 'cognitive attractors' (Lahlou 2000) describe how some areas of the activity phase space automatically induce specific behaviours; 'installation theory' (Lahlou 2008) is an evolutionary framework that shows how culture produces a constructed social world that scaffolds, guides and constrains individual activity at three levels: by the affordances of objects, the embodied mental representations of the subjects, and the coercive power of institutions.

This paper will focus on the method, based on the experience of the author and his colleagues in developing this technique since 1997, selecting what seems at this point solid and transferrable. While we developed the method primarily as an instrument for our own purpose of studying human activity and its determinants, and later for professional training, we believe it has other potential applications, for example in therapy and counselling. The reader will adapt it to her own purposes.

3. Getting beyond limitations of the current methods for collecting and analysing subjective experience

In this section we address the two issues that have been highlighted above in epistemic terms: understanding the phenomenon, and describing it ('catching and canning'). But this time we will tackle the issues directly in operational terms.

We consider successively:
Spatio-temporal issues and the situated perspective in data capture (3.1)
Attentional focus and episodic memory in sense-making processes (3.2)
Goals (3.3)
Interpretation and its explicitation (3.4)
Presentation and transfer (3.5)
For a constructive approach, we will present in the same sections the current gaps and how the new technique deals with them.

3.1. Spatio-temporal issues: the situated perspective in data collection

Cognition is *situated*, how subjects act depends upon the context of action (Lave 1988; Suchman 1987); therefore if we want to understand what really happens we need a situated recording of the subject's activity, as close as possible to the actual perspective of the actor. Cognition is *distributed* between the subjects and their cultural context (D'Andrade 1989; Hutchins 1995; Roberts 1964), therefore activity can only be observed realistically 'in the wild' (Hutchins 1995): only then can we see the subject confronted with a complete ecological environment. Indeed the determinants of action do not reside solely within the individual: the World is constructed as a cultural 'installation' (Lahlou 2008) which scaffolds, guides and constrains human activity at three levels (physical, psychological, institutional). Therefore, we need to capture *in situ* all these determinants (objects, mental states, social interactions…) if we want to understand activity. As Tinbergen noted, 'natural experiment' (observing things as they happen in their actual environment, as opposed to trying to replicate them in laboratory) is the main resource for ethology (Tinbergen 1953).This is why using natural experiments in social science have been advocated for (Lazursky 1911), although rarely applied.

But situated capture entails some classic problems for data collection. First, even video recording is inevitably a selection process (Rieken and Lahlou 2010). Activity was on-going before the camera was turned on and will continue after it is turned off. Then, depending on

the camera angle or when the film starts, interpretation can be reversed. For example, during our conversations about activity recording with British police, one officer 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 an automatic surveillance video-camera on a pole had captured the whole scene from the beginning and from another angle, which enabled to prove the witness' interpretation was wrong, and saved the policeman's day.

Another problematic issue is the very design of the human body, and its lack of transparency. Human bodies are designed to ensure best vision of own action to the subject herself. The manipulation zone is a small volume situated directly in front of the subject, by nature within arm's reach. Unfortunately, this means that most of what the subject does, as seen from the external observer, is hidden by the subject's body, or from the wrong perspective. For example, in the study of office work, it is difficult to catch what a subject reads or what he types on his keyboard. More generally, gesture must be guided by minute details of the situation seen from the right perspective. Try to open an oyster with only the vision given by a camera located a few meters away and you will see what I mean.

In fact, the subject is the best film director, since where she directs her senses are probably to the most relevant aspects of the situation for her. A solution is therefore to have the recording focus oriented by the subject herself. But the device should not get in the way of activity, it should not need any specific action on the part of the subject (e.g. require the subject to use her hands). The system should also capture a large enough array of the visual field to include peripheral attention, and record sound, in stereo, with good quality (as experts know, capturing image is easy, while sound is more difficult).

To sum up, experience should be recorded as it emerges on the fly, in the flow of actual activity, and from the very perspective of the actor. This is easier said than done. For example, as we discovered through experiment, filming from the exact level of the eye produces a different effect than from a camera attached to the forehead. The latter, although already a major progress (Omodei and McLennan 1994; Omodei, Wearing and McLennan 1997) provides the perspective of someone slightly taller, does not match exactly with the subject's own perception, and does not frame well objects manipulated close. 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. Therefore the capture device must be as close as possible to the human sensors: camera at eye level, and microphones at the ear.

This is precisely what the *subcam* technique was designed for (Lahlou 1999, 2006; Le Bellu, Lahlou and Nosulenko 2010). The subcam is a miniature wide-angle video-camera with a stereo microphone worn on a pair of glasses, or other form factors depending on the activity (e.g. attached to a helmet for industrial activity, on a bandana for children, etc.). The field is wide enough to include the hands and the manipulation space. The mike's adaptable dynamics have been designed to capture the subject's voice as well as context sources. We hand this wearable tool to the subject and simply ask her to perform the activity. Sound is captured at ear level –but we still struggle with binaural microphones. Similar systems have been independently invented in various places, the closest of ours to our knowledge being the systems developed at La Trobe (Omodei and McLennan 1994; Omodei, McLennan and Wearing 2005; Omodei, Wearing and McLennan 1997) and the first, in 1980, being Steve Mann's pioneering wearable computing devices later used for life-logging (Mann 1998).
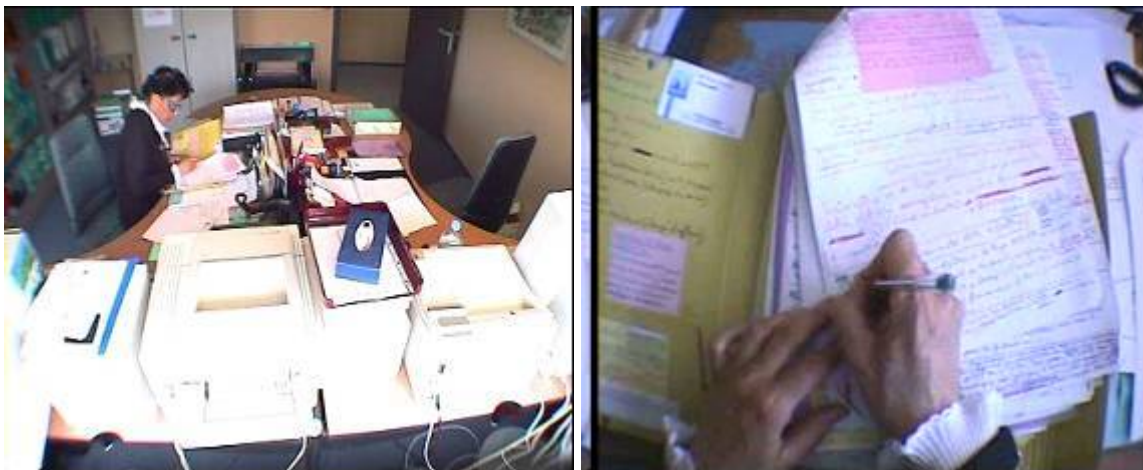
Figure 1a&b: same scene captured from a classic camera (left) and from a subcam worn by the subject (right).

By naturally orienting her attention in the course of natural activity, the subject, without any effort or extra attention load, enables the subcam to capture what she considers relevant, in its context.

The first question that scientists ask about the device is does it introduce biases? The answer is, yes it does; but they are minor compared to most techniques, and in many cases can be suppressed or corrected with a proper protocol and form factor. Limitations will be described extensively in section 7.

3.2. Attentional focus and episodic memory in sense-making processes

3.2.1. *Focus and blindness*

The subcam, as we have seen, solves most issues with getting a situated record of auditory and visual array. But while the orientation of the subject's sensing in a specific direction is easy to render with mechanical sensors (e.g. directional microphone), it is less easy to account for the *interpretive selection mechanism* operated by the mind on the data (e.g. the capacity to tune-in to a specific conversation in the noisy environment of a cocktail party). The best access we can have at this point seems to be to ask the subjects what their interpretations were. The subjects are not asked to produce theory, but simply to try to remember and explain why they acted so, grounded in the empirical evidence provided by the subfilms.

Indeed, having an object in our field of vision or audition does not necessarily entail that we consciously perceive it. Perception is an activity. It results from an exploratory action with the sensory organs (Gibson 1966; Lenay 2008; Leont'ev 1976) and cannot be separated from interpretation (Von Uexküll 1965). Attention is the *behaviour* by which we orient our sensory systems to the environment; in doing so, we select some specific aspects and oversee 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' to. Studies on 'inattentional blindness' (Mack and Rock 1988) have shown that unexpected objects are not always 'seen'. A classic example in psychology is the film featuring two basketball teams, one dressed in black and the other in white (Simons and Chabris 1999)The viewers are asked to count the passes of the ball within the white team. Half way through the film, a man dressed as a black Gorilla ostensibly walks among the players, beats his chest in a typical Gorilla manner, and leaves. Half of the subjects *do not* notice this unexpected Gorilla because their attention is focussed on the white players. The 'cocktail effect' is another example, where we are able to listen to someone in a noisy environment, and sort out his very speech out of the noise.

Nevertheless, we may be influenced by subliminal perceptions, and peripheral attention is precisely a mechanism that extracts some relevant features in the context out of our initial focus of attention. Therefore, 'what' the subject actually perceives is not always obvious from the recordings alone. This is why we get this information from the subjects themselves in confrontation interviews.

3.2.2. *The confrontation interview*

> The only feeling that anyone can have about an event he does not experience is the feeling aroused by his mental image of that event. That is why until we know what others think they know, we cannot truly understand their acts. I have seen a young girl, brought up in a Pennsylvania mining town, plunged suddenly from entire cheerfulness into a paroxysm of grief when a gust of wind cracked the kitchen window-pane. For hours she was inconsolable, and to me incomprehensible. But when she was able to talk, it transpired that if a window-pane broke it meant that a close relative had died. (Gorman, Clayton, Rice-Lively and Gorman 1997: 3)

So, how do we access the subject's own interpretation? In SEBE we confront the subject with the recorded scene and explore it together. In these sessions, the subject watches the film with the researcher, and comments, frame by frame if necessary, the scene and his own interpretation.

