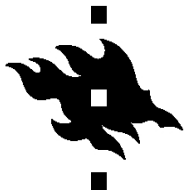


Center for Activity Theory and Developmental Work Research

Mervi Hasu
and
Reijo Miettinen

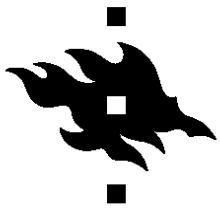
Dialogue and Intervention in Science and Technology Studies: Whose Point of View?

Working Papers 35 / 2006

Dialogue and Intervention in Science and Technology Studies: Whose Point of View?

Mervi Hasu
Finnish Institute of Occupational Health
mervi.hasu@ttl.fi

Reijo Miettinen
University of Helsinki
reijo.miettinen@helsinki.fi



University of Helsinki
Center for Activity Theory and
Developmental Work Research

Contents

Foreword

The very first version of this paper was presented at the Annual Conference of 4S, the Society for Social Studies of Science, in San Diego, 28–30 October 1999. It was based on the methodological reflection of the experiences of two dissertation studies that started in 1995 in the Center for Activity Theory and Developmental Work Research: Mervi Hasu's (2001) study on the development and implementation of a high-technology innovation, the Neuromagnetometor device, and Eveliina Saari's (2003) study on the work and development of an application-oriented aerosol research group. These were the two pioneering studies of our research group at the Center, which studies innovation and the organization of research work. The field data of the two studies were collected in 1996 to 1998. The results of their analyses were deliberately used to enhance reflection and change in the activities that were studied. We felt that it was important to try to make the approach we were developing explicit.

Although its foundations had been previously delineated (Miettinen 1993 and 1999), the use of ethnographic data in an intervention was developed in these two research projects. In the beginning, Mervi Hasu, Reijo Miettinen, and Eveliina Saari were writing the paper together. After including an analysis of both of the projects in the paper was found to be too difficult, Mervi and Reijo finalized the paper. Professor Sergio Sismondo (Queens's University) and Dr. Petri Ylikoski (Helsinki University) kindly commented on the first draft of the paper. When the paper was revised in December 2003, a section called 'Problems of the dialogist approach' was added to meet the critical points that they presented. When the paper was again revised in June 2006 for publication as a working paper, our colleague Merja Helle made good suggestions for its improvement.

The paper was written to participate in the debate about intervention and the relevance of research within Science and Technology Studies. That is why it is framed primarily by referring to material from the journal *Social Studies of Science* (SSS). As a consequence, it does not discuss the interventionist and dialogist approaches in sociology and organizational studies, such as developmental work research (and the Change Laboratory) (Engeström et al. 1996), which have inspired this work, participatory action research (Reason & Bradbury 2001), or the approaches based on Habermas's idea of democratic inquiry (Gustavsen 1992). The work has continued after this paper. Mervi has developed her approach of the sensitive ethnography of change (Hasu 2005). Reijo has compared the normative commitments of three interventionist

research approaches (Miettinen 2004). The revised 1999 paper, however, merits publication because it discusses the epistemological foundations of a dialogic and interventionist approach. It also deals with how 'academic' (scientific/epistemic) and practical aims (relevance) can be reconciled in interventionist or participatory studies.

7th of December 2006, the authors

Introduction

In 1995, *Social Studies of Science*, an international journal, published an article which began a discussion about the relationships between practitioners of social studies of science and technology and scientists. In his paper, Jay Labinger, a chemist, raised the question of the nonexistent interdisciplinary collaboration between social and natural scientists. He (1995, 285) provocatively compared the interaction between social scientists and scientists to the experimenter–subject relationship, which has clear cut boundaries: the scientists are treated as non-participatory laboratory specimens. He called for a reorganization of the relationships by implementing collaborative projects aimed at improving the practice of science.

A number of distinguished sociologists and anthropologists of science and technology commented on Labinger's paper, illuminating the various aspects of the problem. One line of argument was that the type of explanation pursued in the social studies of science does not help practising scientists in their work. Therefore, the conditions are poor for a dialogue or for mutual collaboration (Collins 1995, Pinch 1995). Several commentators agreed that the epistemological controversy, dominated by the realist-constructivist opposition, has been a visible issue in the public debate, hampering collaboration and leaving a number of important other issues aside. Some of the commentators, on the other hand, stated that there has already been mutual interaction, albeit less visible, between the social scientists and scientists: the social scientists have gained both data and insight from the practitioners they study (Lynch 1995, Stockdale 1995). Most of the writers agreed that further development of this interaction is an essential part of the future program of the social studies of science and technology.

The classical constructivist laboratory studies of the 1980s shared a tendency to preserve an ethnographic distance from the scientist that they studied. In early, trailblazing ethnographic reports, collaboration with scientists was not reported, and neither were the interpretative voices of the scientists who were being studied included in the narratives.[1] The background for this methodologi-

[1] Nigel Gilbert and Michael Mulkay evaluated this phenomenon in the 1980s (1984, 2): 'Most sociological analyses are dominated by the authorial voice of the sociologist. Participants are allowed to speak through the author's text only when they appear to endorse his story. Most sociological research resorts are in this sense univocal.' Latour and Woolgar (1979, 40) mention in their book *Laboratory Life* that the observers discussed his preliminary drafts with the participants and organized several seminary discussions. The contents or results of these discussions are not reported or commented on. The methodological summary (pp. 252–258)

cal tendency was the critical epistemological mission of the constructivist sociology of knowledge: dismantling the realist conception of science, as well as the standard view of scientific methods and norms of science. Today, since this dismantling has largely been accomplished by the STS, this methodological premise seems to be no longer relevant.

The realist-constructivist opposition contributed to the unfortunate phenomenon dubbed the science war. However, the opposition itself was simultaneously being transformed into an array of diverging interpretations: several types of realism and constructivism have been elaborated on and theoretical programmes developed to transcend the distinction between the two.[2] In addition, it is evident that differences of opinions and points of view do not hinder either collaboration or elaboration on the shared problems. On the contrary, multivoicedness may be a resource.

A year later, another discussion began in *Social Studies of Science* concerning neutrality and commitment in STS. Brian Martin (1996) analysed the strengths and weaknesses of a partisanship intervention by a social analyst in a scientific controversy. He called for a particular kind of participatory fieldwork, in which the goal is 'to effect change in the phenomena to gain understanding' (1996, 223). He also points out the central problem of interventionist study, the risk of being captured by one set of participants, which is 'typically, but not always, the side of lesser cognitive authority' (Ibid. 265). Harry Collins defended methodological neutralism. He, however, specified that he is not against commitment in general, but against the 'commitment to commitment', that is, against a priori commitment to any party of the controversy. Methodological neutralism requires the analyst to listen to both parties before making any commitment (1996, 255).

Martin Hammersley agrees with Collins in his review of the problem in his book '*Taking Sides in Social Research*' (2000). He strongly argues for methodological neutralism, which he suggests would be the best and natural way for social sciences to make its results publicly available. In his realistic account, any other goal except that of gaining new knowledge in the research process would jeopardize the objectivity of knowledge. He thinks (2002, 15) that any kind of engagement in political or practical activity will lead us away from research.[3]

---

focuses on analyzing how the authors' construction is analogous to that of the scientists: both make observations, use inscription devices and construct accounts.

[2] For instance, Peter Markl, a chemist, regards evolutionary epistemology as necessary for understanding the change in chemistry. He (1990, 170) thinks that 'science does not speak with one voice today'. About the varieties of realism, see, for instance, Megill (1994); about the types of constructivism see Sismondo (1996) and Hacking (1999).

[3] Hammersley discusses the various interpretations of Howard Becker's paper 'On Whose Side Are We' (1967). He concludes (p. 72) that Becker analyses why the researchers cannot avoid being 'biased' or 'taking sides' in the research process. According to him, however, Becker 'was

David Hess (2001), in turn, calls for a second generation or a 'postconstructivist' ethnography, which underlines another kind of normativity and is supposed to study 'how knowledge and technology could be better constructed' (Ibid. 246). Edward Woodhouse, with Hess, Martin and Brayman (2002), suggest in their paper in SSS a reconstructivist, activist-oriented approach in STS that avows partisanship and tries to combine practical relevance and scholarly excellence.

The 1996 SSS issue on neutrality and commitment (vol. 26/2) showed that the discussion between the two positions was narrowly framed, concentrating on specific scientific controversies (Wynne 1996), that there was confusion in the use of the terminology (Pels 1996), and that the identification of the 'side' is a problematic issue (Richards 1996, Wynne 1996).[4]

In this paper we will discuss the possibility of combining practical relevance and scholarly quality of research in terms of dialogue. We will not, however, argue for such a possibility by taking a moral or political stance (activism, partisanship) as a starting point. Instead, we will adapt an epistemological starting point arguing that the strict division between subject (analyst) and object (people studied) in the research process can be transcended by using the situated partial positions of the participants as a resource. We wish to elaborate on the significance of the dialogue between social scientists and the scientists/engineers and users of technology that they study.[5]

We will first discuss the epistemological foundations of dialogue in sociology of knowledge, discursive social psychology and feminist epistemology. Problems of the dialogic approach will be discussed. Second, we will discuss how dialogicity can be realized in empirical research and specifically how dialogue is related to the collection and analysis of qualitative and ethnographic data. To deal with this relationship, we will introduce the concept of a trajectory

---

not proposing that researchers should choose on what side they are and do research in such a way as to serve it.' Although 'bias' or partiality is the effect of research, taking a side cannot be used as a methodological prescription. This interpretation squares with Collin's position in the STS debate on neutrality and commitment (1991, 1996).

[4] 'The confrontation between "naturalist" and "committed" perspectives operates from a mutual reification of "sides", and neglects other alternatives. Despite of their sharp differences over the "taking the sides" question, both neglect the more fundamental question: what constitutes a "side" in the first place' (Wynne 1996, 362). We will not further discuss the connection of the neutrality-commitment debate to the concepts of symmetry or impartiality (see Pels 1996, Radder 1996). We have elsewhere argued that attempts to use symmetrical language in the empirical studies of innovations lead to insurmountable difficulties and, instead, an approach based on dialogue is needed (Miettinen 1999).

