
Connecting STS to Mobility Studies: Sociotechnical Mobile Practices

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Abstract

The theoretical attempt pursued in this contribution is to intertwine the so called 'Mobility Turn' and the field of Science and Technology Studies (STS). Indeed, mobility is inextricably linked to the vast array of sociotechnical infrastructures, artefacts and discourses which allow people, objects and information to be (im-)mobile in contemporary society.

Three streams are taken in consideration as relevant to this analysis: ecological analysis of 'boundary objects', Social Construction of Technology (SCOT), and Social Informatics. Each of them provides a key category for studying mobility as a socio-technical practice in the context of an ongoing research based on two case studies (international consultancy in developing countries and ubiquitous computing design).

Introduction

The objective of this contribution is twofold. On the one hand, it aims to link different bodies of literature (Science and Technology Studies and the so-called 'Mobilities' approach, or 'Mobility Turn') so as to identify conceptual bridges and reciprocal contaminations between them. On the other hand, this theoretical effort is designed to circumscribe key concepts in order to understand current and future scenarios of technologically mediated mobilities, and to apply them to two cases of mobility practices investigated in an ongoing research project.

In particular, the issue of mobility is analyzed in the light of three different approaches, which can be considered as broadly belonging to the STS field: the ecological perspective (Bowker & Star 2000); the SCOT approach (Bijker 1995) and the Social Informatics framework (Iacono & Kling 2001).

First of all, mobility as an 'object' is inextricably intertwined with technological mediation: while we are on the move, and even when im-

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mobile, we depend on sociotechnical arrays which make (im)mobility possible. Miniaturization of technological devices, their extended portability and the increasing diffusion of wireless networks seem to emancipate mobility from infrastructures. Indeed, these phenomena make all of us more and more interlinked within an invisible web of embedded socio-technical relations. From this viewpoint, the ecological approach and the 'boundary objects' perspective (Bowker & Star 2000; Star & Griesemer 1989) support an analysis of the invisible infrastructures playing a role around mobility. Emphasizing the issue of standardization, classification and saturation, as well as the necessity to negotiate around objects belonging to multiple social worlds, the ecological theoretical framework highlights the relational character of mobility.

Secondly, mobility as a discursive and material practice linked with new technologies could benefit from both the Social Construction of Technology (SCOT) approach (Bijker & Law 1992; Bijker 1995), and the Social Informatics stream, especially concerned with the issue of public discourse (Iacono & Kling 2001). In this respect, mobility constitutes a technological frame for mobile technologies, which are interpretable in a flexible way by various relevant social groups (Bijker 1995). Some of them are especially concerned with framing a favourable public discourse about mobile technologies, e.g. the media, the academics, and the designers (cf. Iacono & Kling 2001). The technological mediation of mobility is, therefore, a discourse and a practice where different articulations can be identified as referring to non-stabilized, *in fieri* sociotechnical assets inspired by the ubiquity metaphor (Pellegrino 2007).

Such a multilayered STS approach will then inform the analysis of the preliminary results of an ongoing research project concerning the study of mobility and proximity practices, carried out by interviewing mobile consultants in international organizations, as well as designers and researchers involved in planning ubiquitous computing infrastructures.

Both groups of informants allow the mobility field and its components to be reconstructed, investigating the changing conceptions of space, time and place experienced by consultants in developing countries where infrastructures are unevenly spread and the spatio-temporal notions designers inscribe (Akrich 1992) in innovative, ubiquitous computing systems.

STS approaches and mobility

Science and Technology Studies (STS) constitute a diverse interdisciplinary field born from the Sociology of Scientific Knowledge (SSK) and the critique of scientific and technological determinism, linked to the modern idea of irreversible progress driven by scientific and technological innovation. Technology being 'out there', autonomous from society and, therefore, out of control (Winner 1977) is criticized as a static, opaque perspective which marginalizes actors' choices, constrained by a binary framework: they can either accept or reject technology.

Pervasivity and technological saturation of our everyday life makes a critical approach to the technology / society interrelation more and more urgent. Such a necessity can be assumed as even more crucial when observing the multiple mobilities of people, objects, information, and cultural representations.