Greeno makes the distinction between situative approaches that use records of interaction (Greeno 2006) as opposed to verbal reports – such as thinking-aloud protocols (Newell and Simon 1972) – used in cognitive approaches. Such confrontation interviews, --- where the subject is confronted with some empirical evidence --- are classic in ergonomics, and different variants have been described: self-confrontational interview technique (Von Cranach and Kalbermatten 1982), self-confrontation (Theureau, 1992), crossed self-confrontation (Clot, Faïta, Fernandez, and Scheller, 2001; Clot, 1999), explicitation interviewing (Vermersch, 1994), cued recall debrief (Omodei, Wearing and McLennan 2002), etc. Other techniques using verbal protocols to describe the same, but without direct confrontation with the recordings, have also been used with some success; e.g. instructions to an alter-ego (Oddone, Re and Briante 1981) where the subject is supposed to describe the activity to a learner, or reasoning out loud (Bisseret, Sebillotte, and Falzon, 1999). While some authors claim that their own technique is very specific (e.g. Rix and Biache, 2004 and their 'subjective re-situ' interviews), the idea remains the same: to use some 'stimulated recall' (Lyle 2003) to obtain an explicitation by the subject of the mental events underlying the activity, based on using the available elements, usually film or subfilm.

Depending on the specific goals of the research, the nature of the prompts given by the researcher to the subject may vary. Other elements than the film may be added (for example we also use the formal rules or descriptions of procedures, or other subject's films to compare with, etc.) We may focus on goals, tasks and affordances when detailing professional activity in the perspective of constructing training films; while for the same activity we may focus on emotions, desires, and 'problems' when we are interested in re-designing the installation for more fluid usability etc. Furthermore, other parameters will play: the nature of the activity, the degree of knowledge of the researcher and his proximity with the subject.

The risk here is to fetishize the method, by focusing on the device (the subcam) or on some rigid confrontation method for the interview. The research techniques are not goals per se, but merely an instrument to the research itself. The reader will adapt the techniques to their own research problem.

Another difficult issue is that mental activity is not a straightforward single narrative where the subject would be consciously monitoring one single track of action (I am doing this then this then that…) but rather multitasking and running multiple processes in parallel (Lahlou 2000), of which only some come in the focus of consciousness, especially when a decision is needed. Understanding activity needs 'peeling off' these different layers of simultaneous processes; which have their own logic. Therefore, forcing explicit description of activity into the description into a single course of action would not only be incomplete: it simply does not render the very nature of the processes (cf. Infra, Section 5). The interviewer must remain careful in the search of explicitation: he should not aim systematically for a single, coherent and non-contradictory account of what happened. Real action is often ambiguous and may have multiple determinations. Beware of Damastism.

Anyway, human memory seems to be closely linked with the perception of place and action, a property that the ancient arts of memory have discovered very early, by training orators to remember their speeches by associating the various items to objects in a familiar place, as an imagined trajectory in this place. Maybe the following has already happened to the reader: at home having entered a room he realizes he has forgotten what he was looking for. Walking back to where he started from, and entering the room again, memory of intention suddenly comes back. This is the effect that the subcamer often experiences when viewing his own subfilms: he is put back on track to comment actual activity. This helps the subject recover and make explicit her goals in the confrontation interview. And indeed goals are crucial to understanding activity, as the next section will develop.

3.3. Goals

3.3.1.   The 'why' issue

The activity of Humans, as of most animals with a brain, is oriented by some purpose. If this purpose is not part of the description, we may completely lose the meaning of the activity. Let us quote the following example by ethologist Jacques Vauclair:

> Suppose you walk along the road and that at some point you see 50 meters ahead a pigeon which takes off and flies to a tree 50 meters on your right.

The empirical description will be:
- rapid and alternate contraction and relaxation of pectoral muscles
- flapping wings
- flight

Functional description will consist simply in saying that the pigeon fled by flying away. (Vauclair 1984, my translation)

As we see, knowing goals and motives considerably simplifies the description, which is great news because detailed analysis of videos can be pretty cumbersome.

While Schütz is quite right that the scientist should not limit herself to what the subject says (Schütz 1964), 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, *that specific day*, not to lose 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 (Schütz 1964, p. 76)

Activity theory (Bödker 1989, 1991; Engeström 1990; Engeström and Middleton 1998; Ginsburg, Brenner and Von Cranach 1985; Leont'ev 1974, 1981; Nardi 1996; Nosulenko and Rabardel 2007; Rubinstein 1997; Von Cranach, Mächler and Steiner 1985) precisely takes this purposefulness as a fundamental feature to describe activity. In a nutshell, in activity the organism strives to reach its goals in the conditions given by the environment; goals are conscious representations of desired states; goals are specific ways of fulfilling motives. Motives are the subjective perception of its needs by the subject (hunger, security etc.)

> Motives and goals are rather general levels of determination. In practice, to reach the goal the subject will have to create a trajectory from current state (conditions given) to desired state (the goal). To do so the subject goes through steps ('tasks'); each one having its own aim (sub-goal). For example, to operate an electric valve, the subject may have to first check actual state of valve and compare with expected state as given by his instruction sheet, connect the motor of the valve to the mains, operate the controls, check the valve has attained desired value, report, consignate valve, disconnect from mains. And each task may break into subtasks (e.g. checking state of valve starts by checking one is in front of the right valve by checking valve reference number).
> Execution of some tasks might reveal problems, and need conscious monitoring of motor and mental actions by the subject; while for some others a routine sequence of automatic actions is sufficient. When actions are automatic and are applied beyond

conscious control (e.g. changing gear when driving a car, turning on the cooker, typing a password, etc.) they are called 'operations'.

So activity appears as an oriented trajectory from a given state ('conditions given') to a consciously represented expected state ('goal'). Attaining the goal satisfies the motives of the subject. The trajectory of activity is a succession of small problems to be solved ('tasks'), which can each be seen as reaching a local subgoal. The operator solves each task by taking actions (consciously controlled motor or mental moves) and operations (automatic, routinized moves taking place beyond threshold of consciousness). At each moment, the subject is confronted to the possibility of taking a different local route to reach the final trajectory, and may do so opportunistically in consideration of the local conditions given at this point.(Lahlou 2011, italics in original)

Using Russian activity theory combined with SEBE makes it amazingly simpler to describe activity. One of the crucial advantages is that activity theory provides a natural breakdown of the activity flow in sequences (task, sub-task, and finally operations) with their goals and sub-goals. Using this technique considerably reduces the process of coding, and suppresses a problem that kept us blocked for years (when coding video, how do we cut it into elementary units?)

In sum, if we want to get a full understanding of activity, we must know the motives and goals of the subject. As these are internal to the subject, the easiest way is to get the subject to make them explicit. Such endeavour is one of the purposes of the confrontation interview (another being to make the description transferrable in etic terms).

3.3.2. *Empowering the subject to explain*

Unfortunately, subjects may not always be conscious of their internal states and goals; they may not want to express them to the researcher; even when they are willing and conscious they may not be able to verbalize. Furthermore, as the human machine is designed for attentional economy, most of what we can do without cluttering our limited attention and consciousness span is done automatically (that is: often below conscious threshold), and not stored in explicit memory. So we tend to forget these transient states, or at least have great difficulty to recall them from memory only. This is why every description *ex post* is necessarily some kind of reconstruction by the subject: a reconstruction done in the Damastic framework of the culture, representations and other experiences of the subject. One classic example of this problem is the inconsistency of accounts of the 'same' event by different eyewitnesses (Read 2001). This is why it is so crucial that the interpretation be made in a context as close as possible of the actual events in order to have the reconstruction based on *actual* context elements ('evidence-based').

It is also crucial that the researcher helps the subject to explain, as the latter may not be

familiar or able to introspection and the process of untangling the motives. *The general idea is to put the subject into a 'reflexive mod'* where she is comfortable and fully willing to elucidate the various layers of internal goals and motives, and also external elements or events, which caused the observed behaviour.

While we have not found another technique than *trust building* with the subject to deal with the cases where the subject would not want to share his goals with the researcher, the other cases (subconscious processes, difficulties of expression) are usually dealt with by the confrontation phase. In most cases, the subject is able to recover the memory of his goals as he views his own activity on the subcam film. In many a case, the way the subject expresses his goals, by finger pointing at elements of the contexts, explains why it would be very difficult to do so without the context being visible in self-entheaty, because many details of the activity are in practice context-driven. For example 'Here I want to grab the keyboard, but because I am afraid the mouse that is attached will fall there, I have to open the drawer first, so I must pull the chair back'. Or 'You see the way she looks at me? Then I understand I should not have told her and I feel really bad. Then I must explain, because, that Patrick was not there when this happened'.

Therefore, our technique aims at collecting the motives, goals and sub-goals of the subject during the confrontation interview. This also enables to gather the relevant dimensions of the phenomena from the perspective of the subject, their 'perceived quality' (Nosulenko 2008; Nosulenko, Parizet and Samoylenko 1998; Nosulenko and Samoylenko 1997, 2009a; Nosulenko, Samoylenko and McAdams 1994). Nevertheless, the process of recovery, to be efficient, needs in our experience a much more active role from the researcher than classic semi-directive interviewing, the collection of life stories, or critical incident technique. How we proceed is detailed in section 4.5.

It is also to be noted that this technique enables the explicitation of many aspects of what has been called 'tacit' knowledge in the knowledge management literature (Nonaka and Takeuchi 1995; Polanyi 1958, 1967), that is knowledge that was not expressed verbally by the experts. Our experiments in transferring professional knowledge among the operators of nuclear plants were a good surprise in this respect (Le Bellu, Lahlou and Le Blanc 2009; Le Bellu, Lahlou and Nosulenko 2010).

3.4. Detailed description and its construction from the emic and etic perspectives

All analysts are prone to Damastism. Insiders and outsiders exhibit different biases. 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 elements that

are inconsistent with the image they want to have of their community. This is why it is better where possible to cross the eyes of an insider and an outsider(Cicourel and Lahlou 2005). The confrontation interview precisely allows this triangulation.

It is worth noting that, as explanation is an abductive process, the discussion with the subject is necessary to produce an etic description *which the subject also considers valid*. Sometimes the subject is fully able to express spontaneously all necessary elements, but this is the exception. Because many elements seem obvious to the subject, she will not spontaneously verbalize them. This is because in conversation what is obvious is not supposed to be verbalized - this is one of Gricean conversational maxims, the maxim of quantity (Grice, 1979). This is also why *what* the subject says depends upon what the subject thinks the researcher needs.

Sometimes, the subject does not have the words, sometimes why she acted so is not obvious even to herself and a more detailed investigation is necessary. In this collaborative process, an explanation that is understandable, consistent, and 'valid' from the emic perspective of the subject, is constructed.

This part of the technique is probably the most revolutionary in terms of emic/etic. It demonstrates that we can go beyond the classic divide between observer and observee and construct, in a collaborative investigation, an interpretation that is a proper translation of the subject's experience in understandable terms. Here is an extract of a confrontation interview with an expert of the LSE 'laptop surgery' where he comments the subfilm where he solved a difficult case. The laptop surgery is a place where students can bring their laptop and get it fixed. In this particular case, the student's PC screen would 'freeze' inexplicably. In this extract, the researcher tries to validate his interpretation of the expert's strategy for problem solving, and tries to find the right terms with the subject, as they just watched and discussed an extract of his subfilm.