[5] About the relationships of the terms dialogue, dialogism and dialogicality, see Marková and Foppa (1990, 3–4) and Linel (1998, 7–8). According to Marková, the terms dialogue and dialogical have two different and, yet, complementary meanings: an epistemological point of view that is often called *dialogism* and a more narrow sense referring to face-to-face symbolic communication. In addition to these two, we want to study the research process as a dialogue.

of dialogues. This concept is elaborated by analyzing a study on the development and implementation of a high technology innovation, a measuring device for brain research and diagnostics known as the neuromagnetometer or MEG. Finally, the implication of the analysis for science and technology studies will be discussed.

Objectivity and dialogicity

In the philosophy and sociology of science, the concept of objectivity has been an object of profound re-evaluation in recent decades (e.g. Megill 1994). If no one scientific method can assure an objective, epistemologically privileged point of view, how can objectivity, then, be attained? Dialogue is an answer to this question. It also redefines the relationship between the subject and the object. Mary Hesse (1980) proposes that the guarantee of objectivity in social science is dialogue between the investigator and the investigated in which reciprocal interaction occurs. She further states (Ibid. 181) that complete assimilation of the methodologies of natural and social sciences will fail because nature cannot be regarded as a partner in dialogue.

The founder of the sociology of knowledge, Karl Mannheim, presented in his outline for the sociology of knowledge the idea of a situated perspective and the need for dialogue. Mannheim elaborates on how the perspectives of socio-historically embedded groups present a partial truth of reality. He states (1936, 296–297):

> The problem is not how we might arrive at a non-perspectivistic picture but how, by juxtapositing the various points of view, each perspective may be recognized as such and thereby a new level of objectivity attained. Thus we come to the point where the false ideal of detached, impersonal point of view must be replaced by the idea of an essentially human point of view which is within the limits of human perspective, constantly striving to enlarge itself.

This theoretical tradition of dialogue has not been largely elaborated on within the mainstream of social studies of science and technology. One of the few examples is Christopher Hamlin's attempt to redefine reflexivity in technology studies in terms of interdisciplinary conversation (1992).[6] Instead,

[6] Hamlin states that we must leave the safe territory of the knower in which we legitimated our own activity within our own disciplines and in which we can safely objectify others. Instead (1992, 534) 'We must enter the territory of the unknown, that we are as subject to others' explanations as they are ours. In doing so, we give up the claim to be the ultimate explainers of

Mannheim's program for a sociology of knowledge that underlines multivoicedness has an affinity with the theory of the Russian linguistic and literary scholar, Mikhail Bakhtin (Morrow 1998). Bakhtin (1981) developed an original arsenal of theoretical concepts to analyse language use, language as part of human communication, and daily dialogue between speakers. A speaker always directs her utterance to an interlocutor – to another person. She derives her voice from speech genres – ways of speaking – developed in different human practices. Her speech and thought is, therefore, thoroughly dialogical and connected to a complex of languages used and developed in the network of human practices. The significance of these ideas transcends the field of linguistics, and these ideas are being used in the study of the cultural and social nature of human consciousness and activities. Michael Holquist (1990,15) defines dialogism as 'a pragmatically oriented theory of knowledge' that seeks to 'grasp human behavior through the use human beings make of language.'

Bakhtin's affinity to both Wittgenstein and ethnomethodology has been pointed out (Shotter 2000). Sampson (1993), in constructing his dialogic account of human nature, derives ideas from both Wittgenstein and Bakhtin. The speech genres developed in different human activities by Bakhtin, and language games as parts of forms of life by Wittgenstein, both refer to the social nature of language use and its indivisibility of material, practical activities. Ethnomethodologists' insistence on analyzing discourses as inseparable parts of material, situated practices underlines the same thing on a local level. Bakhtin's ideas have been further developed in recent years as epistemological and methodological principles in psychology and cultural studies (Billig 1987, Bruner 1990, Engeström 1995, Markova´ & Poppa 1990, Shotter 1993, Wertch 1991). John Shotter (1993, 172), for instance, characterizes multi-voiced conversion in which the interlocutors represent different practices and traditions as a process in which 'people can make available to each other the socio-ontological resources required to explore amongst themselves the development of different modes of being.'

One of the developers of dialogism, social psychologist Edward Sampson (1993), has analysed what he calls the monologist tradition in social sciences. He states that the central device used by researchers to gain objectivity has been the distancing of themselves from the object of study (Ibid., 176–177):

> By distancing the researcher from the objects studied (i.e. its other) monological approaches exclude, deny or erase their own involvement in constituting their knowledge of the self-other reality that is of interest to them. They try to become a third-person observer of a phenomenon

---

science. There we can engage in inter-disciplinary conversation about what the science is, and what it should do.'

> that has been created by the dialogic encounter between themselves as first person and their subject-others of second persons. As a result of this initial distancing, monological approaches create a world in which they not only stand apart and outside but occupy a hierarchically superior position as "those who know" – that is, as experts.

According to Sampson, this third person distancing is unfortunate for two reasons. First, because the basis of knowledge is by nature dialogic, that is, co-constructed, its transmutation into a monologue is epistemologically unsound. Second, making the third-person voice of the researcher a privileged standpoint results in the denial of the need for participation, responsibility and obligation to the vital interests and points of view of the object of study.

Feminist theorists of science have elaborated methodologically on the problem of objectivity and the relation between the subject and the object (Haraway 1991, Harding 1993). They denounce the conception of objectivity as neutrality or as a god's eye perspective on reality. The new understanding of objectivity that they suggest attempts to avoid both the concept of one voice being right and relativism. Sandra Harding states that both the subject and the object must be understood as different from what they are in the empiricist and objectivist epistemologies. The development of 'strong objectivity' requires that 'the subject of knowledge be placed on the same critical, causal plane as the objects of knowledge' (Harding 1993, 69). The object is no more, to use the expression of Evelyn Fox Keller, a Cartesian object – merely knowable, never itself capable of knowing (Keller 1985).

The standpoint of each actor (either subject or object) is socially and historically situated and, thus, partial. Any kind of universal objectivity is, thus, unattainable. This means that standpoint theory also renounces the possibility of falsification in science (not only verification). The problem is the maximization of objectivity (Harding 1993, 68). None of the situated standpoints has a privileged access to objective knowledge. However, the unilaterality of one dominant, partial standpoint (male, white, Eurocentric) can be avoided by taking into account the standpoints of others, particularly of marginalized people, whose standpoint remains mostly unheard. 'The standpoint approaches have had to learn to use the social situatedness of the subjects of knowledge systematically as a resource of maximizing the objectivity' (Ibid. 69). The feminist standpoint theorists regard 'a dialogue across differences' as an alternative for both the universalizing standpoint and relativism.[7] Mikhail

[7] 'Relativism is a way of being nowhere while claiming to be everywhere equally. The "equality" of positioning is the denial of responsibility and critical inquiry. Relativism is the perfect mirror twin of totalization in the ideologies of objectivity: both deny the stakes of location, embodiment, and partial perspective: both make it impossible to see well. Relativism and totalization are both god-tricks promising vision from everywhere and nowhere equally and fully, common

Bakhtin made the same point regarding dialogism as a methodological principle that transcends both relativism and dogmatism (1994, 69):

> The polyphonic approach has nothing in common with relativism (or dogmatism). But it should be noted that both relativism and dogmatism equally exclude all argumentation, all authentic dialogue, by making it either unnecessary (relativism) or impossible (dogmatism).

This kind of dialogism is connected to the social ontology of practical materialism or practice. The ultimate realm in which we live is the realm of doings and deeds (Shotter 2000, 122). This connection is epistemologically vital, since it is in this practical activity that objects and people resist our goals and purposes and force us to change our conceptions (Lenoir 1992, Pickering 1995, Latour 2000). This connection distinguishes dialogism from, for instance, the idea of dialogue suggested by the hermeneutics of Gadamer and by Habermas's idea of communication in ideal speech situations. As Richard Bernstein suggests (1985, 298) a discursive ethics underlining the genuine mutual understanding tend to become disconnected from the realities of power, politics and from the important problems of society. Therefore, we agree with those who suggest that communication should be studied as a part of object-oriented, artefact-mediated activity in which people collaboratively try to make sense of the world in order to solve problems or accomplish something together (e.g. Engeström 1999; John-Steiner 2000).

Problems of the dialogist approach

The dialogic approach evidently brings about a new set of epistemological problems. One of them has been characterized by speaking of the phenomenon of capturing (Scott, Richard & Martin 1990, Martin 1996). If a researcher has or develops during the research process a special relationship to one person or group of persons, she is likely to become captured by the point of view of that person or group. In innovation studies it might be, for instance, the management of an innovative firm or the design engineers. Or if a researcher adopts a special relationship to a marginalized group of people from the beginning, can she or he advance a dialogue leading to a strong objectivity? It can be further asked, since researchers often do not have the time or resources to listen to all potentially relevant informants, whose voices should be included?

---

myths in rhetoric's surrounding science. But it is precisely in the politics and epistemology of partial perspectives that the possibility of sustained, rational, objective inquiry rests' (Haraway 1991, 191).

To handle the problem of capture, it is important that research reports deal with the nature of the contract between the researcher and the organizations or practices that she/he studies. The funding of the study and the initial motives of the participants as well as important developments in the relationship should be included, and the implications of these for the quality of data and for the results should be presented and elaborated upon. This should be a standard part of introducing the context of research. Examples and models of such accounts are available (e.g. Abofalia 1998, Hasu 2005, Saari 2003). Knowing what form these accounts should adopt is a challenge. Harding (1996) comments on 'the strong reflexivity' which assumes the forms of researchers' personal confessions of their social values and position or the submission of the results for approval by the natives. She states that although these forms have some value they are inadequate to resolve the problem of objectivity (see also Hamlin 1992 and Knuuttila 2002). In contrast, she maintains that (1996, 159) 'maximizing the objectivity of our accounts requires that the conceptual frameworks within which the work (…) be subjected to the same critical examination that we bring to bear on whatsoever else we are studying.'