'Mobility has become an evocative keyword for the twenty-first century and a powerful discourse that creates its own effects and contexts. The concept of mobilities encompasses both the large-scale movements of people, objects, capital and information across the world, as well as the more local processes of daily transportation, movement through public space and the travel of material things within everyday life' (Hannam, Sheller & Urry 2006, 1).

Mobility is always mediated by some technological infrastructure, enabled by arrays of old and new technological systems of communication and transport, as well as amplified by multiple discourses circulating in the public arena.

Three main dimensions emerging from the STS field have been identified as useful in framing mobility: infrastructures, technologies, and discourses. The following paragraphs will analyze each of them, then the three approaches will be linked to the analysis of mobility.

Mobile infrastructures:

The ecological approach of boundary objects

The ecological analysis of infrastructures (Bowker & Star 2000) configures them as 'boundary objects' (Star & Griesemer 1989), robust and flexible

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at the same time, around which different social worlds interact with each other. Why is this approach 'ecological'? In the sense this word is used here, it indicates an epistemological perspective concerned with the co-existence of differences. Ecology means not taking any partial viewpoint but taking the whole (a specific whole, unit or system) as unit of analysis. Ecology takes into account ambivalences of phenomena and overcomes the deterministic view about technology and the media for which they drive social transformation irreversibly. In this respect, ecology is constitutive and even implied by the STS perspective, which emphasizes how technology is articulated and changed in passing from hand to hand, in a continuous movement of transformation occurring in local, situated contexts.

Technical objects, as well as standards and classifications, can be conceived of as boundary objects, more or less taken for granted by the diverse social worlds which use them.

Of particular interest for the analysis of mobility, is the infrastructure as 'a dense interwoven fabric, that is, at the same time, dynamic, thoroughly ecological, even fragile' (Bucciarelli in Bowker & Star 2007, 230).

Being (im)mobile, either materially or immaterially, is the result of a relational process (cf. Adey 2006); therefore, (im)mobility is linked to infrastructure, which is something *between* people, tools, rules. The 'betweenness' of infrastructure, which makes its meaning close to communication itself (Bowker & Star 2007) is also the basis for its invisibility, taken for granted character and difficulty in studying it. As a consequence, '[Infrastructure] becomes visible upon breakdown. The normally invisible quality of working infrastructure becomes visible when it breaks (...)' (Bowker & Star 2007, 231).

Technical objects, as well as information infrastructures, come out of collaborative processes where hybrid, socio-material networks allow multiple social worlds to communicate to each other, both re-affirming and overcoming their local, situated character (cf. Star & Griesemer 1989). This is one of the reasons for which infrastructure and standards retain a crucial role in bridging diversity, multiplicity, but also (im)mobility of people, information and objects.

Mobile technologies: The SCOT approach

Wiebe Bijker, the main representative of the Social Construction of Technology (SCOT) approach, argued that 'technology and society are both human constructs' (Bijker 1995, 3).

The SCOT approach defines technology as emerging from interpretations relevant social groups carry out with reference to specific technological artefacts, bearing in mind that these interpretations shape the artefacts themselves and are coherent with technological frames (the set of technical cultures, goals, rules associated with a technology). Therefore, it can happen, as in the case of fluorescent light (Bijker 1992), that an artefact can be invented in the stage of what is usually called 'diffusion'. Questioning the linearity and predictability of technological development is the starting point of an analysis in which instead of 'traditional' separations between production and use of technology, the multiplicity of groups involved in the process, along with their interpretations, shape technology both symbolically and materially. Constructing technology is a matter of negotiation and conflict among different social groups; technological artefacts are flexible, as they can be interpreted differently and used differently in the context of a certain frame (Bijker & Law 1992; Bijker 1995).

The interpretative flexibility of technology as well as the concept of technological frame can be applied to mobile technologies (mobile phone, smart phone, mobile Internet etc.). These technologies can play different functions for different social groups, which also shape the characteristics of the frame and interpret what 'being on the move' means.