Note how the subcamer and the interviewer are both in 'reflexive mode' (frequent use of ahmm, ehm, hesitations); and how the subcamer, remarkably didactic, constantly checks the interviewer follows and understands what he says in emic mode (very frequent use of 'you know', an expression this subject almost never uses in the verbal interactions with the users whose laptops he fixes).

> *Subcamer*: But that's a very unusual case I mean. With most of, stuff, you know, ahmm it's a pretty automated process, I could give somebody a piece of paper and they could follow the process and get rid of like 90% of this stuff. Hm. This was a particularly awkward one.
> *Researcher*: It's interesting, because you had to display hmm a lot of strategy.
> *Subcamer*: Yeah, well more than anything you know you've got to show a bit of initiative as well, ahm, and, you know often you'd start going on Google or something like that to find the answers and… You know with a lot of problem solving with

computers, you know, probably like, I'd say, may be 50% of it is prior knowledge and then 50% of it is knowing where to go to find the answers. You know.

Researcher: I see

Subcamer: Like here, you know, with the guys that work here [they are expected to] to know to find the answers. Hmm. You know. That, that's, You know, I joke with my Mom about it. My Mom will say 'Well how do I fix it?' So I say 'Google it!' You know, because that's what I'm gonna do, y'know [laughs]. You know. That, that's how you fix lot of these problems.

Researcher: So, so, there's a moment when, ehm, just ehm. Well. It's like first you, you thought that could be a, you saw very quickly that was not a classic case, right, because the guy   [already

Subcamer: [yeah

Researcher: had taken the virus   [away

Subcamer: [yeah

Researcher: which means that he he's computer literate also

Subcamer: Yeah, exactly. He'd, he'd actually done, you know, probably the first two steps that we would have done here, so we were already at an advanced ... place

Researcher: All right. So then you check that he did right

Subcamer: Exactly

Researcher: And then you realize that this is gonna be a tougher case than expected?

Subcamer: Yeah

Researcher: And, ehm, did, did, did that prompt you into some different kind of 'expert mode' or?

Subcamer: Ahmm, I don't know really? I don't really know what that means.

Researcher: Ehm, I, I, I don't know either. I, [I mean

Subcamer: [I mean I, I guess

Researcher: Firstly, If you get a change in your [gestures],   [your mood

Subcamer: [Yeah, yeah.
I know what you're saying. So it's basically like, with a lot of things here, with viruses; you know here we get lots of viruses it's a repetitive task   [so
          [they both move position on their seats and make hands gestures]

Researcher: [Right. So you
have an auto, automatic   [eh

Subcamer: [Yeah, we have a process that we follow, you know, to (attain ?) we will follow that same process, ahm, and he'd gone half way that process already so. So you're right, yeah, I checked the, the process that he'd followed would be the same process that I would do, amh, and then, yeah, I guess, you know at that point it ends you start to get more creative in, in your thinking. Yeah.

In this case, the subcamer makes explicit, in his own words, the procedural rationality that been described by classic literature on human problem solving. Interestingly, although this process is collectively shared by the team's experts, it not an explicit reference procedure in

the surgery, but could be ('I could give somebody a piece of paper and they could follow the process and get rid of like 90% of this stuff').

The subcam provides material that is especially relevant for the reconstruction of the mental activity. Experience shows that subjects are able, even weeks after the fact, to recall very precisely the situation. We can check whether this is not a reconstruction by asking the subject 'what will happen next', and then compare with the actual action on film.

This recall effect is probably due to the nature of episodic memory(Tulving 1972, 2002). While semantic memory recalls general relations between objects, episodic memory is a multimodal association connected to an actual lived event (time, place, associated emotions, intentions, contextual knowledge and other associations) which come back as a bundle when the subject recalls the event. At the view of his own film, when put back into an exact perspective of the actually lived sequence, the subject is naturally induced to recall this sequence. Getting multimodal cues allows much better recovery of events experienced (ref. Marcel Proust's madeleine episode, or emotions relived by returning to the scene of an event). At this stage it is possible to have access to thoughts and emotions of the subject (Bentley, Johnston and Baggo 2005) even months later – a delay often needed for the analysis and finding an appointment with the subject. Such an effect is observed with classic film recording, but not to the same degree as with the subcam. The neurophysiological mechanisms behind this interesting phenomenon are yet to be discovered. It is possible that the mirror neuron system (Gallese, Fadiga, Fogassi and Rizzolatti 1996; Rizzolatti and Craighero 2004; Rizzolatti, Fadiga, Fogassi and Gallese 1996) is involved, but this is only a hypothesis.

While discussing the interpretation with the subject is not new, we found that adopting an "evidence-based" approach, by discussing a material that strongly supports recall of subjective states (intentions, emotions…) brought ground-breaking progress to our research. One fascinating but embarrassing fact is that often our previous own explanations based on viewing the film without the subject, although plausible, were denied by the subject who fostered quite different, and obviously 'true' interpretations. We should highlight here that, now that we have practiced this for a while without major difficulties, we find it surprising that most of the time research in social science does not even care to check its interpretations with the subjects themselves.

3.5. Presentation and transfer

We need not insist here on the advantages of using the film for presenting the phenomena and the results themselves, instead of a transcript. We believe that some years from now the film will become a primary publication media, and gradually replace text in the presentation of

empirical material in scientific journals.

As a preview to this yet to come era, this paper is linked with presentations of subcam films, available at: http://www.psych.lse.ac.uk/socialPsychology/faculty/saadi_lahlou/subcam-films

Nevertheless, the presentation formats combining video and commentary are still in infancy. Further research is needed in this domain.

4. Equipment and protocols

However exciting SEBE may appear, it would be foolish to think that buying some off-the-shelf head mounted camera designed for sports will do the trick, as some colleagues naively hoped. Just as it takes more than a tape recorder to make good ethnography, it takes more than a head-mounted camera to do proper SEBE. The most important element of the whole method is building trust with the subjects, and in practice the devices and method to create a good environment for SEBE research are unfortunately heavy. They need careful preparation and often the help of several researchers on the field.

4.1. Equipment

4.1.1. Capture : the subcam

The device should be portable and light enough not to change the behaviour observed.

Our first subcams date back to the 1990's when video equipment was still using tapes, was energy greedy and was not as small as today (Lahlou 1998, 1999). We were forced to design it and then have it build from scratch. The first prototype was built by the French company Genitech and operational in 1997. Now, although we still cannot find what we need off the shelf, subcams are easily assembled from cheap components available to any laboratory. In a dozen years, cost dropped by a factor 50, size and weight by 15, while resolution and autonomy grew by a factor 4. This trend will continue. The current versions (except the very high resolution one which was custom made in a small series and can record enough detail to read details and text) are made of a small recorder, about the size of a mobile phone (Figure 3), a very small camera (about 1 cm) which we attach to glasses or a to bandana (Figure 2), and a microphone a few millimetres in size.

Figure 2 : subject wearing a subcam ('light' version, 2010): the camera is attached to the subject's own glasses (small black cylinder). Wire goes behind ear to wearable recorder

Figure 3 : Subcam, 2010 version, the recorder (carried in a pocket or clipped to belt). Wire goes to camera head.

Subcam-like devices are now employed more and more. Often integrated into a helmet, they are used in sports such as bike racing, skiing, hunting etc. Subcams are also used by emergency response services, the police and the army. The pioneer of wearable cameras, Steve Mann, advocated the use of first person recording to develop 'sous-veillance', a

citizen's answer to digital surveillance, by authorities. With such recordings, the individual could document his own perspective and challenge the authority's recordings (Ganascia 2010; Mann 1998, 2004; Mann, Nolan and Wellman 2003). Some of his predictions start to realize: already individuals use them on a daily basis, as this British cyclist who used one to document an accident with a van (Aldridge-Neil 2011).

In feature movie production subjective perspectives has often been used, sometimes systematically: see *Being John Malkovich*, *REC*, *Das Szenario* (a marketing event by Cortal Consors Germany where subcams where used in a popular 'experiment' to communicate the experience of participants to a wider audience). But subjective view in cinema is very different from what appears on subcam films (see infra, section 5).

Here is how to make a subcam for research purposes, to study human activity, from off-the-shelf components. The camera should be very small, and the recorder as well. The angle of view must cover the manipulation area. The camera must be equipped with a wide angle lens (about 115 degrees of field coverage), which captures the hands in the record field. This can be obtained with add-on lenses because small cameras often do not have wide-angle.

As the camera should be mounted at eye level, subjects who already wear glasses (and they are many, especially after the age of 45) are a problem. We make custom attachments in such cases (Figure 5).

It is also important to have good stereo sound, and one issue is to have a dynamic range that enables capturing both distant voices and the subject's voice, but not saturate in noisy environments such as the street. This forced us to develop specific additional hardware and firmware to adapt off-the-shelf equipment. Ideally we need binaural microphones (one in each ear) to capture directional sound, and phone conversations. Otherwise, simply using a small digital recorder in the subject's pocket and dubbing it to the video can do.

Because we capture sound on the subject's body, voice and other body sounds (like breathing) are of better quality and higher volume compared to physical sounds (object manipulation). This gives us clues about the subject's emotional state: breathing, hoarseness, throat clearing, grunting, primary vocalization, etc. We can detect, for example, during a discussion, the times when the subject seeks to utter without necessarily succeeding, by hearing the primers ('Er..' 'I..').

The longer the autonomy the better. We can record many hours of video without changing the memory card (a whole day if necessary); but we are currently limited to about 3.5 hours of battery life. One full day autonomy is the target.

For very young children and animals, we can use a version with a radio transmitter, where the recording is done on a remote VCR. This equipment is small and light (Figure 4), but we do not use it for adults because we prefer the subject to be in full control of the recording at all

times, to build trust (cf. Infra, sections 4.4 and 7.1); also the wearable recorder provides better image quality. The technology changes so fast that there are many custom-made versions in various labs, based on different components. Over the years we have used more than 10 versions. Decent results can be obtained in many cases with rather primitive equipment, but specific research where one need to read details and have high quality sound can be technically challenging.

Figure 4: Child wearing our lightweight wireless subcam on a bandana

In conclusion, two important things to keep in mind with subcams:

a) the device must have wide-angle, good sound, reliability and be very easy to use by the subject. Off-the-shelf devices, like the ones made for sports, are usually not adequate: actual use on the field reveals that devil is in the detail, for example equipment must be easy to attach to people who do not wear belts or helmets.

b) the capture device is necessary, but not enough. The protocol is very important, and is the most difficult part of the technique.