The vital question of whose voice should be heard and included cannot be answered in general normative terms only. In science and technology studies, researchers focus on complex practices having division of labour and power structures as well as a variety of connections to other relevant actors. Even if we have general normative starting points, such as including the socially disadvantaged, we cannot know beforehand who they are and in which sense they are marginalized. That is why the conception of the relevant actors (within an organization and in networks) in an activity is both a theoretical question and a result of empirical work. It is keenly related to what kind of practice we study and also what the research questions are. As Harding suggests, a social history of marginalization in different communities and activities is needed (1996, 150). She presents, for example, research-based substantial foundations of why women should specifically be heard in developmental studies in African local communities (1998, 116–118).

In science, technology and innovation studies, the issues of the producer-user relationship, analysis of user activities, and user involvement in technology development have been central since the 1990s (von Hippel 1988 and 2005, Suchman 1994, Victor & Boynton 1998, Miettinen & Hasu 2002, Oudhoorn & Pinch 2003, Rochracher 2005). However, various kinds of users and context-specific producer-user relationships are constitutive of the development and implementation of technology. Users co-evolve with the development of technology. They often comprise communities with a division of labour and constitute chains and networks of users (Hyysalo 2004a).

Therefore, it is by no means clear which user groups are most relevant and should be included in a study.

Without sharing the epistemological commitments of Collins and Hammersley, we think that the moderate methodological neutralism that they propose makes sense in studying networks and distributed work. It is sensible to postpone commitment until the key actors have been heard and a substantial analysis of the data has been accomplished. A strong prior commitment may exclude important standpoints from the study. If we are supposed to induce changes in an activity, the strategy of defending a point of view of one actor (one who is marginalized) from the beginning might impair the possibilities of inducing change. Change implies changes in relationships between the more powerful and more marginalized. From the point of view of inducing change or helping marginalized voices to be heard, it might be more sensible for the researcher to have a detached role in the network of actors and base her/his suggestions on research data and key findings, not on her/his prior commitment or loyalties.[8]

Organizing dialogue in empirical research

The scientists, engineers and other people whose activities social scientists study provide an important source of insight and explanation that social scientists cannot afford not to use. In contrast, the reverse might be possible. A social scientist may contribute to the practice of the people that they study in several ways. They can provide (disciplinary) conceptions of social and organizational issues that do not belong to the expertise of the people studied. Second, by presenting analysed data to scientists, social scientists can make disturbances in communication, differences in points of views, and problematic forms of practices visible. The researcher can propose a hypothesis of the reasons for these and suggest alternative practices.

The forms of dialogue between the researcher and the researched include: interviews (e.g. Holstein & Gubrium 1995), discussion on the drafts of scientific papers, the researcher's presentations in the meetings and seminars of the community that she/he studies, interventions facilitating the community to reflect upon its own activity and to induce change, and informal non-planned discussions during the fieldwork. These forms of dialogue are often intertwined with one another during the research project.

[8] Pels (1996, 295) characterizes such an autonomy, or 'critical third position,' as follows: 'Its detachment is locally bounded and pragmatically defined. It is oriented towards specific substantive issues, rather than defining a generalizable prescriptive rule which is ensconced in the "logic" or "nature" of social science.'

In our projects, the drafts of papers written by the researchers and dealing with some aspect of the research object's activity were given to the informants for comment. Usually, they gave their comments individually in meetings with the researcher. The main motivation for submitting the manuscripts for the informants' comments is for the researcher to confirm the validity of the analysis and to promote basic trust between the parties. In commenting on the drafts of papers, the practitioners correct mistakes, provide additional background information and evaluate the conclusions made by the researchers. It has been proven that commenting on the conclusions of the manuscript also serves as an instrument for the practitioners with which to reflect on their own activity, as will be discussed later.

Several research traditions have developed intervention techniques, that is, ways of consciously breaking up normal, routine or spontaneous ways of action to elicit data for analysis. Harold Garfinkel (1963) used the breaking of rules to show how social structures are being maintained ordinarily and routinely.[9] Lev Vygotsky, the founder of cultural-historical psychology, developed the principle of double stimulation based on the concept of mediation (van Der Veer & Valsiner 1991, 167). A new means, a concept or a tool is brought into the problem-solving situation to elicit unanticipated solutions and a new type of learning and thinking. Engeström and his colleagues have developed an interventionist research approach based on this idea called the Change Laboratory method (Engeström et al. 1996). In it, the researchers systematically introduce to a work community particular activity theoretical concepts that the community uses in order to analyze the history and the contradictions of the present activity. They also bring selected parts of data on the community's work practice to the laboratory sessions to induce reflection and change in the activity. A Change Laboratory is realized in a series of meetings agreed on beforehand by the researchers and representatives of the community.

In the context of a dialogist approach, we define an intervention as a special type of dialogue in the research process that has three complementary characteristics:

1) Deliberate participation of the research objects (scientists/engineers) in reflecting on some aspect of their activity, in order to be able to develop new ways of acting and collaborating.

2) The researcher introduces means of reflection to the participants. They may be relevant new concepts, pieces of data collected by the researchers, preliminary research results or hypotheses of alternative ways of acting based on the analysis of the data.

[9] For an account of experiments of rule breaking, see e.g. John Heritage 1984, pp.78–82.

3) The concerns or problems dealt with in an intervention are relevant or important to the developmental trajectory or present key challenges of the community's activity.

To analyze how the forms of dialogue and interventions are organized in the research process and how they are connected to the data collection and analysis, we introduce the concept of a *trajectory of dialogues*. A trajectory of dialogues is comprised of three interrelated elements: 1) a series of discussions and interactions that are related to 2) an important problem or challenge of an activity or a network of activities studied, 3) mediated and carried on by the data collected, and analyzed by the researcher. The results of data analysis and the conclusions based on them are presented by the researcher(s) in a paper, which is given to and discussed with the people studied. The paper is later published in a scientific journal. The results of the analysis presented in a paper may therefore function both as a means of dialogue and of inducing change in a community or a network studied, and as a contribution to a scientific debate.[10]

This conception will be elaborated on using a study on the development and implementation of a high technology innovation (Hasu 2001) as an example. The technology studied was a measuring device for brain research and diagnostics called MEG (Magnetoencephelography).[11] The early versions of the device were originally developed, collaboratively, by low temperature physicists, neurophysiologists and psychologists at the Low Temperature Laboratory (LTL) of the Helsinki University of Technology during the 1970s and 80s. A spin-off company called Neuromag Company was established in 1989 to commercialize this innovation. In the first wave of commercial installations, the company sold eight installations to Japan, Germany and the United States. They were used, primarily, for basic research on the human brain. This basic research, however, did not suffice to create a demand for the industrial

[10] Martin (1996, 263) presents a version of such mixed motives by comparing his own projects with the classical study of Festinger and his colleagues (1956) and with the study of Collins and Pinch on parapsychology (1982): 'Their stated primary purpose was understanding, though their participation also lead to considerable impacts on the subjects and fields of the studies. My purpose, by contrast, was at least as much to effect change as to gain understanding.'

[11] Magnetoencephelography is the measurement of extracranial magnetic fields produced by electrical currents within the brain (Hari & Lounasmaa, 1989; Hämäläinen et al., 1993). In MEG recordings, weak magnetic fields outside the head are detected with an array of sensors, and on the basis of the measured signals the underlying cerebral currents are estimated. Development of sensitive SQUID (Superconducting Quantum Interference Device) sensors allows the detection of small changes in the magnetic fields. The sensors can function only at low temperatures and are located within a container filled with liquid helium at a temperature of -269 Celsius.

production of the appliance. Neuromag Company faced the necessity of opening new markets in the hospital environment and developing an application in clinical diagnosis for brain disorder patients. The competition in the field was increasing: two other MEG suppliers, one in Canada and one in the United States, were developing their own devices.

Consequently, the interests of the developer company's management and researcher-engineers coincided in the necessity to understand the producer-user relationships in a transitional phase of the innovation. It was agreed that the results of the empirical research would be submitted for discussion within the company and its network, as soon as it seemed possible and reasonable. However, the manner, form and time of these discussions was not planned or decided upon beforehand. The company was not funding the research, which gave the researcher considerable freedom to decide what initiatives and measures she would take in relation to the company and other actors of the innovation network. The study started in January 1996, the fieldwork was conducted in 1996 and 1997, and the discussion with the practitioners continued in 1998. In the study, a local Finnish producer-user network was principally examined.

In this paper, three organizations involved in the development of MEG are discussed. (1) *Neuromag Company* is the developer and manufacturer of the neuromagnetometer that originated from the research on low temperatures at the LTL. (2) *BioMag Laboratory* is a Finnish user laboratory starting patient measurements with MEG in 1996 and 97 at Helsinki University Central Hospital. Its role as an intermediating actor between the developer company and the end users at the hospital clinics was becoming strategic for the anticipated clinical use of MEG. (3) *The New Mexico Institute of Neuroimaging (NMIN)* at the Veterans Hospital (Albuquerque, USA) is a foreign user laboratory that started to use MEG in its clinical work in 1997. In addition, the contribution of the potential end users of MEG, medical practitioners in hospital clinics, will be briefly touched upon.