In the last part of this contribution, two groups acting on the mobile technologies frame are taken into consideration: mobile consultants experiencing the uneven distribution of communication and transport infrastructures; researchers and designers of ubiquitous computing systems, engaged in overcoming barriers to mobility of information and portability of data (cf. section "Two cases of "extreme" mobility practices").

Mobile discourses: The social informatics approach

Discourse is a key issue in mobilizing interpretations of technology as well as technological visions linked to future developments: 'Technologies in

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their development stage have played a dramatic role in visions of the future and beliefs in possibility of change' (Sturken & Thomas 2004, 1).

Iacono and Kling (2001), in the context of the Social Informatics approach, identified the emergence of a new technology (the Internet) in 'a socially constructed process of societal mobilization (...)' (Iacono & Kling 2001, 97). The core of this process of mobilization lies in social movements (termed 'computerization movements'), whose collective action elaborates frames for meanings and counter-meanings, drawing on ideational and cultural materials circulating at a certain time in a certain social context.

The key issue in framing is that meaning, analogously to other theories (Bijker 1995), is enacted through interaction around a new technology, seen as interpretatively flexible: '(...) Participants in computerization movements build up frames in their public discourses that indicate favourable links between internetworking and a new preferred social order. (...) The symbolic struggle over these new technologies socially constructs the organizations that adopt them (...). Public discourse is necessary for particular understandings about new technologies to widely circulate (...)' (Iacono & Kling 2001, 97, 110). With reference to the rise of the Internet, four layers of public discourse were identified by the authors: government discourses, the discourses of scientific disciplines, organizational and professional discourses.

Since this typology is mainly analytical, it can be applied to mobile technologies and the mobility discourse. In this case, the media discourse, the institutional discourse, the professional discourse by designers and the sociological discourse constitute sources and actors of the construction of mobility as technological and discursive frames. Beside the media, it is institutions, professionals and social researchers in particular who also contribute to the construction and circulation of discursive frames of mobility, adhering to the conventions and rules of the scientific and academic community.

Key words for studying mobility practices

What consequences can be drawn from the approaches illustrated above, in terms of studying mobility practices? In this section, it will be argued

that infrastructures, technological frames, and discursive practices constitute the starting points for studying mobility practices.

Infrastructure, saturation and ecologies of artefacts

Since infrastructure is built on an installed base, there are many hidden interdependencies which connect it to inertial elements, weaknesses and strengths of pre-existing infrastructures. This characteristic can also be referred to as 'interoperability' and 'saturation' (Bowker & Star 2000; 2007). Indeed, there is more of a hidden saturation: technologies not only saturate and fill up an individual body but also the surrounding environments. This seems to be a commonsense inference. However, its importance becomes clearer when saturation and interoperability stop working as expected and when any kind of breakdown, interruption, misuse or unexpected use occurs. This can happen, for example, with the mobile phone as a ubiquitous technology accessible anywhere / anytime, whose saturation increases expectations of continuous availability of participants in the communication process. Furthermore the concept of saturation provides a good description of the way our bodies and environments are intertwined into inextricable chains of socio-technical relationships, analogous to the 'everyware' texture of ubiquitous computing, imagined as a technology able to colonize the surfaces and settings of everyday life (Greenfield 2006).

Saturation and the interdependency of infrastructures, as already highlighted (cf. par. 'Mobile infrastructures: The ecological approach of boundary objects'), call for an ecological approach in studying mobility practices. While on the move, multiple infrastructures and artefacts are involved in making both us and the environment move on. What is happening here is more of an integration than a substitution between old and new media, technologies and infrastructures. The evidence here is linked with media history (cf. Marvin 1990 amongst others), which shows how each time a new medium appears on the scene it is shaped through dreams and fears of substitution, but more often it integrates with older media which are already socially appropriated. In this respect, it is illuminating to think of information and technological artefacts as ecologies.

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Ecology as a metaphor can be characterized through five elements: system, diversity, co-evolution, keystone species, locality (Nardi & O'Day 1999). Using the metaphor in a loosely-bounded perspective so as to avoid biological determinism, three of the five elements appear to be crucial: diversity, co-evolution and locality. Diversity means mobility encompasses concentration and integration, but also distribution and variety across contexts and artefacts. Old media are tied together in new artefacts and so are communicational practices and routines. Co-evolution means, among other things, no longer looking at single, individual artefacts but at systems of them, so as to change the perspective on (im)mobility.