4.2. The protocol

This paper presents the current state of our protocols for data collection and methods of analysis based on a dozen years of experience which provided hundreds of hours of films. Nevertheless, the method is still in infancy and the protocols will evolve. We trust the readers will adapt them to their specific needs.

For the sake of clarity, we call here, respectively, 'subcamer' the subject who wears the

subcam, 'colleagues' other members of his community where data are collected, 'cast' persons appearing on the film, 'researchers' those conducting the experiment. In general we shall call 'participants' all of the above except the passers-by who are hardly recognizable on the recordings.

4.3. Preparation

The nature of subjects and length of observation are selected according to the research problem (usually a few hours recording or less).

It is wise to pay a preliminary visit to the environment where the subcam will be used. Recruitment is not just about the subcamer, but also about his environment (colleagues, cast). We must ensure that such recruitment is complete and has informed consent of all participants and stakeholders (e.g. the hierarchy in organizations, owners of the setting, parents or caretakers of subjects etc.) The protocol is explained to participants, they are introduced to the device, shown films, explained the purpose of research, and given the subcam for a test on their own.

If some people do not want to appear on film, adequate measures must be taken to take their wish into account. It must be made clear, and in writing, that no image will be used without previous written consent of people who appear on film. In some cases where it is not possible to avoid capturing some passers-by, face blurring is an option. It would be too long to describe in detail the process by which we ensure all this, but be aware that in public spaces this is a painstaking task that requires preparation, e.g. with preparing informed consent forms, setting logistics to give participants access to the recordings, keeping track of addresses and consents, etc. This is why the method is easier to apply in a closed environment where subjects can be traced.

For subjects who already wear glasses, we make a special attachment that enables the camera to be tied to their own glasses (Figure 5). This takes about an hour in our workshop. We take pictures of the subjects' glasses so the attachment can be made offline between first contact and collection day.

People with standard eye correction can use one of our special set of glasses with attachments.
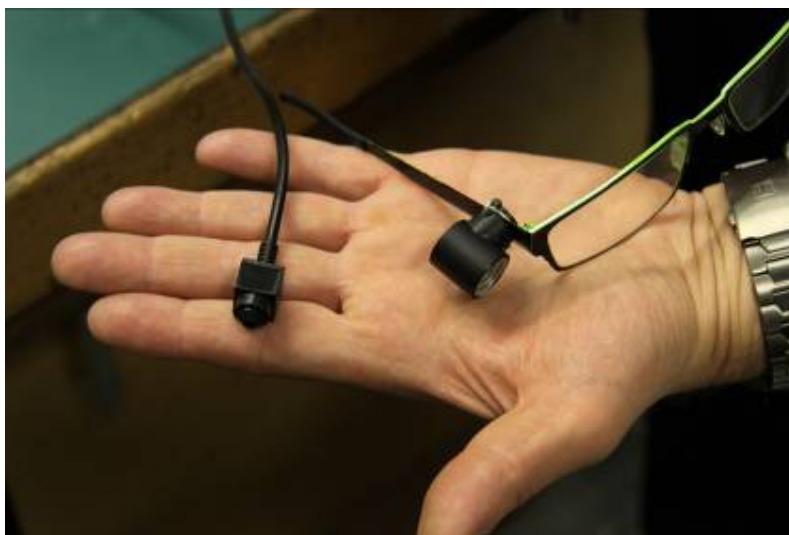
Figure 5: Subcam attachment to glasses. Left the camera head, right the subject's glasses with the attachment clipped to them. The camera head clips into the cylinder.

A preliminary interview with the subject enables to better understand the context. The first visit will also help spotting potential issues, especially with colleagues and cast. Preparation does not remove all the reactions of surprise and jokes by colleagues to the subcamer, but it does reduce them significantly. The ideal case is of repeated capture sessions, which enable all participants to get used to the device and not pay attention to it any more. Keep in mind that the cooperation of all participants will be necessary in the analysis process, and for publication. Informed consent of all individuals on the films should be done before or just after recording, and track kept of who is actually visible on the films. This is easier if the issue has been addressed well in advance.

Experience shows that difficulties arise less with the subcamers themselves than with other participants: as he wears the camera, the subcamer feels in a psychological position on the side of the researchers. Also, the subcamer usually benefitted from more attention from the researchers, and is taken into an involvement process that results into compliance and motivated participation (Joule and Beauvois 1998; Mayo 1949).

One might be tempted to use 'spy' recording devices. We are opposed to the practice of recording unaware subjects. This is not only unethical but short sighted since it is trust and cooperation of the participants that make the method so productive. The protocol aims to build trust through concrete measures and strict ethics. It is in the best interest of the researcher to earn that trust by being the guardian of the 'face' of subcamers. One need sympathy and care for the subject. Only at the cost of a constant endeavour of responsibility vis-à-vis the participants can one get access to their experience. The principle that should

guide the researcher is to avoid at all costs the possibility of an incident, even if it means sacrificing data collection.

4.4. Collection phase

On the day planned for recording, one or two experimenters, of whom one at least is already known by the subcamer, come to equip the subject. One should stick around to help the subcamer to change memory/batteries and to solve any arising issue, technical or social. It also makes the subcamer's life easy: if a participant wants more explanations about the process, the researcher can do this off-line while the subcamer remains undisturbed. It should be clear to the subcamer and his colleagues that stopping the recording is a benign act, which will not be taken badly by the researcher. This helps all participants feel comfortable and in control. And indeed, if the subject chooses to delete the record of the day this is no big deal: this session may be replaced by another later.

The subcamers are instructed to go about their activity 'as usual'. As this may be disturbing for the subject --- 'be-natural' being a paradoxical injunction (Sluzki and Veron 1981) - the subject also receives *technical* instructions. These instructions focus on technical aspects: the subcamer must stop recording when going to the bathroom, if he feels that one of the colleagues is embarrassed, etc.

The adjustment of the subcam, especially for those already wearing glasses, takes several minutes. It is somewhat similar to a session at the tailors' or the radiologist and may cause the same type of discomfort in the subcamer, because the experimenter is quite close and must touch the body of the subcamer to fix the recorder and adjust the wire and the camera angle. The researcher must announce and explain aloud her manipulations.

During recording, the researcher takes note of all incidents. Immediately afterwards, she holds a quick debriefing. There she seeks the subject's feedback to assess whether the behaviour was biased by wearing the subcam; and if so where and why.

In the general opinion of users, the subcam is forgotten after a few minutes and their behaviour was spontaneous, except for brief episodes where they paid more attention to what they said. Anyway, as the subjects are taken in the flow of real action, they are in some way induced by the context to behave 'normally' in order to reach their goals. Biases when they occur do so in interaction with fellow humans, not with objects.

After debriefing the subcamer keeps all records and equipment for a few days, with instructions to watch them, to make sure he is comfortable with researchers watching it, and otherwise destroy any or all of the data, with no questions asked if he decides to do so. As the recorder automatically breaks down the recording into 15mn files which can be read on any computer, erasing a part of the recording is easy even for people with very limited technical skills.

Another reason for our protocol is to constantly make the researchers aware of the subject's interest so as to avoid any blunder on their part, e.g. showing the films without consent etc. We are aware this is heavy. But this is part of a philosophy of collaborating with the subjects, considering them on the same level as the researchers, and the results are worth it. It also makes it a more interesting experience for the subjects, who learn about themselves.

Debrief at the end of the recording session is an opportunity to fill a short questionnaire with the subcamer and make an appointment for the confrontation interview. The timing of the self-confrontation must leave some space for the subject to watch the films and then for a short preview of the films by researchers, where the most interesting parts will be clipped to be discussed later with the subcamer. In this clipping process, researchers will make a first interpretation attempt, to be confronted with the subject's own interpretation for validation or amendment. (NB: clipping is a Damastic operation, and the researcher must be quite clear about her rationale in this operation (see infra, section 4.5)).

After having being given the films, subcamers usually do not ask for cuts. Here is the most frequent case: subcamer viewed in detail the beginning of the subfilm and found it fascinating; then fell on a long sequence where not much happens (e.g. doing email on computer, taking public transports, etc.); then passed into fast forward mode, possibly watching a particular episode. Most have not even watched all of the films. In fact, after the excitement of re-living the situation in detail, the 'déjà vu' aspect lowers interest and the subject finally realizes that the films only show mundane, everyday activity. This first experience usually takes away the last reluctance to use the tool and subcamers often offer spontaneously to repeat the experiment if necessary. This is a good thing because usually the second take is better, all participants now having lost their initial anxiety if there were any. This is also valuable because the subcamer then becomes a subcam advocate with his colleagues and a potential recruiter who has best access to local participants. This is another reason why the subcam is particularly well-suited to long field work.

4.5. Analysis: confronting the subcamer with recordings

> A tremendous advantage of recorded data is that it permits repeated, detailed examination of actual sequences of talk and embodied work practices in the settings where practitioners actually perform these activities (Goodwin 1994 p. 6077).

The films made by the subcamer are viewed by the researcher, 'interesting' scenes are clipped and undergo an initial analysis. These clips can be a few minutes, or much more, but one should be aware that long extracts may take very long to discuss, and keep in mind that the subject may not always be able to stay concentrated for many hours. This is why we tend to clip, and focus only on scenes that are relevant to the current research.

The subcamer is then showed the clipped extracts and invited to comment them (self-confrontation). Figure 6 shows a typical view of debrief on site. We often invite subjects to view the films in a specific room in our lab, on a very large screen.

These sessions, in the presence of the analyst, are videotaped with an external camera, or with a subcam worn by the subject (which is the now option we adopt usually). This way we know what the subject refers to when commenting the clip, and we can control for the influence of the researcher in the confrontation interview (cf. the Damastism issue, section 1).

When extracts from the films are considered to be used for a public presentation, informed consent is sought on the occasion of the confrontation interview.

Figure 6 : confrontation interview. Subcamer (centre) comments subfilm (right) to researcher (left)

The material selected for the analysis naturally depends on the research problem; everyone can build their own strategy for selecting clips. When investigating small samples, we clip as we collect the data and therefore do the confrontation interviews as just described. On larger samples the strategy we use most frequently is 'retrospective sampling'. It follows from the general heuristic of 'experimental reality' in which we follow over a long period (several months up to three years), in great detail, the activity of entire groups, e.g. by accommodating them in a building specially designed for observation (Lahlou 2009). This strategy is also used when we do not know exactly what is relevant *ex ante*, or to re-use videos from previous

captures with a new perspective –the latter being especially useful because it spares new data collection. And more generally, it happens that we only realize after the fact what was interesting to study in a situation.