Trajectories of dialogues in the study on the implementation of MEG technology

The general research problem in the study on the development of MEG was related to the producer-user relationships in product development. This problem turned out to have specific form in the development of MEG at the time the study was started. The device has been used exclusively in basic research on the activity of the human cortex. To develop MEG into a product, the spin-off firm, Neuromag Company, needed to sell it to the hospitals, that is,

to implement it into clinical use (Hasu 2001). The problem of the transition from one type of use, basic research use, to another, clinical use in hospitals, was studied in different contexts. That problem became divided into a series of subproblems, of which a separate set of data for each was collected and analysed. Three of the data sets were: 1) how the designers make sense of users needs related to MEG, 2) how routine patient MEG measurements were organized in a university hospital laboratory, and 3) how the MEG imaging service for brain surgery was organized in a hospital. In the study of MEG development and implementation, each trajectory was based on the analysis of ethnographic data collected at different fieldsites: (1) in a producer-user seminar organized in affiliation with the Neuromag Company and its local Finnish network, (2) in a MEG laboratory at the Helsinki University Central Hospital where data related to patient measurement were collected and (3) in an American hospital where the organization of MEG service was being studied. The trajectories were realized through what has been characterized as multi-site or global ethnography (Burawoy et al. 2000).

The first trajectory concerning the problem of understanding user needs developed in the following way. 1) The researcher (Mervi Hasu) interviewed potential clinical users of MEG in spring 1996. The users had apparently never talked with the designers of the device, and the company had never heard, face to face, what the users were expecting of MEG. The company agreed with the researcher and his supervisor that a user seminar would be useful to bring the participants of the emerging innovation network into contact with each other – for the first time. 2) In January 1997, the user seminar was arranged by the researchers together with the managing director of the Neuromag Company. Representatives of the key producer and user communities in Finland participated in the seminar. The seminar was videotaped. 3) Immediately after the seminar, the researchers analysed the transcripts of the seminar and wrote a manuscript of a conference paper on it. The paper presented a hypothesis of the major problem in the transition process of MEG from basic research use to clinical use (Miettinen & Hasu 2002). Because of the strong tradition of using the MEG device and method mainly for the purposes of basic research, nobody was willing to commit themselves to the organization of the routine-measurements services necessary for clinical use in a hospital. 4) The management of the company and the hospital laboratory read and commented on the text before it was presented at a conference. 5) As a result of the seminar and the dialogue, a clinical neurophysiologist was hired at a university hospital laboratory to organize the routine patient measurement service that would enable the clinical use of MEG. The researcher started to follow this work. The new data proved to be instrumental in understanding the conditions of the

clinical implementation of MEG and the power relationships within the hospital and its MEG laboratory (Hasu 2000b).

Although a distinction must be drawn between the human and nature (Hacking 1999), an analogy to experimental research in natural sciences can be drawn in characterizing the trajectories of dialogue. An aspect of complex phenomena – in this case product development and implementation process – is analysed, the results and hypothesis based on that aspect are presented to subjects of the activity. This is supposed to induce change in the activity or at least to produce more knowledge about the conditions and constraints of the activity.

We will describe the three trajectories of dialogues within the research process of the neuromagnetometer innovation. We will give a brief description of each of the trajectories, how they were realized, and who were involved. We will clarify the significance of the dialogue for the innovation process by trying to answer two questions: What did the different actors learn from the interaction, and what practical measures were taken as a consequence of the dialogue and intervention?

The user need trajectory

In spring 1996, the key participants of the innovation network were interviewed in order to identify the local user groups of MEG. In addition, an ethnographic observation was conducted in BioMag Laboratory, and measurement situations were videotaped. After recognizing the main clinical users, the researcher started to interview them for an analysis of their activity and their needs in relation to the use of MEG. The practitioners at the hospital expressed real interest in the clinical application of MEG, and, at the same time, feelings of confusion about the availability of patient measurements in BioMag Laboratory. Consequently, in late autumn 1996, the idea emerged in the discussion between the researchers and the company to organize a user seminar in which all the relevant local clinical users could present, in an organized way, their conceptions of the need and usability of MEG. All the clinical users, as well as the developers of the MEG device, showed an interest in the seminar.[12] This was the

[12] The following four clinical practices gave presentations in the seminar: the epilepsy surgery team of Kuopio University Hospital, the brain tumour surgery team of Helsinki University Central Hospital (HUCH), the pediatric neurology unit of HUCH and the Clinical Neurophysiology Department of HUCH. These groups had already had experience with MEG, or they were interested in experimenting with it. Within each of these groups, more than one representative usually spoke. In addition, representatives from Neuromag Company, BioMag Laboratory and Low Temperature Laboratory participated in the seminar. Altogether, nearly 30 participants attended the meeting.

first time all the appropriate local actors were gathered together to discuss the development of the clinical use of MEG.

The user seminar 'MEG in Clinical Use – Seminar for the Designers and Users of the Device' was planned and organized by the researchers and Neuromag and held in January 1997. The seminar was videotaped. In a letter mailed to the participants, we asked them to assess their experiences and expectations in using MEG using a two-level scheme:[13]

1. ANALYZING THE USE-VALUE OF THE ARTIFACT FOR THE USER ACTIVITY IN HISTORICAL PERSPECTIVE

   1.1 What kind of problems or contradictions in the activity does the device and method solve and why?

      a) in a shorter perspective

      b) potentially in the long run

   1.2 Compatibility with other devices and methods used

2. ANALYZING THE SITUATED USE OF THE ARTEFACT

   2.1 Availability and feasibility of measurements (usability, instrumental disturbances and problems during the measurements)

   2.2 Support of the users and possible disturbances in communication and collaboration

   2.3 Availability and usability of analyses and the usability of software

Seven representatives of the designers or MEG research-scientists from three organizations and sixteen representatives of users from hospital clinics participated. The users were medical doctors, mainly neurologists and neuro-surgeons with seniority and authority in the hospital organization.[14] It seemed that answering the first part of the questions regarding the potential use-value of MEG was intelligible and relevant to them. They were capable of formulating many basic preconditions for applying MEG in clinical work.

The perceptions of the practitioners revealed, first of all, the problem of unorganized measurement and analysis services at BioMag Laboratory. This, according to our analysis (Miettinen & Hasu 1997), implied major difficulties in starting to utilize the device and in creating an additional set of evaluation

[13] According to our view, the use of a new product is integrated into the development of user activities as potentially complementary (not alternative) to the existing array of means. In such a case, it is necessary to analyse user activity broadly, independently of the particular innovation (see also Norman & Ramirez 1994, 62). Consequently, we proposed that a user need should be analysed on two levels: on the level of the development of user activities and on the level of the situated use of the artefact.

[14] Many of the users had a Ph.D. and a high position in the hospital hierarchy and scientific community (head of the unit, professor etc.).

means (e.g., the collection of reference databases and procedures for the validation of results) required in the application and implementation of the device. After the seminar, the researchers' analysis of the points of view of the clinical practitioners was presented to the managing director of Neuromag Company and the manager of BioMag Laboratory.

The participants, especially the representatives of Neuromag Company and the manager of BioMag Laboratory, found the seminar to be important and informative. They stressed that listening to the views of the clinicians evoked some new insights about issues which they had not considered before. One month after the user seminar, BioMag Laboratory recruited a medical doctor to develop clinical routines for MEG. Neuromag Company, in turn, founded a support group for clinical routine development in order to assist the work of the consultant doctor with the measurement and analysis systems. An attempt to start a routine measurement and analysis service of MEG emerged at BioMag Laboratory over the following five months. This attempt was closely followed by the researchers as well.

The researchers wrote a paper summarizing the concerns expressed by the participants in the seminar. It presented a synthesis of the points of view presented by the users in the seminar and conclusions concerning the difficulties of the designers and measurement laboratories to meet the expectations of the clinical users. This paper was commented on by the management of Neuromag Company and BioMag Laboratory. It was presented in a conference in June 1997 (Miettinen & Hasu 1997) and later expanded on in a scientific paper (Miettinen & Hasu 2002), which that was again commented on by the managing director of Neuromag and then went through a peer review.

The concerns expressed by the users in the seminar triggered, or at least hastened, the practical measures of the two central actors. BioMag Laboratory recruited a medical doctor to start a measurement and analysis service for MEG. Subsequently, Neuromag Company founded a technical support team to help the work. In this way, the seminar functioned as a catalyst for a new collaborative enterprise within the network. The researcher followed the process as it developed at BioMag Laboratory. It turned out, however, that hiring a doctor did not solve the problem of organizing the clinical use of MEG. Her attempts to organize the measurements revealed that more extensive measures related to collaboration within the hospital organization would be needed (Hasu 2000b).

The user seminar and the participants' comments on the researchers' conclusions took place in 1997. The advisory group of the research project had a meeting in February 1998. The meeting included a short dialogue on the approach of the study. It started, when a member of the group, a doctor of

business economics, asked the managing director of Neuromag Company to evaluate the developmental dimension of the project:[15]

> *Member of the management group:* I would like to ask, ... I have understood there is a developmental aspect in this project. What are your expectations concerning this study?
>
> *Managing director of Neuromag (doctor of technology, Physicist):* It seems clear to me that this kind of a process, that is, making an analysis, does influence the objects under study. Things, such as impediments to development, become uncovered and it is, in my mind, an entirely positive thing. The process has influenced this network, in a certain way – I would say in an insight producing way. And then, these further steps [of the measures taken to advance the clinical activity] are partly a result of this process. In that sense, this has been a very nice business (…) which was soon evident.
>
> *A little later he also presented a methodological comment on the significance of the interventions in the research process by making a comparison to the experiments in natural sciences:* In my mind, you must make it fully explicit in this study. The measurement disturbs the system [laughing]. It is a physical principle, or a well-known thing in natural science.

The comment of the managing director well reflects the attitude of the many participants towards the approach of the study. At the same time, it shows that, during the research process, a mutual understanding of the goals and methods can be constructed between the researchers and the people under study.

Patient measurement trajectory

Field observations showed that several research groups and individual researchers from different organizations were conducting measurements at BioMag.[16] Most of them were graduate students working with their PhD studies. The laboratory turned out to be a centralized research facility for diverse purposes. Except for a laboratory manager and a nurse, no other personnel

[15] Transcript of the meeting of the management group of the project, 6 February, 1998.
[16] These findings were based on field observation and the measurements diary of the Laboratory.

were working there on a daily basis. Each researcher was responsible for his or her own measurements and for operating the measurement system. Largely, healthy adults were being measured. The basic research mode dominated the work at the laboratory.