As for locality, the ecology metaphor ties together the past, the present and the future, meaning the temporal dimension of technology, which is also important to situate mobility practices in a historical perspective. In fact, all societies have been 'mobile' over time, albeit in a different way from the meaning and experience of modern mobility. Furthermore, new ecologies of artefacts can be traced in the way different arrays and assemblies of material-discursive frames attach a new favourite social order to a specific set of technologies (cf. par. 'Ubiquitous computing design as the envisaging of future mobilities').

(Mediatized) mobility as technological and discursive frame

Over the past decade, anthropologists and sociologists have pointed out how the world is based on flows, fluxes, hybrid interconnections, movement and displacement (Appadurai 1996; Castells 1996; Hannerz 1992; Urry 2007; Wellman 2001). In this sense, mobility constitutes a common discursive frame in the way it identifies a frontier and a challenge for the analysis of contemporary society (Hannam, Sheller & Urry 2006). This discourse makes mobility both a popular topic and the key word to understand practices and discourses concerning the way objects, people and information move around. In this sense, *mediatized mobility* refers to both the fact that mobility is more and more mediated by a plurality of technological artefacts qualified as mobile (the mobile phone first and foremost); and the way mobility becomes a popular topic of and through a wide set of public discourses depicting society and people as being 'on the move'.

Correspondingly, the image and sociological representation of a 'mobile communication society' contributes to the discourse of mediatized mobility (in both senses specified above). Mobility is the frame enacted and mobilized through these discourses, so as to create a favourable 'milieu' in which people, objects, information and risks participate in the link between mobility and a new social order. Furthermore, since horrors and hopes can be traced in any technological imagery and public discourse about technologies (cf. Kling 1996), utopian and dystopian attitudes can also be retrieved in the perspective of a (hyper)mobile society, where travelling and intermittent co-presence are routinized patterns of action. In fact mobility is neither a totally free choice nor a right in itself and for everybody. Mobility and, correspondingly, immobility, can be coerced or freely chosen (Urry 2002) and at the same time a 'mobile divide' can be drawn from the apparent hypermobility of contemporary societies, with different possibilities to access and experience mobilities in their mediatized and non-mediatized aspects.

Those entitled to mediatized mobility are, often, members of micro-communities, or 'mobile elites'. Paths of exclusion and inclusion can be traced at both the level of macro-technological infrastructures or architectures, and at the level of e-literacy in using smaller and multifunctional technological devices. On the two sides, different paces and degrees in appropriating technology can be observed. Furthermore, privacy issues seem to constitute the 'horrific' side of mobile and ubiquitous technologies, with the emergence of risks of total surveillance and traceability of the 'electronic body', whose fragmentation and concentration bring about new challenges for ethics (cf. Pellegrino 2009a).

Ubiquity as projection towards future mobilities

Ubiquity can be defined as the tension involved in 'being anywhere anytime' as opposed to the *hic et nunc* constraints of face-to-face interaction. The mobile phone, again, is an example of such a ubiquity because of the 'perpetual contact' (Katz & Aakhus 2002) it makes possible.

The tension in approaching and reaching a virtual, potential omnipresence is supported by convergent artefacts, which make ubiquity more

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at hand than ever. Being here and there, interacting with absent persons, performing multiple tasks at the same time, distributing attention to different media, communication partners and communicational routines, are everyday experiences for an increasing number of people.

Ubiquity seems to annihilate spatio-temporal differences, since it questions categories of space and time. The term 'instantaneous time' is appropriate to define the temporality of ubiquity: the absence of delay increases focus on what is immediate with the result that 'the future increasingly appears to dissolve into an extended present' (Urry 2000, 128).

In terms of space, ubiquity is a condition in which simultaneity is accomplished; it means competition but also co-occurrence between remote and co-present interaction, with the result that a very diverse range of proximities (in presence and at a distance) is made possible. Many kinds of co-presence thus deserve the attention of research. It is no longer merely face-to-face interaction but rather the extension of proximity and mobile co-presence that transform the way we are able to communicate on the move.