When viewing the films, if an event seems particularly interesting, we develop interpretative assumptions. If we have a large sample we then derush other recordings from which we systematically extract clips of similar situations to validate/falsify our interpretation. We thus obtain a sample of natural situations where a particular type of phenomenon occurred. These clips are then systematically coded in detail, and hypotheses tested. For example, Cordelois, when studying the activity of 'returning home', noticed an interesting 'sigh' on one recording, after the subcamer just passed his home door. He then went fishing for similar occurrences in all the rest of his sample to test his hypothesis. It turned out that 73% of subjects did have some sort of relief or relaxation 'sigh' right after they had passed the door when coming home (Cordelois 2010). This had gone unnoticed in most cases except one in the first analysis of tapes; but was very significant for the analysis of what it means to 'come home'.

In another instance, we extracted and analysed systematically 101 interruptions during office work by a visitor or by phone, retrieved from 50 hours of subfilms (Lahlou 2000). This allowed us to better understand how interruption was handled by the subjects and how it affected their subsequent activity.

Another technique is to compare the same activity in different environments (Nosulenko and Samoylenko 2003). For such analyses we identify the tasks, the participants, the activity components (goals, tasks, actions and operations) and the tools that mediate them. We can also compare the differences between the planned activity (as described by the subject during a preliminary interview) and actual activity. Such comparisons are instructive regarding the influence of the environment on actual activity. In a comparison of planned and actual tasks by an expert (in this case, sending an email with a PDA), it was found that 7 out of the 16 actual subtasks were not planned, and that unplanned operations accounted for 58% of the actual task duration (Lahlou 2008; Lahlou, Nosulenko and Samoylenko 2002). From an operational design perspective, understanding these differences and reducing them by acting on the installation improves comfort and overall efficiency in the workplace.

The subject comments as the film plays, he pauses or moves forward and backward to explain in more detail the reasons for his actions. This kind of comment requires the subject to understand what the researcher is after; and is more demanding than classic semi-directive interview, or debriefs. This is why the first minutes are used to train the subject as the analysis begins, by encouraging him in the right direction, and make him feel completely at ease and in control of the process. The main fear of subjects is to lose face. Therefore the researcher must reassure the subject that what is being discussed is quite usual. One way we do this is

sharing our own experience. For instance, most subjects, when commenting subfilms made at home, apologize that 'my house is a mess'. Our typical answer is 'You must be kidding, you should see mine! It's funny, everyone says the same thing. It would be impossible to live in a house that is always perfectly ordered.'

Especially in the beginning of the process, the researcher must ask the subject to pause the video many times, and insist on getting a detailed account of action, in the minutest details. In doing so, the researcher ventures various hypotheses and asks the subject to confirm, give precision, in order to peel the various layers of goals and motives that lie behind the observed action. The subject must be introduced to this notion, and empowered into detailed introspection.

As said earlier, natural activity is about running several processes in parallel. There are several layers because, in real settings, subjects constantly pursue several goals at the same time, perform sequences of tasks with diverse time horizons, switch from one to another in order to make the best use of resources. Subjects also actively try to avoid some unwanted situations. Experts can be recognized in their capacity to take early measures avoiding potential problems later in the course of activity.

The confrontation phase is dedicated to the peeling of the various layers in order to recover the processes that were at work. The challenge of activity in everyday life is precisely for the subject to run all these processes in parallel with a limited capacity of consciousness (e.g. short term memory), limited capacity for action (two hands) and of perception (limited visual field and focus), within an environment that is not always cooperative. Therefore, some tasks must be fragmented and put in waiting line while others are being processed. In practice, humans show amazing proficiency to do so; they take advantage of the external limitations imposed on the activity in order to optimize the use of their resources: e.g. in the following example, during the time the water for tea takes to boil, the subject intercalates tasks relating to another course of action.

> This subject, on coming home, prepares tea. While the water boils, she goes up to her room and opens her computer to check the timetable of the gym for activities; while the laptop boots she goes to the bathroom and collects her dry swimsuit to put in in her gym bag. And as she had kneeled in the first place to take her laptop out her school bag, she had collected her sneakers that were on the floor and put them in the gym bag…

Cordelois provides a similar example of a subcamer making tea after returning home, who was at the same time storing the clean plates etc. She managed to perform 127 operations in 4:09 minutes (Cordelois, 2010), effortlessly and as part of her daily routine.

Subjects are usually unaware of the amazing psycho-motor expertise they display in such performance, which they mostly run in auto-pilot mode. In the example of the gym bag mentioned supra, the subject apologized to the interviewer as she found her activity looked

'confused'. It is the main task of the researcher to create trust with an engaging and reassuring manner and set the subjects into a reflexive mode. Showing the subjects how subtle and agile interweaving of operations is the final observed behaviour helps them understand that compared to their splendid overall performance, small hesitations, mistakes or blips are inevitable and do not lead to losing face. The subject, now freed of the preoccupation of losing face towards the experimenter, relaxes, enters a reflexive entheaty mode and becomes gradually more and more efficient at explicating her activity, in a collaborative and detective-like cooperation with the experimenter. This enables constructing an explanation that is both emic and etic, that is accurate from the subject's perspective although understandable by others.

This is our answer the postulate of adequacy, which is formulated by Schütz 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 for himself as well as for his fellow man. (Schütz, 1976: 19)

As one researcher may not always be capable alone to do this re-construction with the subject, we sometimes need experts, or the perspective of other subjects/analysts who have first-hand experience of the type of situation analysed. In some cases, we proceed to a collective analysis of the film, and include other subjects or experts to construct the explanation. This collective process has been described by Cordelois (2010).

4.6. Accessing the data

This has two aspects. Video must be accessed for analysis purposes by the researchers and subjects.

It must also be made available for publication of the results.

As video is our primary research material, accessing the data, annotating them, giving access to the subject etc. is of crucial importance. We use several systems for video analysis, but the most useful is Diver, an online annotating system developed at Stanford SCIL by Roy Pea and colleagues (Pea and Hoffert 2007; Pea 1994; Pea, Lindgren and Rosen 2008; Pea, Mills, Rosen et al. 2004) which enables *online* collaborative analysis of videos by searching, visualizing, annotating and editing in a shared manner all of the videos. With Diver one can participate in interpreting videos from anywhere one can access the Internet.

As this system has been described elsewhere, I shall not expand here, but it must be clear that whatever system is used should enable easy access to the material to both subjects and researchers at any time, and empower them to build together explanations. Diver is a fantastic tool in this respect, with an easy interface (a version has been developed for 5-year old

children) and of course this easiness of access is a plus when we want to show the data for publication (how could a paper article without links to the videos render the content of action?)

Diffusion seems to be a more straightforward issue, especially since video has become a very common media on the internet. One of the fastest growing fields exploring the use of video for non-leisure purposes is in education. Often under the category *learning sciences* a whole range of application of video in education is investigated (Goldman, Pea, Barron and J. 2007; Sawyer 2006; Weiss, Nolan, Hunsinger and Trifonas 2006). Nevertheless, a series of serious problems remain: how to present best the subfilms, how to combine the primary material with comments, how to safeguard the subject's interests in avoiding further reuse of the data out of context. More development is needed. Inserting links to subfilms in an online paper, as did (Brown, Dilley and Marshall 2008) seems to be a good practice that could be generalized.

5.   The view from the other

The pace of the subfilms is very different from the motion picture 'subjective camera' perspective, in that the subcam constantly follows the head movements. Human head is surprisingly stable, much more than the image obtained by a camera held by hand or shoulder, through the perfection of the natural system of support and guidance of the head muscles. But the sweeping movements are often very rapid ('ballistic movements'), and can make some viewers seasick. For this reason, it is preferable that the person performing the analysis has direct knowledge of the physical environment where the shooting took place, in order to have a clear proprioceptive representation. It is in her own subjective spatial representation that the subject acts, and it is the same for those who watch the film, making it easier for analysts to follow the action when the environment where it happens is familiar. Analysis of films in a familiar environment is much less tiring, probably because it requires less effort for sensory interpretation. This calls for the analyst having been in the field herself, which is a limitation. Interestingly, as viewers are taken into the perception-action loop of the subcamer in entheaty, an identification process emerges and empathy occurs, based on sharing similar phenomenological experience. Although we do not get a fully multimodal recording, it seems that the elements recorded on film are enough to elicit in the viewer an experience similar to the subject's. To what degree this is deceptive is difficult to assess. 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 each are the result of our respective total life-experiences. Theory and practice diverge here. Experience shows that entheaty 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 films. 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.

5.1. Sympathy and fascination

Analysis of subfilms is a striking phenomenological experience, for both the researcher and the subject. The subcamer sees his action, in detail but without being caught in the flow of activity and pressure to act. The researcher takes a dive into the world of someone else.

Over the last dozen years we many times had the opportunity to present our work to colleagues. It became very clear to us that unless one has experienced using the tool it is impossible to get a clear idea of it, because it is so different from external video that one's previous experience is misleading. The same questions always come up: possible influence of the device on the subjects' activity, comparison with eye-tracking, reconstruction vs. remembrance, influence of the researcher in the confrontation interview, etc. But their intuitions are very different from the actual effects. Quite naturally, colleagues suspect our own enthusiasm is due to the fact that we invented the technique --- although they often don't dare expressing this scepticism too openly! It is strange indeed that such a minute change as filming from the other's perspective, and discussing mental activity with the subject based on evidence rather than memory would make such a radical difference. Nevertheless, even colleagues who saw subfilms, had long discussions with us, and whom we thought had understood what it's about, do come back changed and exhilarated after they tried the technique for real. Similar change of perspective probably occurred when ethnographers started going to the field to get a first-hand experience instead of relying on explorers' travel stories as a primary material.

The idea of voyeurism one could fantasize disappears quickly when viewing the recordings, where the researcher acquires an empathy with the subcamer. The notion of empathy is improper in that it means sharing emotions, which is not really the case. This is why we had to forge the neologism of 'entheaty' to express this new and unprecedented situation in human experience: sharing the spectacle of activity from the actor's perspective.

Unlike in motion pictures, nothing is done deliberately to elicit emotions. The subcam is not a mode of expression as the conventional film; it produces a raw material, without intent to 'show'. The researcher is somehow connected in parallel with the subcamer's sensorimotor loop, a bit like a driving instructor. The term 'passenger' used in the film 'Being John Malkovich' accounts rather well for this position.

By closely following the activity with the same visual focus, and to some extent auditory focus we induce some identification mechanism, some ability to guess the thoughts of the subcamer. Our explanation is that not only humans are capable of empathy --- see (Hatfield, Rapson, et al., 2009) for a review --- but also that in daily life we share so much implicit knowledge in a common culture that such exercise is relatively easy. In fact, the subfilm puts us 'in the shoes' of the subcamer, and often in her situation we would have acted the same. The socio-cultural context requires certain behaviours, or at least largely determines them, as Goffman demonstrated quite convincingly (Goffman 1959). Without such a framework of conventions that make the actions of others predictable, social life would be difficult.