The situation started gradually changing as interest in the clinical use of MEG arose due to some promising research results in functional brain mapping for pre-operative planning (Tiihonen et al. 1990, Paetau et al. 1991). In 1996, the researcher followed the work of two BioMag doctor-researchers who measured real patients as their research subjects. These research projects can be considered pre-clinical research. In spite of the interest in experimenting with the clinical possibilities of MEG, the aim of the research was frequently a written Ph.D. thesis or a journal article. Still, measuring real patients in a hospital setting was expected to be the next phase in the transition of MEG from basic research use toward clinical use. This was the reason why the researcher videotaped a few patient measurements at the laboratory, to record information about the problems and challenges of the concrete use of MEG in its transitional phase.

Among these patient measurements, a failed measurement event and the ensuing conversations between the users (a doctor-researcher and a nurse) and two of the developers of the MEG device turned out to be particularly informative, revealing the constraints of the practical use of MEG in the real context of patient measurements. In addition, that data also provided valuable information about the constraints and challenges of the producer-user relations and interaction in the transitional phase of the innovation.

The analysis of the data showed several problems (Hasu & Engeström 2000). First, the division of labour turned out to be unplanned and inadequately organized in the measurement, inviting problems and hampering the users' collaboration and attempts at problem solving. Second, the measurement system itself did not guide the users properly in problem solving. Third, the producers and users failed to discuss the systemic problems looming behind what could be seen on the computer screen at the moment, that is, the inadequate organization of the measurements. It also became apparent that the developers were not familiar with real-patient measurements and the practical organization of the measurements at BioMag.

In order to inform Neuromag Company and BioMag Laboratory about the findings, the researcher arranged a feedback meeting in spring 1998 to show the participants excerpts of the videotaped data of the failed measurement event, the ensuing interactions, and the results of the preliminary analysis. In this way, the whole practical work activity of real patient measurement and its constraints were made visible to the developers. In the feedback meeting, a 'mirror' of their own work and interactions was provided to the developers and users.

The participants – also the managers of the organizations – were listening to and watching the presentation intensively. A lively discussion and debate emerged during and after the presentation. A few weeks after the meeting, BioMag hired a technician for the technical maintenance and support work at the lab.

Both managers and shop floor users as well as the developers participated in the feedback meeting. They represented different levels of educational background and authority. The researcher's intention was to help the young woman doctor and the nurse in particular to present their points of view to the male developers and managers. The doctor and nurse had shared their concerns – some of which were critical and important to their work – to the researcher in various interview situations during the fieldwork. However, in the feedback meeting, the nurse remained silent and did not express her concerns. The two managers, one of the developers and the doctor-researcher mainly dominated the conversation. It is possible that the presence of figures of authority and the academic status of the other participants[17] reflected in their language and ways of building arguments made her feel uncomfortable or inadequate in the discussion.

The feedback meeting on the failure of the patient measurement differed from the user seminar discussed in the previous section. The researcher presented her analysis and interpretations about the failed patient measurement to a limited number of participants. The researcher had organized the meeting and summoned the participants together.[18] The meeting was scripted with data excerpts from real life situations, and the participants could watch themselves in the video. The situation was intense, especially at the beginning. The participants spontaneously and anxiously commented on what they saw – adding some new aspect or supporting or questioning the interpretations of the researcher. Some of the participants – especially the doctor whose measurement had failed – quite openly recalled and voiced their feelings of stress and frustration in the situation.[19] As the participants commented on what they saw in the video, they also tried to make sense of their own intentions and thoughts underlying their actions. In this way, the different perspectives of the developers and users were made visible, giving support to the researcher's overall interpretation.

---

[17] The two managers as well as the two product developers had an academic background (both had a Ph.D. in low temperature physics), and the physician was a doctoral candidate.

[18] The participants of the feedback meeting were the same as those in the breakdown situation under study: the doctor-researcher, the nurse and the two product developers. In addition, the managing director of Neuromag Company and the manager of BioMag Laboratory were present.

[19] Transcript of the feedback meeting, 11 May 1998. The audio recorded discussions were transcribed in detail and used as research data.

The dialogue in the feedback meeting turned out to be meaningful and significant to the participants in several ways. In the meeting, firstly, the authentic measurement situation with a real patient – and the problems involved therein – were made visible to the developers and those managers responsible for the development of the technology and the measurement services. They could learn the perspective of the shop floor users struggling with the complex technology and complex social environment. They would potentially benefit since the user-oriented redesign of the MEG device was emerging as a new phase and challenge in the innovation process. The problems of the developer-user interaction were also made visible through data excerpts by showing how diverse situational perspectives may block efforts towards mutual problem solving. Interpreting breakdown situations merely as an individual user's errors was questioned by expanding the analysis to cover also the division of labour and the organization of the measurements.

After the meeting, the researcher's analysis of the failed patient measurement, which was developed into a conference paper and later an article manuscript, was commented on by the key practitioners, and the dialogue continued on in this way. The dialogue also resulted in practical measures. Soon after the feedback meeting, BioMag Laboratory hired a technician to provide technical support and maintenance for the MEG system. This corrective, practical measure was, possibly, partly in response to the inadequacies revealed in the analysis.

Trajectory related to the organization of MEG service in an American hospital

During the summer of 1997, the researcher visited a foreign user laboratory and customer of Neuromag Company, the *New Mexico Institute of Neuroimaging* (NMIN), at the Veterans Hospital in Albuquerque, New Mexico, USA. According to Neuromag, the institute was at that time the only customer systematically oriented to developing routine clinical work with MEG. However, the company was not closely familiar with the situation or state of clinical work at the institute. They did know, however, that there was a transitional phase going on at the institute, since the director together with the leading figure of MEG research, were leaving the institute to start a new neuroimaging center in another state. For this reason, the managing director of the company supported the researcher's idea to visit the NMIN and recommended this opportunity to the director of the NMIN as well. It was agreed that the researcher would inform Neuromag Company and the local

user, BioMag Laboratory, about her 'observations and findings' after returning to Finland.

For six weeks, the researcher conducted interviews with the NMIN staff and the medical practitioners of the local district hospitals utilizing the MEG measurement services. In addition, she conducted ethnographic observation of the laboratory activities and videotaped various patient measurements, analysis sessions and the application of the results in neurosurgical operations.

In August 1997, meetings were arranged, first, between the researcher and Neuromag Company, and, second, between the researcher and BioMag Laboratory. In both cases, the managers were also present. In the 'report meetings,' the researcher presented to the participants the main observations of her visit to the NMIN. Data excerpts, including videotaped events, were shown to the participants to support the findings. The meetings were also audio recorded.

The main news presented in the meetings was that, in spite of various problems, the clinical measurement and analysis service was quite successfully running at the NMIN, and that active development of the clinical work had, indeed, taken place and was still being carried out by the new leader of the institute. The key elements and conditions of this development, as well as its future challenges, were analysed and presented to the audiences by the researcher. The example of the NMIN also showed that the prior experience of the service providers in organizing various imaging services was an important precondition for the development and evaluation of MEG as a clinical tool. Considering the main future task of the company, namely, the acquisition of clinical applications and markets for MEG, the NMIN case represented the challenge of a more advanced user laboratory than the BioMag Laboratory in Finland. The concept of lead user suggested by v. Hippel (1988) was introduced by the researcher in the meetings to indicate the significance of a highly motivated advanced user, such as MNIN, for the implementation of technology.

In the meeting with BioMag Laboratory's staff and collaborators from the hospital, the additional data introduced was the ongoing clinical work process of MEG at the NMIN. The various phases of the process, the central means, and the communities involved in the process, from referral to the operation room, were presented and depicted to the participants as an advanced or anticipated model of organizing clinical service. In both meetings, the participants asked many detailed questions about how some particular things were done at the NMIN, questions which were, in many cases, impossible for a social scientist to answer. However, the participants of both meetings found the information valuable and 'thought-provoking'. During the presentation held at BioMag Laboratory, the manager of the laboratory stated several times that 'this is very important information for us' and 'we can learn a lot from this information.' A physician suggested that the researcher should analyse the functioning of

BioMag Laboratory in a similar manner. A lively discussion between the participants took place during and after both of the presentations.

The setting of this 'report meeting' followed the script of the feedback meeting discussed above: using data excerpts, the researcher described the practices and concerns of the foreign MEG practitioners and users to the practitioners of the local Finnish network. Again, the researcher initiated two meetings which were open to the entire personnel of each organization. Not surprisingly, remarkable interest in the issue emerged. Nearly all of the company personnel attended the meeting. The participants were anxious to know about the situation of using MEG in the foreign user laboratory. More than in the other two meetings in which dialogue emerged, the participants now often engaged in intensive conversations and debate with each other, leaving the researcher out of the discussion.[20] At times, they immediately were able to integrate the information provided by the researcher into their ongoing projects and concerns. This form of dialogue was probably due to the fact that the meetings were organized separately. Had there been a joint meeting between the organizations, the situation would have been different. This setting did not enhance dialogue among the whole local network, only between the immediate parties.

It seemed, however, that the meetings were significant for the current phase of the innovation process. Neuromag Company and BioMag Laboratory had an opportunity to acquire detailed ethnographic information from an advanced reference laboratory engaged in developing clinical MEG. The participants were able to learn about the issues concerning the work organization, forms of collaboration and division of labour in another user laboratory. Also, the problems and challenges of the next phase of development, the phase of sustaining the emerging clinical use in the hospital, were touched upon in the data excerpts. The overseas practitioners and users, with their respective worries and concerns, were shown as living personalities who, on the one hand, are very much motivated and engaged in their work, but, on the other, are worried about the future of MEG.

The meetings and discussions also resulted in practical measures. In November 1997, a Ph.D. student from BioMag Laboratory was sent to visit the NMIN and the newly founded centre at the University of Utah. The visit was funded by Neuromag. Neuromag, in turn, made new arrangements to be able to supply in time a new device ordered by a new, strategic customer, who had left the NMIN and was now starting a new centre in Utah.