Ubiquity as aspiration to omnipresence is embedded in discourses, information and artefacts which are supposed to be accessible anywhere anytime (at least in principle). The myth of ubiquitous computing as invisible, unobtrusive infrastructure embedded in material surfaces is the basis of a prolific literature. Moreover, it is exemplary of a trend to imagine and design contexts of interaction, both public and private, redefining the materiality of technology. Ubiquitous computing envisages the projection towards future contexts of interaction, characterized by an increased mobility and interoperability of information (cf. par. 'Ubiquitous computing design as envisage of future mobilities'), as well as by simultaneous and instantaneous spatio-temporal patterns.

Two cases of 'extreme' mobility practices

The research project on mobility practices, partly carried out at IFZ in October-November 2008 (cf. Pellegrino 2009b), focuses on the key words illustrated above in order to analyze the issue of ubiquitous communication and extended co-presence. Adhering to the phenomenological

standpoint of the obviousness of everyday life, which can be questioned only when something goes wrong, the project selected two cases where mobility and ubiquity of communication are, to some extent, extremely stressed and challenged.

In the first case study, the starting point is that a potential ubiquity is experienced by users of current sociotechnical systems, especially by those users who are highly mobile in space and time and also in their work. The users chosen are consultants in international organizations. They are peculiarly mobile as their communicative and work practices are situated culturally and their status of 'boundary operators' obliges them to comply with both standardized methods of consultancy and highly specific on-site projects. Furthermore, their mobility constitutes, in many ways, an 'extreme' experience of diversity: not least, diversity of infrastructures available in specific settings. Such a diversity allows a focus on the relationship between mobility and access to technologies, emphasizing breakdown in the continuous texture of ICTs, often described as 'ubiquitous'. The interview stage was started in October 2007 in Rome. The key informants were consultants involved as free-lancers or independent experts in monitoring, evaluating and carrying out projects in developing countries.

In the second case study, ubiquity is framed by examining the design of advanced computing systems, defined as 'ubiquitous', sometimes 'pervasive' and, of course, mobile. Designers represent a peculiar social group involved in technology construction: they are translators of users' needs as well as of a vast imagery concerning potential developments of current and future technologies. Studying design allows highlighting of gaps and continuities between public discourses of future technology and their translation into artefacts and contexts of interaction. The interview stage for the second case study was started at Klagenfurt University in November 2008. The key informants were researchers studying solutions in the field of ubiquitous computing and networked / embedded systems.

Contrasting two case studies which at first glance are so different from each other allows relationships between proximity and distance, ubiquity of information and patterns of future interaction to benefit

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from the analysis of the breakdown of technologies expected to guarantee continuous connectivity.

The following paragraphs summarize the findings from pilot interviews with both groups of informants.

International consultants and discontinuous infrastructure

Co-presence as based on face-to-face interaction is a feature in 'traditional' mobile work (e.g. sales representatives). However, the possibility of working far away from a central headquarter location has changed through history, especially through the mobility of information enabled by ICTs. This part of the research aims to focus on the relationship between mobility as a 'permanent' characteristic of practice (for some communities / professions) and its increasing technological mediation.

Starting from an ecological approach to infrastructure (cf. par. 'Mobile infrastructures: The ecological approach of boundary objects') the interviews aimed to re-collect the narrated experience of discontinuity, or disconnectedness, from the 'always on' modality of mobile, portable multimedia communication.

The key informants interviewed had been exposed to a diversity of infrastructural density due to their experience as fieldwork consultants in developing countries. An interesting result is that this diversity is less broad than expected and is also highly situated:

Many countries have cell phones only, landlines have been destroyed as a result of wars as in the Congo. In many cases basic infrastructures are lacking, but at the same time some of the most advanced ones also exist.

This confirms the hypothesis that infrastructures are embedded and built on an installed basis (cf. par. 'Mobile infrastructures: The ecological approach of boundary objects'); furthermore, their evolution is often characterized by gaps and uneven paths, as in the excerpt quoted above.