In a detective story, 'Murders Rue Morgue' (Poe 1978), Edgar Allan Poe describes how, as detective Dupin and his friend walk along in Paris without speaking, Dupin suddenly answers aloud a *thought* of his friend, to the amazement of the latter. Then Dupin explains how he reconstructed the thread of his friend's thoughts, or rather followed it, by observing his successive foci of attention and mimics during the last few minutes. Dupin, who lives with his friend, could guess correctly the associations of ideas that emerge from a shared culture in a given context. In the case of the subcamer, provided that the analyst knows the subject and her environment, observing subfilms allows him to make similar deductions, as can be checked during the self-confrontation interview.

Understanding the meaning of the activity does not exclude a sense of strangeness at the viewing of subfilms. Diversity of being-to the-world is the same as with writing styles or ways of walking. The way one moves and acts is surprisingly personal: more or less abrupt, sharp, fluid, reactive. How to manipulate objects, and behave with others, is obviously subject to individual variations, as we all know. But it is surprising how perception itself is a matter of personal style. As said earlier perception is an activity in itself (Leont'ev 1978), an exploration that results from the orientation of sensory organs towards a particular point of the scene. In fact, the subfilms show how the dynamics of orientation vary between individuals. They show different personal investment in the situation, according to the degree of coupling of their action with the events and the context, as well as by the selection that is made out of this context in order to focus attention and respond.

Subfilm watching is for the observer the opportunity of an insight on the variety of how different individuals perceive the world and a lesson in tolerance. A subfilm is very enlightening of the way-of-being of the subcamer. It is therefore an intimate material, which must be approached with respect, sympathy and sensitivity. It is the responsibility of the analyst to extract only materials regarding the on-going research, without exposing to the public the intimate and personal aspects that the material can reveal about the individual psychology of the subcamer.

Subfilms produce some fascination effect on the viewer. Unlike with films with a fixed camera, or held by an operator, one can watch for hours without boredom subfilms on activities that would otherwise seem tedious, like laying bricks or eating soup, and be captivated a bit like when watching a campfire. I must insist that this is not only the personal case of this author, but a phenomenon attested by many viewers. That, of course when the relevant details are visible or audible, it is not the case e.g. when the subject reads and we cannot distinguish the words. We have yet no definitive explanation for this phenomenon. For example, when the same scene was filmed simultaneously with a fixed camera, and a subcam, the recording derived from the fixed camera often seems uninteresting, while that of subcam is quite watchable. It seems to be a kind of capture of the viewer by the phenomenal flow of the subcamer rather than some interest in the action as such, as if the audience was reluctant to interrupt the current action.

The perception of time is also different between subfilm and fixed camera recordings, and between reality and subfilm. We have not yet found a general rule, or explanation, but this effect is striking enough to have been reported by different analysts. For example, a subfilm sequence often appears shorter than the same sequence in external camera. But a subfilm sequence sometimes seems longer than the action in reality experienced by the subject himself. For example, a 9 year old subcamer, when watching his subfilm of himself eating soup, asked candidly 'You must be joking, you're showing me the film in slow motion' (and later eventually fell asleep during self-entheaty).

This is even truer for sequences of routine activity. In self-confrontation, routine activity (commuting by car, traveling between the office and cafeteria, doing e-mail) appears 'much longer than in reality'. Indeed these activities were usually performed in auto-pilot mode. Xavier de Maistre, in 'Voyage autour de ma chambre' (1794), provides a hilarious account of such effect by describing how, as he was *en route* to the king's palace, his mind started wandering and he finally found himself in front of the door of the house of his mistress, Madame de Hautcastel, half a mile away from the palace. He describes this as a situation where 'the beast' (his body) took over operations while his mind was wandering. This is one of the limits of the subcam: we do not capture the flow of thoughts in such moments of routine, often used for background considerations, and which the subcamers have some difficulty to recover in self-confrontation, if ever they do.

Such effects of strangeness in self-confrontation clearly show that there is a lag between entheaty and the initial experience. Therefore the confrontation interview also involves additional reconstruction, because the subject is not exactly in the same situation, especially regarding cognitive pressure to act.

Sympathy for the actor is another surprising effect of viewing subfilms. It becomes difficult if not impossible to bear a moral judgement upon the acts observed, since they include the perspective of the actor. From his own perspective, the course of action often seems natural and understandable, including errors. The viewing of many subfilms eventually induces a general attitude of benevolent neutrality towards the subjects, comparable to the physician's and expert's professional detachment, or the psychotherapist's. In this perspective, the intentions of subjects lose their moral connotations, and are perceived by the researcher as mere explanatory factors in the sequences of observed phenomena. This attitude of detachment and 'no judgement' vis-à-vis the data inevitably reflects in the researcher's relationship to the subject, and contributes, we believe, to facilitate acceptance of the protocol by the subjects. Their main concern as we have said is indeed to be judged or lose face.

5.1. Research on inter-subjectivity

A stimulating aspect of SEBE is the ability it gives the researcher to analyse the same scene from different individual perspectives. Every individual lives in his own phenomenological tunnel. For example, we filmed a dinner between friends, where 2 of the 4 participants wore a subcam, while the scene was also filmed from a fixed camera in the dining room (Lahlou 1998). The subfilms show that while the guests attend the dinner scene continuously, the host follows parallel courses of action, of guest, cook and host; cooking and doing the service. A similar experiment where we used three subcams and a panoramic camera in a restaurant also showed that what we consider a single 'scene' covers in fact a series of very different individual 'phenomenological tunnel' paths which cross occasionally.

The subcam clearly shows there is no uniqueness of the situation, because individual experiences are objectively different. Obviously, comparing the bands of several protagonists of the same scene show that what they see is different. More worrisome: they do not *hear* the same thing. As sound is something we would expect to be shared by all participants; this can appear somewhat disturbing a finding, discovery. In transcribing the tapes from various participants of the same scene, we noticed discrepancies in the transcript of different subfilms. Overall the transcripts were similar. But in the detail, they varied (e.g. 'I mean' instead of 'You see'). For example, the order of transcribed speech turns when several people speak about the same time would not be the same, or the moment when two utterances started to overlap. Difference in transcription of certain words that are hardly audible on one recording and clearer over another was noted. Such effect is normal and can be observed even for successive transcriptions of the same tape, because transcription is a difficult exercise that needs a lot of concentration. Here discrepancies did not disappear after several attempts of transcription at normal speed.

The last type of discrepancy (synonyms) points at the nature of the mechanism. Just as visual

interpretation results from reconstructions of local captures of the scene by the eyes as they sample the scene in ocular saccades, then assembled in a mental reconstruction of a 'single' scene, language comprehension is probably the result of acoustic sampling of the speech flow and reconstruction, with the help of other cues in the context (mimics, mouth movements etc.). In other words, subjects sample the scene with their senses and reconstruct a global picture from this sampling, based on their existing knowledge-of-the-world. Therefore, two subjects situated in different positions may sample different cues, and reconstruct slightly different pictures. The coder did not in fact accurately 'transcribe', he reconstructed from sampling the speech flow. Because his reconstruction depended on the subcam's perspective, the coder reconstructed slightly different pictures from different tapes. This would be especially noticeable when the sound was poor; but we can assume that the subjects themselves face identical problems, and so each protagonist 'hears' something slightly different depending on where he focuses his attention. Of course, detailed and many times repeated listening for word-by-word transcription would usually in the end produce two similar transcripts, but this is not the ecological situation where subjects construct interpretation on-the-fly based on ambiguous cues. *This has vast implications: Damastism is not only a researcher's problem, but a general one.* We do live in different worlds because all we can access is our own interpretation, which will by construction differ slightly depending upon our own position. This is why 'reality' has to be negotiated. This sheds a new light on the nature of inter-subjectivity.

Only through a series of powerful social mechanisms do subjects manage to join in the same inter-subjective space where communication and action occur. Cooperation is made possible because all participants share a social representation (Moscovici 2008) of the situation. This led to the idea that cooperative action, and social life in general, is rendered possible by the psychosocial pact, a naïve realist postulate that 'What you see is what I see' and that we live in the same phenomenal world (Lahlou 2006). The existence of such a pact underlying the interaction has often been reported in various forms, including the study of communication, where participants must share a code (Shannon and Weaver 1949), respect the principle of cooperation (Grice 1979), having a communications contract (Ghiglione 1986), referring implicitly to a given narrative world (Eco 1979) etc.

In other words, the world is a mosaic of individual views, whatever the naive realists believe. But each view is linked to others through social relationships and communication, and the objects of each other are not independent, whatever the naive solipsist claims. SEBE can help study in detail the relationship between the three sides of the psychosocial 'Ego, Alter, Object' triangle (Faucheux and Moscovici 1971; Newcomb 1953), which is central to the problem of social psychology. It can show the detail of how people manage in practice to cooperate despite their different perspectives. E.g. we can peel the fine interleaving between

modes of verbal and nonverbal communication, particularly in exchanges of glances, which are often difficult to capture and analyse with traditional techniques. SEBE is therefore an ideal method for the social psychologist.

Although we know about all these issues in theory, and even though they have extensively been discussed in philosophy, situated recording provides fascinating evidence-based insights. SEBE enables an *evidence-based phenomenology*. Using the method to study inter-subjectivity is therefore an exciting avenue for future research.

6. Applications

The method has many potential applications: understanding the nature of social construction (from individual perspectives); enabling stakeholders to share perspectives (inclusion, conflict resolution); transferring tacit knowledge; studying child development etc. For the time being, it has mostly been applied for studying determinants of activity, for basic research on representations and inter-subjectivity, for training, to inform change policies, and for design.

Because of its mobile nature, the subcam is particularly useful to follow the activity and psychological processes of moving subjects. This explains why it has been used by our colleagues to monitor the use of mobile phones at UC Irvine (Christensen 2001; Mark, Christensen and Shafae 2002), France-Telecom R&D (Zouinar, Relieu, Salembier and Calvet 2004), as a contribution to Dominique Boullier's multimedia laboratory LUTIN (LUCSI 2003); to track activity in round patrols in nuclear power plants at EDF R&D; to analyse decision-making in occupational therapy (Unsworth 2001), sportsmen or fire-fighters (Omodei and McLennan 1994; Omodei, McLennan and Wearing 2005; Omodei, Wearing and McLennan 1997), etc.