---

[20] Transcripts of the meetings at Neuromag, 2 September1997, and at BioMag, 9 October 1997. Audio recorded discussions of both meetings were transcribed in detail and used as research data.

In the meeting with the BioMag Laboratory, the following discussion on the interventionist methodology took place:

> *A psychologist from BioMag:* How do you see your own position? You have a research object and you are participating in its life. Don't you simultaneously affect it?
>
> *Researcher:* I was expecting this question. This is a difficult question. My starting point is, why can't the researcher be in dialogue with the research object? It would be miserable, to me, just to look from a distance and even laugh at what they [research objects] are doing there, and not share my own impressions and interpretations of what I may have seen.
>
> *The psychologist:* I really didn't want to criticize it – I just wonder what it means and what is thought about it from the point of view of sociology. But, in my opinion, we have a lot of use for this stuff in the system.
>
> *The manager of the laboratory, physicist:* This is a kind of a multidisciplinary approach. You (referring to the researcher) have gone into the various aspects [of MEG use] and if these were just left on the shelf, if you wouldn't say [anything] to anybody, they would be of no use to anybody.

This is also an example of how the conditions of mutual dialogue are constantly constructed during the research process.

The characterization of the three trajectories of dialogues in the MEG study is presented in table 1. It was argued that a trajectory is composed of 1) a series of discussions 2) concerning a problem or challenge of an activity or a network of activities studied 3) mediated by results and conclusions from a set of research data collected and analyzed by a social scientist (columns 2 and 3). We further asked what the key actors (Neuromag Company and BioMag Laboratory) learned from these dialogues (column 4), and finally, what practical measures they took as a result of the dialogues (column 5). Although the measures were not dramatic, they show that the conclusions drawn from the data were significant for the key actors.

Table 1 Three trajectories of dialogues related to the study of the development ands clinical implementation of MEG

Trajectory of dialogues	Data and scientific papers in which the results of the analysis were published	The findings/ conclusions the researcher brought to the dialogue	Significance of the dialogue and intervention for designers and the Helsinki hospital user laboratory	Measures taken by designers and the Helsinki user laboratory
Trajectory related to the needs of clinical users	Interviews of designers and users and discussions in a user seminar (Miettinen & Hasu 1997; 2002)	A trap in the development network: because MEG was thus far used in basic research, nobody took responsibility for organizing the routine measurement service needed in clinical use	Designers and the personnel of the hospital measurement lab discussed, for the first time, with the clinical end-users about the expectations concerning the use of MEG	The user lab hired a medical doctor to organize routine measurements Neuromag established a support group
Trajectory related to the patient measurements in a hospital MEG laboratory	Video recordings of a failed patient measurement and the ensuing discussion between the product developers and MEG system users (Hasu & Engeström 2000)	Severe problems in the interface of the system and in the organization of patient measurements Severe difficulties of communication between developers and system users	The designers saw for the first time the measurement from the beginning to the end The problems in the organization of the measurements and in communication became visible	A support technician was hired to enhance the establishment of routine measurements
Trajectory related to the organization of MEG service in a hospital	Interviews of hospital personnel, observations of MEG activities (Hasu 2000a)	Complexity of the implementation process: number of clinics, labs and professional groups included in the MEG service	The complexity of organizing the measurement service in a hospital became visible	A doctoral student was sent to the US to study the organization of the MEG measurement service

The 'conclusions' in column 3 are abstractions by the authors for this paper. They are formulated from the point of view of the dialogue with the practitioners. They do not communicate the scientific or theoretical significance of the study which has been evaluated in the relevant disciplinary communities. The papers contributed to the dialogues in various ways. They included pieces of data useful for reflection and results of several analyses as well as the social scientific concepts used in the analysis of data and in the framing of the papers. However, in the dialogue with the practitioners, especially in intervention meetings, the researcher worked to select the data and results which she regarded as important for the practitioners and their future activity. In addition, each of the trajectories also contributed to the network construction, either in creating new connections (trajectories 1 and 3) or in changing the ways of interaction between the 'old' partners (trajectory 2).

Conclusions

We have dealt with dialogism in science and technology studies as a principle related to the problems of objectivity, relevance and collaboration between social scientists and the practitioners they study. First, we see dialogue as a solution to the problems caused by the dualist and monological tradition in science and technology studies, in which the scientists and engineers being studied are not taken as partners in the research endeavour. We suggest a multidisciplinary dialogue utilizing the cultural resources of the people under study as a positive solution. This kind of dialogue should utilize not only different disciplinary resources, but also the practical knowledge of the various participants.

A dialogist approach is important in science and technology studies because its research object, fact and artefact construction as a distributed activity, is, by its nature, multivoiced and presupposes the inclusion of the perspectives of different actors. This was obvious in our case, the design and development of the neuromagnetometer. The device and the method have different meanings for the key actors. For Neuromag Company, the question is of a product that should be sold in the market; for the brain researchers, it is a fascinating new device for studying brain functions and publishing scientific papers. For the hospital laboratory, it is a means of producing services, and for surgeon groups, it is a possible extra diagnostic tool – one among many – to increase the relevant information needed in the planning of surgical operations. The reconstruction of these points of view is essential when trying to understand the dynamics and constraints of a distributed innovation process.

Our case represents object- and site-specific forms of interventionist and dialogic research. The study on the development and implementation of MEG was an academic dissertation project oriented to understanding the dynamics of producer-user interaction in science-based innovations. It was primarily oriented to analysing data collected in order to answer the research questions and publish scientific papers, and to write a dissertation. Simultaneously, the data and results were used as means of intervening in the design and implementation process.[21] An interventionist approach can, therefore, be founded on the basis of an academic commitment.[22] It has been suggested that it is unlikely that researchers themselves can act as 'catalysts' for significant changes in an activity or an organization. However, she/he can contribute trough dialogue. Independently of this, the epistemic significance of interventions as means of accessing more nuanced data of the object must be underlined. We agree with Martin (1996) that interventionist research makes it possible to collect data that is unavailable to non-interventionist research. Specifically it allows the collection of data of the conditions and barriers of change and of the mechanisms of power involved (Hasu 2000b).

The problem of intervention studies, as described here, is often assumed to lie in the limited opportunities for publishing, due to the organizations' unwillingness to allow the researchers to use contextual information from which they can be identified in the publication. We have shown in this paper that intervention and publishing academic papers can be done simultaneously. We feel, however, that communicating results to a limited academic audience is not enough. Extensive public funding necessitates that researchers will go beyond single studies in order to produce a synthesis of a research programme.

We agree with Woodhouse and his colleagues (2002) of the importance of developing a new kind of boundary-crossing publications, such as cross-over books aimed both at scholarly readers, as well as practitioners, politicians and a larger public. Our research group has consequently written the book *From a Product into a Tool: New Technologies in Health Care* (Miettinen et al. 2003). It reviews the research literature of producer-user relationships and co-configura-

---

[21] Bent Flyvberg, who has studied city planning, expressed this kind of commitment as follows (2001, 156): 'I would deliberately and actively feed the results of the research back into political, administrative and social processes that I have studied.'

[22] Outside STS, several interventionist approaches have been developed in recent decades (see e.g. Whyte 1991, Engeström et al. 1996, Flyjberg 2001, Long 2001). Each of them is based on different theoretical traditions and on divergent ideas of the role of the researcher, which cannot be discussed here. A shared idea is to create a space, an arena of contestation or struggle (Long), or a laboratory (Engeström et al.), in which people of the site studied reflect on their activity and articulate ideas for alternative action. Compared with these suggestions, the approach delineated in this paper is 'academic' in underlining the use of research results (that are also published) as means of intervention.

tive design, compares three empirical studies of health care technology development and implementation, of which one was the MEG study presented in this paper. The results of all three highlighted the importance of user involvement for the success of the innovative activity and the various barriers for such an involvement.[23] The conclusions and recommendations based on the studies were divided into four parts according to the audiences: designers, health care organizations (recipients and users of technology), politicians and technology development funding organizations, and finally, researchers of design and innovation. We struggled to develop a style of presentation that would make the book accessible to all these groups without giving up our theoretical insights or the most important scientific findings. In spring 2005 the book was used as a textbook in four Finnish universities and polytechnics. This corresponds to the traditional idea that the results of critical social research will have an effect when they are made actively accessible to relevant social actors.

The connection of dialogue and intervention to objectivity has been discussed in terms of validity in research. Steinar Kvale (1989) introduces in his analysis of validity in qualitative research the concepts of discursive and pragmatic validity. Discursive validity refers to the fact that the reliability of an account is approved in the dialogue with an interpretative community. In science studies this community has been a disciplinary community engaged in peer review and scientific controversies. Kvale maintains that the dialogue should also be extended to the subjects investigated or the 'larger epistemic community, who will decide what our knowledge means', as Hamlin (1992, 537) puts it. Knorr-Cetina (1982) used the term 'transepistemic arenas' of the extended networks of communities participating in the construction of the credibility of the research results.[24] Pragmatic validity refers to the extent to which the generated knowledge can be applied to improve the conditions of the activity being studied or to its 'problem solving effectiveness' (Nelson 1995).

Our case underlines the connection between discursive and pragmatic validity. First, the dialogue between the researchers and practitioners is likely to be active and productive if the issues to be commented on are relevant for the practitioners. Second, if the issues are relevant, they are likely to result in measures to change the activity. These changes, in turn, uncover new conditions and aspects of the practices to be studied. The case of the neuromagnetometer device included such a data-producing series of events.

---

[23] The other two cases were a diabetes management software system (Hyysalo & Lehenkari 2003) and a safety wristband for elderly people (Hyysalo 2004b).

[24] Knorr-Cetina contends that the scientific specialist community cannot be a unit of analysis in science studies. The relations of researchers transcend disciplinary borders and include collaboration with significant non-scientists as well. 'Different games are played at the same time by a variety of people' Knorr-Cetina 1982, at 118.