The same consultancy mission, and the mobility style associated with it can be very different, as pointed out by one of the informants:

It's a very diverse world and you can meet a great many different kinds of people. You can also do this job very badly, by just looking at signatures and not being empathetic. There are at least two kinds of monsters: the young son of a UN diplomat who speaks 5 languages perfectly, but does not really understand this job; and the cynical NGO employee interested in getting rich by cutting and pasting the reports. (R.)

The prevalence of integrative communicational patterns across different tools is confirmed by most of the interviewees, pointing out that what have been called the 'ecologies of artefacts' are often reconstructed with reference to the physical place (e.g. getting into the local infrastructure through a local SIM card for the mobile phone).

One of the crucial points is the range of feelings associated with the experience of disconnectedness, of not being able to access the network and communicate continuously:

Up to a week, I am almost happy not to be able to reply immediately to email. Chat communication is more demanding, people are there waiting for your reply (...). Some people are really addicted to communication, I am not like that. (G.)

In fact, disconnectedness is the opposite and complementary side to ubiquity as the desire for omnipresence, continuity and uniformity of communication.

Ubiquitous computing design as a tool to envisage future mobilities

Studying the design of technologies means to understand the vision innovators inscribe into artefacts (Akrich 1992) as well as the set of discourses, practices and imagination involved in bridging gaps between the state of the art and the virtuality of future behaviour.

When looking at the design of ubiquitous computing, this hybrid set of meanings associated with design work is even broader, since

Ubiquitous computing is not a technology but a paradigm (...) It means you get rid of the dependence between digital artefacts and physical tools. (R.)

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Three dimensions emerged from the pilot interviews. First, the necessity to configure transitions between physical and virtual worlds, where access to digital resources is independent of single devices or single communication tools:

Nowadays, we build a house into the hammer, that means we forget that the hammer (e.g. the USB pen) is the tool, not the building. (R.)

Secondly, the awareness of the fact that big gaps between attractive solutions proposed in the media and current technological possibilities constrain the designers' work:

There is a lot more very different things to see when looking behind the curtains. (R.)

Last but not least, the policy implications of ubiquitous computing research, as shaping advanced infrastructures where devices can be fully interconnected and able to 'talk' to each other depends on the availability of scarce resources. As another informant put it,

We are allowed to use a very small bit of the spectrum for wireless communication experiments. And our aim is to make the best of it. (W.)

The solutions and ongoing projects focused on at Klagenfurt University showed how ubiquitous computing is concerned with envisioning the future of mobile information, data and environments. Issues of social desirability with reference to privacy and control also emerged from the interviews.

The informants admitted that a future in which the fridge tells you what to buy would be neither attractive nor desirable. Indeed, the dimension of the future envisaged through infrastructures for desirable and innovative patterns of action is one of the most fascinating aspect in studying ubiquitous computing design. In this respect, the future is once again linked to the eternal dream of omnipresence, and realized through the correspondent obliteration of time-space boundaries.

Conclusion

The way we live, act and communicate while on the move is a prominent part of contemporary forms of social interaction and identity. This contribution has sought to argue that the analysis of multiple mobilities can benefit from taking an STS approach. The result is a set of key elements considered as crucial to the study of mobility practices: infrastructures, technologies, and discourses. Focusing on the technological mediation of mobility, therefore, means to configure a convergent, saturated and hybrid modality of co-presence in private and public settings.

Despite the big emphasis on the global and ubiquitous character of 'going / being mobile', however, contextual issues constrain relations between infrastructures, ubiquity and communicational patterns. In this respect, the study of two extreme mobility practices (international consultants and ubiquitous computing designers) allows highlighting criticalities and discontinuities in the expectation of a continuous, unproblematic connectivity to infrastructures and artefacts. The crucial point for further research is represented by the crossroads of current practices of communication where critical points of breakdown emerge, and assumptions driving the design work aimed at envisioning a pervasive, ubiquitous interaction. Ultimately constraints to current mobilities can provide key indications for the design of advanced information infrastructures, by pointing out the relational and situated character of the movements of people, objects and information, as well as the limits and the resistance current practice poses to future, mixed worlds of sociotechnical interaction.

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