Applications for professional training have recently been presented in this journal. Professional activity of power plant operators has been recorded with subcams and analysed using activity theory (Le Bellu, Lahlou and Le Blanc 2009; Le Bellu, Lahlou and Nosulenko 2010). The resulting films have been considered a major progress by the training division of the industry concerned. Applications in design have been presented elsewhere: the technique is used to follow current activity of operators, spot the difficulties, and try to come up with constructive solutions with the users, which are then fed into a recursive collaborative design cycle (Lahlou 2009). Obviously, the technique is well suited to industrial and professional environments, where access to subjects is easy, where trust can be built on the long term, and where the activities studied involve few possible interpersonal issues. In such contexts, the limitations of the method are not so important, and can be overcome with the proper protocols.

But the technique has great potential for other applications.

For the sake of brevity in a paper that is already too long, let us present here one illustration in the domain of social psychology, another one on the construction of representation, and very short anecdotes about interpersonal relations.

6.1. Social representations

This example is borrowed from the work of Sanna Leppämäki on social representations of novel foods and how they are constructed by children and adults (Leppamaki 2004). Subjects are recruited to taste new foods, as part (they are led to believe) of marketing tests conducted in France by a Finnish company. The example comes from the tasting of 'new varieties of tomato purée'. The subject, wearing a subcam, is asked to taste 4 cups containing tomato purée. The cups are completely identical in appearance and contain the same amount of tomato purée. The instructions given to the subject are to taste the products and give his opinion. Figure 7 shows one of the subjects in the experimental situation and a view taken from the subcam he wears.

Figure 7 : Tasting 'new products' with the subcam (Leppamaki 2004).

There are four conditions, which are explained to the subject, and cups are labelled accordingly: 'regular' purée (the classic brand), 'nutritional' (enriched with vitamins), 'organic' purée (tomatoes grown without pesticides), and 'GMO' purée (made from genetically modified tomatoes for better resistance to insects).

Although at first sight the subjects appear to do the similar gestures, and they do not mention any difference in their approach of the various products, frame by frame analysis of subfilms reveals that some subjects do not take the same amount of different products to taste them, and that this difference is not random. In fact, 4 of 11 subjects sampled significantly more from 'organic' purée than from others products.

As shown in Figure 8 (which shows a different, left-handed, subject than the one pictured in Figure 7), if we take the quantity taken as a reference for the '"regular" purée', the subject takes a slightly higher amount (about 125%) of the 'nutritional', a much higher amount of the 'organic' (over 200%) and a much smaller amount of 'GMO' purée (less than 30%). The comparison clearly shows the influence of representation in the fine modulation of the action (see Figure 9 for a close-up). Verbalizations of that subject confirm that he has a prejudice against GMOs: 'When afterwards asked about this the subject admitted his prejudiced bias although he thought that the amount had no effect on the taste experience.' (Leppamaki 2004).

'regular' purée   'GMO' purée

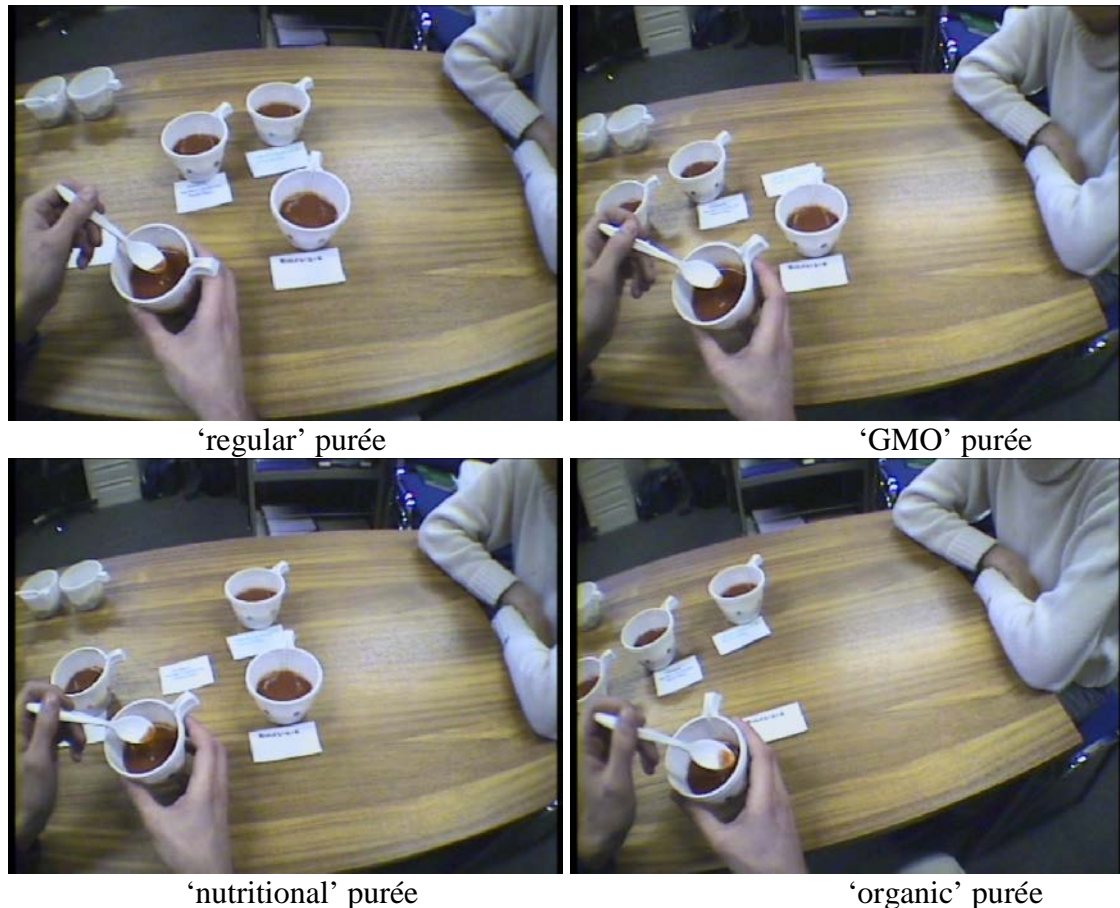'nutritional' purée   'organic' purée

Figure 8 : comparison of quantities sampled by the same subject to taste the four different products (Leppamaki 2004)

Figure 9 is a close up of the quantities sampled from the 'organic' and 'GMO' purées.

'organic' purée   'GMO' purée

Figure 9 : Close up of the sampling for 'organic' (left) and 'GMO' purée (right) by the same subject.

Of course, although the subject are led to believe that these are four types of different tomato purées, it is actually the very same product that has been put in four different cups, which ensures that differences in verbalization and behaviour are due solely to the subject's own representations. A most interesting part of the observed differences is that the subject whose actions are described in the previous figures said the 'organic' purée had more taste, while the 'GMO' purée had no taste. One might suppose that the quantities actually tasted may have contributed to the sensory evaluation; therefore the subject's action would in this case have produced a self-fulfilling prophecy.

Other verbalizations show that subjects tend to attribute qualities to purée in consonance with their representation, whereas in fact these differences derive from their own behaviour. For example:

> Three subjects thought that the 'the GMO purée' was worse than the others. One of these three also found the best (fresh) taste in 'the organic purée' --- which she didn't however attribute to drinking water just before tasting; (…)

> Subject [*drinks water, tastes two spoonful's of the organic purée, looks at the samples*] This is [*points to the organic purée*] at least better than this, [*points to the GMO purée, looks at the interviewer*] (Interviewer: Yes) it has somehow a more fresh taste (Interviewer: Yes) [*takes a spoonful of ordinary purée, looks at it, takes then organic purée*] I don't find big differences in these but maybe, I somehow like this, [*points to the organic purée*] quite good taste [*nods a little*] (Leppamaki 2004).

This example shows how SEBE allows an understanding of mechanisms that would be difficult to grasp with other protocols, especially as the effect observed here was not planned in the experiment. It was assumed that differences would emerge, but it was not known *a priori* which ones. The self-fulfilling aspect of representations appears as a corollary of using

representations to guide action: the subject tends to explore only the channels provided by her representation, and the latter is confirmed. Damastism, again. But also this gives food for thought about the actual detailed mechanisms of social (re)construction of the world (Berger and Luckmann 1966).

6.2. Interpersonal relations

SEBE provides fine-grained accounts of interpersonal relations. Space lacks here to describe in detail several examples, because precisely, as 'an image is worth a thousand words' the detail of gestures and facial expressions is much better rendered directly by showing the subfilm than describing it, and this is why video should be used not only for conducting the research but also for publishing the results.

Let us briefly mention some examples. The way one of our subcamers, a brick layer (who is wearing the high resolution version on his safety helmet, which is rather spectacular), stops in a corridor to let his colleague take a picture of him wearing the subcam on a construction site, although this is obviously disturbing him in his work, evidences, by his very posture and compliance, the good spirit in their team and the kind temper of this man.

On another film, a 9-year old subcamer gently pulls the ear of his grandfather and plays with it as the latter, a fierce looking man retired from the Russian military, cuts his food for him. Although the grandfather obviously tries to manage the image of an authority figure to the boy, the way he reacts to the boy's familiar but somewhat annoying behaviour, in a very benevolent 'I did not notice' way clearly shows the grandfather's loving care for the boy and the limited span of his authority.

In another instance, during a friends' dinner, after a somewhat sarcastic exchange, where it appeared in full light, through his partner's description of their journey, that one of the guest is a dangerous driver, the latter is served wine by the host immediately after the incident. The analysis in slow motion of the serving, where there is a series of minute reciprocal adjustments between the glass and the bottle held by the host and guest, serves as a silent confirmation of the friendly link between them, and reassures the guest on the absence of impact of him publicly losing face.

We deliberately chose positive examples, but there are other kinds. For example, it is frequent that male subjects look automatically at some specific parts of female's bodies; this appears clearly on subfilms, which may create embarrassing situations during analysis in a working context.

Although we are now exploring the use of SEBE in family counselling, where we believe it may have considerable impact, we do advise novices against engaging into such endeavour, precisely because SEBE may uncover very significant details (see infra: ethics, section 7.2).

7. Limitations

7.1. Being observed

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, that '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 and 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.

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, the subject sees the data first and only hands them over to the researcher if (s)he is satisfied with their content. But, in order to use this effect and get across the limitations, the protocol described supra is necessary.

7.2. Ethics

Throughout this paper ethics has been mentioned continuously, especially in its role as a 'research tool' to build trust. However, another word of caution may also be necessary.