The user seminar resulted in a decision to hire a neurologist at the hospital laboratory in order to organize measuring services for hospital clinics. Her attempts to accomplish this task, in turn, uncovered the complexity of the task and its various dimensions: the limitations of the measurement system, the organization of measurements in the laboratory, the difficulty of interpreting measurement inscriptions, inadequate computer programs, and the lack of reference data for carrying out analyses. First of all, it made visible the effects of historically developed power structures around MEG. They paralysed her attempt to organize the collaboration necessary for the creation of the clinical measuring service.

Intervention, as a vehicle for change experiments, proved to be focally important for achieving objectivity concerning the knowledge of the conditions of the innovation process. We think that for the practice turn in science and technology studies, simply observing and recording laboratory and design practices does not suffice. Dialogue in research means also to elaborate on, together with the participants of research, the relevant research issues and problems. It is necessary for transcending the interpretative asymmetry as well as the closed, 'self referential character of sociological analysis of discourse' (Mulkay 1988, 100).

The study also highlighted the relevance of a feminist standpoint epistemology. Studies of innovation have had a tendency to neglect the agency of ordinary practitioners and shop floor workers (Hasu 2001, 64). The analysis of the unsuccessful measurement event illustrated how practical knowledge of the shop floor situation is becoming increasingly important for the design and implementation of innovations. The major challenge of creating a clinical market for MEG is linked with the organization of measurement and analysis services in hospitals. The nurse at the hospital laboratory had rich experience of the practicalities of measurement. Her voice, however, remained unheard. This was, without doubt, owing to her position as the 'assistant' without scientific (physical, engineering or higher medical) qualifications. The inclusion of her point of view is not just a normative question, but crucially important for the emergence of the (routine) clinical use of MEG. It was, therefore, also important for the scientific enterprise, the understanding of the key conditions of the transition in the innovation process.

By whom was the researcher captured in the research process, and were the voices included in the study sufficient? As Howard Becker suggests, the problem of a balanced picture can be solved by making the limits of what we have studied clear (1967, 247). The object of this study was producer-user collaboration and the problems of the transition of a product into a new use context and a new market. Within this frame, the different voices became fairly well heard. It is true that the study started with collaboration with the manag-

ing director of the Neuromag Company and was related to the perspective of creating a clinical market. On the other hand, all the key developers were heard. The researcher worked to make the points of view of the users visible and brought about dialogue between the designers and users. Finally, the laboratory practitioners were given a voice through studying the measurements in the laboratory and the attempt to create clinical routine use in a hospital. Outside the framing of producer-user collaboration, it remained, however, open to what extent the future use of MEG as a clinical instrument will improve the care of neurological patients and whether the abundant and long-lasting public funding for the high technology device was legitimate or not.

References

Abofalia, Mitchel (1998) Markets as Cultures: An Ethnographic View, in M. Callon (ed.), The Laws of the Market (Oxford: Blackwell): 69-85.

Bakhtin, Mikhail (1981) *The dialogic imagination*. Edited by Michael Holquist. (Austin: University of Texas Press).

Becker, Howard (1967) 'Whose side are we on?', *Social Problems* 14, 239-47.

Bernstein, Richard (1985) From hermeneutics to practice. in R. Hollinger (ed), *Hermeneutics and Practice* (Notre Dame, Indiana: University of Notre Dame Press): 272-296.

Billig, Michael (1987) *Arguing and Thinking. A Rhetorical Approach to Social Psychology* (Cambridge: Cambridge University Press).

Bruner, Jerome (1990) *Acts of Meaning* (Cambridge, Mass.: Harvard University Press).

Burawoy, Michael & Joseph Blum & George Shebe & Zsuzca Gille, & Theresa Gowan & Lynne Haney & Maren Klawiter & Steven Lopez & Séan Ó Riain and Millie Thayer (2000) *Global ethnography. Fources, connections and imaginations in a postmodern world* (Berkeley: University of Management Press).

Campbell, John (2002) 'A Critical Appraisal of Participatory Methods in Development Research', *International Journal of Social Research Methodology* 5(1), 19-29.

Collins, H.M. (1991) 'Captives and Victims: Comments on Scott, Richards and Martin', *Science, Technology and Human Values* 16(2), 249-51.

Collins. H.M. (1995) 'Cooperation of Two Cultures: Response to Labinger', *Social Studies of Science* 25(2), 306-09.

Collins. H.M. (1996) 'In Praise of Futile Gestures: How Scientific is the Sociology of Scientific Knowledge?', *Social Studies of Science* 26 (2), 229-44.

Collins, H.M. & Pinch, T.J. (1982) Frames of meaning: The social construction of extraordinary science. London: Routledge & Kegan Paul.

Engeström, Ritva (1995) 'Voice as communicative action.' *Mind, Culture & Activity* 2(3), 192-215.

Engeström, Yrjö (1999) 'Communication, discourse and activity', *The Communication Review* 3 (1-2), 165-185.

Engeström, Yrjö and Escalante, Virginia (1996) 'Mundane tool or object of affection? The rise and fall of postal buddy', in B. Nardi (ed), *Activity theory and human-computer interaction* (Cambridge, Mass.: The MIT Press), 325-373.

Engeström, Yrjö & Jaakko Virkkunen & Merja Helle, & Juha Pihlaja and Ritva Poikela (1996) 'The Change Laboratory As Tool For Transforming Work', *Lifelong Learning in Europe* 1(2), 10-17.

Festinger, Leon & Riecken, Henry & Schachter, Stanley (1956). *When prophecy fails: A social and psychological study of a modern group and predicted destruction of the world.* Minneapolis, MN: University of Minnesota Press.

Flyvberg, Bent (2001) *Making Social Science Matter. Why Social Inquiry Fails and How it Can Succeed Again* (Cambridge: Cambridge University Press).

Garfinkel, Harold (1963) A conception of, and experiments with, 'trust' as a condition of stable concerted actions. In O.J. Harvey (ed.) *Motivation and Social Interaction*. New York: Ronald Press, 187-238.

Gilbert, Nigel & Mulkay, Michael (1984) *Opening Pandora's Book. A Sociological Analysis of Scientists' Discourse* (Cambridge: Cambridge University Press).

Gustavsen, Björn (1992) *Dialogue and development*. (Assen: Van Gorcum).

Hacking, Ian (1999) *Social Construction of What?* (Cambridge, Mass.: Harvard University Press).

Hamlin, Christopher (1992) Reflexivity in Technology Studies: Toward a Technology of Technology (and Science)? *Social Studies of Science* 22(3), 501-544.

Hammerslay, Martin (2000) *Taking Sides in Social Research. Essays on Partisanship and Bias* (London and New York: Routledge).

Hammersley, Martin (2002) 'Ethnography and the Disputes over Validity', *Debates and Developments in Ethnographic Methodology* 6, 7-22.

Haraway, Donna (1991) *Simians, Cyborgs, and Woman. The Reinvention of Nature* (New York: Routledge).

Harding, Sandra (1993) 'Rethinking Standpoint Epistemology: What Is "Strong Objectivity"?', in L. Alcoff & E. Potter (eds) *Feminist epistemologies* (New York: Routledge): 49-82.

Harding, Sandra (1996) 'Standpoint Epistemology (a Feminist Version): How Social Disadvantage Creates Epistemic Advantage', in S.P. Turner (ed), *Social Theory and Sociology* (Cambridge, Mass.: Blackwell Publishers): 146-160.

Harding, Sandra (1998) *Is Science Multicultural? Postcolonialisms, Feminisms and Epistemologies* (Bloomington: Indiana University Press).

Hari, Riitta & Lounasmaa, Olli (1989) Recording and interpretation of cerebral magnetic fields. *Science* 244, 432-436.

Hasu, Mervi (2000a) 'Blind Men and the Elephant: Implementation of a New Artifact as an Expansive Possibility', *Outlines* 2 (1), 5-41.

Hasu, Mervi (2000b). 'Constructing Clinical Use: An Activity-Theoretical Perspective on Implementing New Technology', *Technology Analysis and Strategic Management* 12 (3), 369-382.

Hasu, Mervi (2001). *Critical Transition from Developers to Users. Activity-theoretical Studies of Interaction and Learning in the Innovation Process*. Academic Dissertation. University of Helsinki, Department of Education (Espoo: Otamedia Oy).

Hasu, Mervi (2005). In search for sensitive ethnography of change: tracing the invisible handoffs from technology developers to users. *Mind, Culture, and Activity* 12(2), 90-112.

Hasu, Mervi & Engeström, Yrjö (2000) 'Measurement in Action: An Activity-Theoretical Perspective on Producer-User Interaction', *International Journal of Human Computer Studies* 53(1), 61-89.

Heritage, John (1984) *Garfinkel and Ethnomethodology*. Oxford: Polity Press

Hess, David (2001) 'Ethnography and the Development of Science and Technology Studies', in P. Atkinson & A. Coffey & S. Delamont & J. Lofland & L. Lofland (eds*), Handbook of Ethnography* (London: Sage): 234-245.

Hesse, Mary (1980) *Revolutions and Reconstructions in the Philosophy of Science*. (Brighton: The Harvester Press).

Hippel, Eric von (1988) *The sources of innovation* (New York and Oxford: University Press).

Hippel, Eric von (2005) *Democratizing innovation*. (Cambridge, Mass.: The MIT Press).

Holquist, Michael (1990) *Dialogism: Bakhtin and his World* (London: Routlege).

Holstein, James and Gubrum, Jaber (1995) *The Active Interviewer* (London: Sage).

Hyysalo, Sampsa (2004a) Technology Nurtured - Collectives in Maintaining and Implementing Technology for Elderly Care. *Science Studies* 17 (2), 23-43.

Hyysalo, Sampsa (2004b) *Uses of innovation. Wristcare in the practices of engineers and elderly.* Academic dissertation. Department of Education, University of Helsinki (Helsinki: Helsinki University Press).

Hyysalo, Sampsa & Lehenkari, Janne (2003) An activity-theoretical method for studying user participation in IS design. *Methods of Information in Medicine* 42(4), 398-404.