The observation of one's own records can be an instructive but tough exercise. For example, the author, among other unpleasant habits, has that of imposing his conversation with his interlocutors in embarking on lengthy tirades. Not only that appeared in full light while watching his films, furthermore a feature of the subcam shows how much this bothers his interlocutors, including his relatives. In normal conversation, the speakers will have direct eye contact only a small percentage of the time (about 15%). Eye contact is an experience too intense to be protracted too long; social control imposes specific facial expressions, especially to express attention, which may require some effort. In fact, therefore, when two people

discuss, they mostly look a little off. The subcam, which does not follow the direction of eyes but of face continues to film the other's face, and thus reveals her mimics when she listens to you, and believes you do not see her face. These facial expressions are so often embarrassingly revealing the depth of her thought (boredom, disbelief, stress etc.) This means that the researcher must be extremely careful when using the method, and when clipping should get rid mercilessly of any sequences that could prove too embarrassing for the participants. This is especially the case in interpersonal relations within the family or at work. Although the subject may be vaguely aware of some relational issues with his relatives, seeing the evidence in slow motion and in detail may be hard to swallow, and difficult to forget. And of course the researcher should avoid at all costs displaying sequences that would cause a social problem to the participants: making them lose face, evidencing professional errors, etc. On the other hand, the fact the subcamer is hardly identifiable on the recordings can often solve such issues.

Therefore SEBE is potentially harmful if led without utmost care of the subject's interest. Getting signed informed consents is not enough. The researcher must evaluate potential loss of face, and not use 'risky' films. Some interesting raw data must often be discarded for this reason.

7.3. Preparation phase

The preparation phase, as said earlier, can be heavy, especially in public spaces. As an example, when we recorded the activity of IT technicians in the LSE 'laptop surgery' (where students can step in to have their laptop issues resolved, see supra the example in section 3.4) we encountered no problem of acceptance with the technicians themselves, who found the exercise quite interesting. But we had to set up a warning sign on the door, and to keep constantly three researchers who would explain the situation to the 'clients' who stepped in, get their informed consent signed, track in detail who would not want to appear on the films. The case occurred, and one of these persons, who was only accompanying a student, did not even want to give his name or have his picture taken so we could know who was to be blurred on the recording.

The researcher will have access to the records only after their review and possible censorship by the subcamer. This is a limitation in that it makes the protocol more difficult to apply since there must be one more occurrence of contact with the subject to get the recordings back. This adds to the subject's tasks. But this is important for trust: the subject knows she will be in control at all times of what has been recorded, and no bad surprise is to fear. For this reason, only in exceptional cases do we use the wireless transmission version of the subcam, where subcamer loses control over his records during recording (and may fear we keep a copy).

These precautions may seem superfluous– in the sense that subcamers almost never erase any part of the film, that often they don't watch the whole recording or do so at accelerated speed, etc. Many subjects propose to waive right away their right to preview the film; because they trust the researcher. But this trust has precisely been built by the control they have over their recording. Therefore this preview phase is somewhat a paradox: subjects do not use it, but if it was not there the whole nature of the psychological contract would be different.

7.4. The device and the protocol

Using a technical device always brings extra technical burden.
Although we have recorded hundreds of sessions, we still sometimes get poor quality recordings due to a faulty connector, a discharged battery, a full memory card, deficient prior marking of recordings, inadequate camera adjustment, or simply because the experimenter forgot to start the recording and left the device on 'pause' mode. It is therefore useful to use a checklist. It is highly hazardous to rely on the subject to start the recording himself in absence of a researcher, e.g. at home, unless the subject has experience, and has been carefully instructed.
Operating with many subcams means keeping track of the charge level of batteries, bringing spare equipment, having the right plug adapters in various countries, and a crowd of other details that would be cumbersome to enumerate. Every new situation brings unexpected new issues and makes scouting the field an almost inescapable requisite.

The protocol itself is rather heavy. But this must be compared with other classic protocols.
We designed the subcam in the 1990's when we were studying the use of information in organizations, where we had tested a large array of techniques. In fact, all the classic techniques we had tried failed to capture precisely what was relevant for the activity. Fixed cameras in offices did not capture details --- and subjects were out of their offices half of the time anyway, in meeting rooms or other places. 'Shadowing' the subject all day and taking notes (Mintzberg 1968)) was cumbersome for both subject and observer and not accurate enough. Interviews completely missed the point (Conein 1997; Fischler and Lahlou 1995; Lahlou and Fischler 1996) Protocols that try to get the flow of thoughts made overt by 'talking out loud' face social limitations, especially in situations where verbal interaction is needed, e.g. conversation. This basically excludes using such techniques for any interpersonal interaction, which is problematic in social science. And in participant observation, observers have to rely on their memory of the events, which is fragile, fragmentary, and subject to reconstruction. We then turned to video, but met the problems described supra (body occlusion, etc.). Solving the issues raised by these classic techniques when studying activity will oblige to triangulate with several techniques, and involve incurring vast costs in the

transcription, coding and analysis phases.

7.5. *Distributed cognition*

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. 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. This means that the subcam, for the study of complex situations, should be supplemented with other recording sources which provide a global perspective.

360° panoramic video cameras enable capturing complex scenes in one single take and take any perspective for analysis. But panoramic films are difficult to analyse for the human brain.

8. Conclusion and future perspectives

Recent research, especially in anthropology, psychology and cognitive science, have demonstrated that human activity is by nature situated, that cognition is distributed, that behaviour is the result of a cultural installation, where the material affordances of the setting play as important a role as the social and psychological aspects. It entails that it is, to put it mildly, *optimistic* to hope that we can explore human activity in laboratory settings; those are better suited to demonstration than to exploration. This calls for observation in natural settings. The solution is to have the real world as an observation setting; the subcam is a solution for this, regarding the *capture* of relevant, situated, data.

The problems linked with introspection have always been a limitation to accessing mental states of the subjects in psychology. We have shown here that protocols confronting the subject with empirical evidence of activity from her own perspective enables going beyond the current state of the art in psychological investigation, by empowering the subject to peel the various layers of mental states underlying a given behaviour. The technique presented is therefore a progress in this respect.

Finally, the classic emic/etic issue draws or delete attention to the problems of translating subjective experience into a representation that can be shared across cultures. We have suggested here that evidenced based discussion between the subject and the researcher provides ground for a new kind of collaborative investigation process. The results of this process are better *trans-subjective* description and explication: they can be understood and

validated by both parties.

Furthermore, the empirical material used (subfilms) can directly be included in the presentation, therefore enabling better illustration, control, and further interpretation from the original data.

Combining these aspects (situated capture, empowered introspection, collaborative investigation and presentation of the original material) opens, in our experience, unprecedented possibilities to understand and share human experience.

The method still faces limitations: technical of course, but these are disappearing with technological progress. A major limitation is the cost of trust building with the participants, and trust is the key resource in the method. Preparation is more cumbersome than with classic techniques. The method also requires a systematic follow-up with the participants, which is a rather new concern in social sciences outside of longitudinal studies.

Ethical issues arise from the fact that the method uncovers very private and sensitive aspects of individual psychology.

New theoretical tools are necessary to model the phenomena that appear. The nature of entheaty, as well as the precise mechanisms involved in data-assisted remembrance, is yet to be investigated.

Finally, diffusion of the results needs to make use of video, which questions the limitations of current scientific output formats, mostly limited to text and fixed image.

Our feeling in comparing the weight and complication of various techniques across our experiences is that, for the study of activity with objects SEBE is usually best. For research within bounded environments with a small number of subjects well known to the subcamer (a home, a small unit in an organisation), SEBE will systematically often be a better choice, and in fact lighter than other collection techniques for a far better output. SEBE can be appropriate for field work which stays within the boundaries of the same organization setting because the investment serves for all captures, but the preparation cost is higher than with classic techniques. For studies in very open environments like public places where interpersonal interaction needs to be recorded, one should carefully weigh the pros and cons because the issues linked with right to image may be too heavy to handle, and classic techniques are usually easier to apply there.

Exploring inter-subjectivity is one of the major issues of social science. We intend to use SEBE in order to enable individuals to have an insight of what is another person's life. The SHEOS (Subjective Human Experience Observation System) project led by the London School of Economics and Political Science and involving many colleagues (at Stanford, the

Russian Academy of Science, CNRS, UCSD, UCLA, the Max Planck Institute etc.) is currently building a worldwide database of 'days' or 'activities' (e.g. eating, taking the train, family life, education etc.) lived by humans of all ages, conditions, and backgrounds.

These recordings are collected by people wearing the subcam during their normal activity and commenting the resulting subfilm following the technique we described here. While the full recordings will be archived for scientific, and especially historical and ethnographic purposes, a special format enables to shorten their presentation to smaller clips, therefore providing other people some access to the insight of 'being in that person's shoes'. This is a way to go beyond the usual limitations of someone's perspective to the one of the in-group to which (s)he was ascribed by birth:

> The crucial fact about birth-ascription for the individual and for society lays not so much in the source of status (birth), as in the fact that it cannot be repudiated, relinquished, or altered. Everyone is sentenced for life to a social cell shared by others of like birth, separated from and ranked relative to all other social cells. (Berreman 1972)

What is true for birth ascription is also true for age, and to some extent for all acquired social positions. As perspectival research is now demonstrating, having shared the other's perspective can make communication much easier, especially when there is potential misunderstanding or conflict (Gillespie and Cornish, 2010). We hope that providing access to the Other's perspective on a large scale will have positive effects on humanity in general, and intend to use the method in this political perspective.

The human experience database will be a global resource for social sciences, which will be data-mined for theoretical exploration on inter-subjectivity, activity, memory, communication, development but also validation/falsification of behavioural theories on 'real world' data, comparative or historical studies, etc. SHEOS also will inform and support inclusion policies (e.g. inter-group reconciliation, accessibility, gender studies) by giving access to the perspective of the discriminated 'Other'.

Training, especially professional is naturally another of line of SHEOS.

Finally, we must remind the method is still in infancy and has been limited by the fact that very few researchers have used it so far. We are confident that in a few years, when trans-subjective methods like SEBE will have become a classic tool in social science, many of the limitations we listed will be overcome; and practitioners will be able to look back with a bemused smile at our current pathetic efforts to set up and clarify the method.

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Notes

1. This entails from the fact that a category is defined not in isolation, but rather as in ('paradigmatic') relation and contrast to all other elements of the culture. Since not two phenomena are ever *exactly* identical, whether this event is 'same' or 'different' to this other is a matter of cultural judgement.

2. Abduction is a process by which we select hypotheses to explain an observation. The term was coined by Charles Peirce and can be described as a form of guessing. Formally, it may be considered a syllogism where the major premise is certain and the minor is only probable, likely, or plausible. Or the selection of a hypothesis that is sufficient and likely, to explain the observation, but not necessary (e.g. the grass is wet: probably because it rained last night). Abduction does not have a unique clear cut logical formulation because it is a process rather than a rule. See also Harman , who clarifies the issue of how previous knowledge underlies inferences: (Harman 1965)

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