Hämäläinen, M., Hari, R., Ilmoniemi, R., Knuutila, J. and Lounasmaa, O.V., (1993). Magnetoencephalography - theory, instrumentation, and applications to noninvasive studies of the working human brain. *Review of Modern Physics* 65 (2), 414-497.

John-Steiner, Vera (2000). Creative collaboration. (Oxford and New York: Oxford University Press.)

Keller, Evelyn Fox (1985). *Reflection on gender and science*. (New Haven: Yale University Press).

Knorr-Cetina, Karin (1982). 'Scientific communities or transepistemic arenas of research? A critique of quasi-economic models of science', *Social Studies of Science* 12(1),101-130.

Knuuttila, Tarja (2002) 'Signing for Reflectivity: Constructionist Rhetorics and Its Reflective Critique in Science and Technology Studies', *Forum: Qualitative Social Research* 3(3) http://www.qualitative-research.net/fqs/fqs-e/inhalt3-02-e.htm.

Kvale, Steinar (1989) 'To Validate is to Question', in S. Kvale (ed.) *Issues of Validity in Qualitative Research* (Lund: Studentlitteratur).

Labinger, Jay (1995) 'Science as Culture: A View from the Petri Dish', *Social Studies of Science* 25(2), 285-306.

Latour, Bruno (2000) 'When Things Strike Back: A possible Contribution of 'Science Studies' to the Social Sciences', *British Journal of Sociology* 51(1), 107-123.

Latour, Bruno & Steve Woolgar (1979) *Laboratory Life: The Social Construction of Scientific Facts* (Beverly Hills: Sage Publications).

Lenoir, Timothy (1992) 'Practical reason and the construction of knowledge. The lifeworld of Haber-Bosch', in E. McMullin, (ed), *The Social Dimensions of Science* (Notre Dame, Indiana: University of Notre Dame Press): 159-197.

Linel, Per (1998) *Approaching Dialogue* (Amsterdam: John Benjamins Publishing Company).

Long, Norman (2001) *Development Sociology. Actor Perspectives* (London: Routledge).

Lynch, Michael (1995) 'Collaboration and Scandal. A Comment on Labinger', *Social Studies of Science* 25 (2), 324-29.

Mannheim, Karl (1936) *Ideology and Utopia. An Introduction to the Sociology of Knowledge* (New York and London: A Harvest/HBJ Books).

Markl, Peter (1990) 'Evolutionary Epistemology, Realism and Analytical Chemistry', *Fresenius' Journal of Analytic Chemistry* 337, 168-171.

Markova´ Ivana & Klaus Poppa (eds.) (1990) *The Dynamics of Dialogue* (Hertfordshire: Harvester Wheatsheaf).

Martin, Brian (1996) 'Sticking a Needle into Science: the Case of Polio Vaccines and the Origins of AIDS', *Social Studies of Science* 26 (2), 245-76.

Megill, Allan (1994) 'Introduction. Four Senses of Objectivity', in A. Megill (ed), *Rethinking objectivity* (Durham and London: Duke University Press): 1-20.

Megill, Allan (ed.) (1994) *Rethinking Objectivity* (Durham and London: Duke University Press).

Miettinen, Reijo (1993). *Methodological issues of studying innovation related networks*. VTT Group for Technology Studies. Working papers 4-1993.

Miettinen, Reijo (1999) 'Riddle of Things. Activity Theory and Actor Network Theory as Approaches of Studying Innovations', *Mind, Culture, and Activity* 6(3), 170-195.

Miettinen, Reijo (2004) The roles of the researcher in developmentally-oriented research. In Kontinen, T. (Ed.) *Development Intervention. Actor and activity perspectives*. Helsinki: University of Helsinki, Center for Activity Theory and Developmental Work Research and the Institute of Development Studies, 105-121.

Miettinen, Reijo & Mervi Hasu (1997) 'Artifact and producer-user network in transition. The case of Neuromag', in *1:st Nordic Baltic Conference on Activity Theory*, February 7-9, 1997. Vol 2. University of Helsinki. Center for Activity Theory and Developmental Work Research. Working papers 13, 3-28.

Miettinen, Reijo & Mervi Hasu (2002) 'Articulating User Needs in Collaborative Design: Towards an Activity Theoretical Approach', *Computer Supported Collaborative Work* 11 (1-2), 129-151.

Miettinen, Reijo & Sampsa Hyysalo & Janne Lehenkari & Mervi Hasu (2003) *Tuotteesta työvälineeksi. Uudet teknologiat terveydenhuollossa* (Form product to tool. New technologies in health care) (Helsinki: Stakes).

Morrow, Raymond (1998) 'Bakhtin and Mannheim: An Introductory Dialogue', in M. Bell and M. Gardiner (eds), *Bakhtin and the Human Sciences* (London: SAGE): 145-162.

Mulkay, Michael (1988) 'Don Quixote's Double: a Self-exemplifying Text', in S. Woolgar (ed), *Knowledge and Reflectivity* (London: SAGE): 81-100.

Nelson, Rodney (1995) Pragmatic validity in Mannheim and Dewey; a reassessment of the epistemological critique of *Ideology and Utopia*. *History of Human Sciences* 8 (3), 25-45.

Norman, Richard and Ramírez, Rafael (1994) *Designing Interactive Strategy* (Chichester: John Viley & Sons).

Oudshoorn, Nelly & Trevor Pinch (eds.) (2003) *How users matter. The co-construction of users and technology* (Cambridge, Mass.: The MIT Press).

Paetau, R. & Kajola, M. & Korkman, M. & Hämäläinen, M. & Granström M-L. and Hari, R. (1991) 'Landau-Kleffner syndrome: Epileptic activity in the auditory cortex', *NeuroReport* 2(4), 201-204.

Pels, Dick (1996) 'The Politics of Symmetry', *Social Studies of Science* 26(2), 277-304.

Pickering, Andrew (1995) *The Mangle of Practice. Time, Agency & Science* (Chicago: The University of Chicago Press).

Pinch, Trevor (1995) 'In and Out of Petri Dish: Science and S&TS', *Social Studies of Science* 25(2), 334-37.

Radder. Hans (1996) *In and About the World. Philosophical Studies of Science and Technology* (New York: State University of New York Press).

Reason, Peter & Bradbury, Hilary (2001*) Handbook of action research, Participary inquiry & Practice* (London: Sage).

Richards, Evelleen (1996) 'Ending Up On Wrong Side: Must the Two Forms of Radicalism Always Be at War?', *Social Studies of Science* 26 (2), 323-356.

Rohracher, Harald (ed.) (2005) *The user involvement in innovation processes. Strategies and limitations from a socio-technical perspective* (München: Profil Verlag).

Saari, E. (2003) *The Pulse of Change in Research Work. A Study of Learning and Development in a Research Group*. Academic dissertation. Department of Education (Helsinki: Helsinki University Press).

Sampson, Edward (1993) *Celebrating the Other. A Dialogic Account of Human Nature* (Exeter: Harvester Wheatsheaf).

Scott, Pam & Evelleen Richards & Brian Martin (1990) 'Captives of Controversy. The Myth of Neutral Social Research in Contemporary Scientific Controversies', *Science, Technology and Human Values* 16(2), 474-494.

Shotter, John (1993) *Conversational Realities. Constructing Life Through Language* (London: Sage).

Shotter, John (2000) 'From within Our Lives Together: Wittgenstein, Bakhtin and Voloshinov and the Shift to a Participatory Stance in Understanding Understanding', in L. Holzman & J. Morss (eds), *Postmodern Psychologies, Societal Practice, and Political Life* (New York and London: Routledge): 100-129.

Sismondo, Sergio (1996) *Science Without Myth. On Constructions, Reality and Social Knowledge* (Albany: State University of New York Press).

Stockdale, Alan (1995) 'Stop taking about science': a response to Labinger', *Social Studies of Science* 25 (2), 337-41.

Suchman, Lucy (1994) 'Working relationships of technology production and use'. *Computer Supported Cooperative Work* 2 (?), 21-29.

Tiihonen, J. & Hari, R. & Kajola, M. & Nousiainen U. and Vapalahti, M. (1990) 'Localization of epileptic foci using a large area magnetometer and functional brain anatomy', *Annals of Neurology* 27(3), 283-290.

Van Der Veer, René & Jan Valsiner (1991) *Understanding Vygotsky. A Quest for Synthesis* (Oxford UK: Blackwell).

Victor, Bart & Andrew Boynton (1998) *Invented here. Maximazing Your Organizations's Internal Growth and Profitability* (Boston, Mass.: Harvard Business School Press).

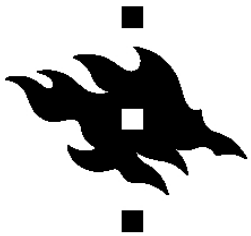
Wertsch, James (1991) *Voices of the Mind. A Sociocultural Approach to Mediated Action* (Cambridge, Mass.: Harvard University Press).

Whyte, William Foote (ed.) (1991) *Participatory Action Research* (Newbury Park: Sage Publications.

Wittgenstein, Ludwig (1989) Philosophical Investigations. (Oxford: Basil Blackwell).

Woodhouse, Edward & David Hess & Steve Breyman and Brian Martin (2002) 'Science Studies and Activism: Possibilities and Problems for Reconstructivist Agendas', *Social Studies in Science* 32(2), 297-319.

Wynne, Brian (1996) 'SSK's Identity Parade. Signing –Up, Off-and-On', *Social Studies of Science* 26(2), 357-391.



UNIVERSITY OF HELSINKI
CENTER FOR ACTIVITY THEORY AND
DEVELOPMENTAL WORK RESEARCH

Center for Activity Theory and Developmental Work Research

Department of Education / University of Helsinki

P.O. Box 26 (Teollisuuskatu 23)

00014 University of Helsinki, Finland

Tel. + 358 9 191 44165

Fax + 358 9 191 44579

ISBN 978-952-10-2684-3
ISBN 978-952-10-3631-6 (PDF)
ISSN 1239-338X