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THE DIGITALISATION OF SOCIAL REPRESENTATIONS

THE INFLUENCE OF THE EVOLUTION OF COMMUNICATION TECHNOLOGY ON THE DEVELOPMENT OF SHARED IDEAS

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ACADEMIC DISSERTATION

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ABSTRACT

Human mentality is in constant change as new ideas emerge, are challenged, become concrete and are compared to existing concepts in the societal discourse. The theory of social representations is an attempt to explain this process. The study contributes to this field of enquiry by discussing how changes in communication technologies influence the process. New digital communication technologies, such as broadband Internet connections, smartphones, sophisticated Web search engines and similar developments, have influenced how people are able to communicate their views and make sense of the world.

The work addresses the question of the ways in which change in communication technologies influences how shared ideas develop by applying a synthesising research approach in consideration of both past and future, both sensemaking and dissemination of messages and both individuals' interaction with technologies and broad societal structures in communication. The study applies varied methods and sources: survey-based statistics, historical reflection and ethnographic observations and interviews. Some illustrative phenomena related to digital communication technologies are explored with case studies: 1) the World Wide Web, 2) plurality of communication technologies in sensemaking practices, 3) hard-disk-drive-based television watching and 4) immersive virtual reality.

The interpretations and concepts considered are varied, at times contradictory, and offer different degrees of plausibility. In the past, the communication technologies complemented myths and other tales with content less suitable for human cognition. Eventually, they afforded decentralised communication, because of a decrease in the resources an individual needs for disseminating messages. Recent digital communication technologies, the Internet in particular, have 1) increased plurality in media sources, 2) given individuals greater capability to filter and choose messages, 3) dissolved the centrality of communication power (especially increasing the ability for those outside the mainstream media to gain wide audiences) and 4) enabled more efficient gaining of various vantage points – with differing arguments and different types of presentations (picture, sound, text etc.). Possible changes in the development of shared ideas include the following: 1) The development is faster with more information available and with it sought more efficiently than before. 2) Increase and/or decrease in 'human intellect' can be seen – expert or researcher-styled perspectives are gained while the quality of knowledge has deteriorated in the absence of truly expert journalist gatekeepers, and new learning is reduced on account of easier access to content corresponding closely with existing interests. 3) There is increased sharedness of ideas globally, but with an increase in fragmentation of attitudes within smaller geographical and cultural areas – ideas can be

explored, and commonality felt, in online groups. 4) The influence of taboos has declined, as anonymous and non-professional alternative online media are more likely to break taboos and norms may change within online communities. Futurologist reflections envision scenarios of utopias and dystopias in which the consequences of current technologies are total and futures in which the latest or currently niche technologies (immersive virtual reality in particular) have entered the commonplace.

Implications for the theory of social representations are discussed. These pertain to its processes (e.g., a narrower gulf between the scientific and lay sphere), its concepts (e.g., challenging the emphasis on strict attachment to culturally distinct social groups in the definition of social representations) and the way in which social representations are studied (e.g., need to explore media use habits and a more varied field of societal actors). The overall message of the study is that the social influences of communication technologies are varied in the extent to which they have influence on which methods and concepts are suitable in social sciences, similarly to any radical variation in the societal context. My study exemplifies reform and synthesis – that is, subtle considerations regarding the existing theories rather than reconceptualising the social order.

TIIVISTELMÄ

Inhimillinen ajattelu on jatkuvassa muutoksessa: uusia käsityksiä ja käsitteitä muodostetaan, kyseenalaistetaan, konkretisoidaan sekä verrataan olemassa oleviin käsitteisiin yhteiskunnallisessa diskurssissa. Sosiaalisten representaatioiden teoria pyrkii selittämään tätä prosessia. Tämä väitöskirja osallistuu edellä mainittuun tutkimuslinjaan tutkimalla, kuinka muutokset kommunikaatioteknologioissa vaikuttavat inhimillisen ajattelun muutokseen. Digitaaliset kommunikaatioteknologiat, kuten laajakaistaiset Internet-yhteydet, älypuhelimet, hakukoneet ja vastaavat uudet työvälineet ovat muuttaneet tapaa, jolla ihmiset kommunikoivat ja ottavat selvää asioista.

Tutkimuskysymykseen teknologisen muutoksen vaikutuksesta inhimillisen ajattelun kehittymisen tapaan vastataan teorioita yhdistävään ja kokonaisvaltaisuuteen pyrkivällä tutkimusotteella. Keskustelun kohteina ovat menneisyys sekä tulevaisuus, rakenteet kommunikaatiovallassa, interaktio kommunikaatioteknologioiden kanssa, viestien leviäminen sekä tavat, joilla asioista otetaan selvää. Tutkimuksessa hyödynnetään useita menetelmiä ja aineistoja: tilastoja, video-observointeja, haastatteluja sekä historiallista tarkastelua. Teknologisen muutoksen eri puolia havainnollistetaan tapaustutkimuksilla. Ne koskevat seuraavia ilmiöitä: 1) World Wide Web, 2) kommunikaatiovälineiden moninaisuus, 3) kovalevyn käyttö television katsomisessa sekä 4) virtuaalitodellisuus.

Tulkinnat ja ehdotetut käsitteet ovat moninaisia, osin ristiriitaisia ja vaihtelevan todennäköisiä. Menneisyydessä kommunikaatioteknologiat täydensivät myyttejä ja tarinoita sisällöllä, joka on vähemmän luontevaa ja helppoa ihmisten luontaisten kognitiivisten kykyjen kannalta. Viime aikoina kommunikaation valtarakenteet ovat hajautuneet, koska viestien laajamittainen levittäminen vaatii vähemmän resursseja. Internet ja muut digitaaliset kommunikaatioteknologiat ovat 1) vapauttaneet keskitetystä kommunikaatiovallasta etenkin lisäämällä valtavirtamedian ulkopuolisten kykyä saavuttaa laajoja yleisöjä sekä 2) lisänneet medialähteiden moninaisuutta ja 3) ihmisten kykyä valikoida viestejä sekä 4) tavoittaa erilaisia näkökulmia – erilaisia argumentteja sekä erityyppisiä esitystapoja, kuten kuvia, ääntä ja tekstiä. Mahdolliset muutokset jaettujen käsitysten ja käsitteiden kehityksessä ovat seuraavia: 1) Kehitys on nopeampaa, koska informaatiota on entistä enemmän saatavilla ja siitä on entistä helpompi tavoittaa erilaisia näkökulmia. 2) ”Inhimillisen älykkyyden” lisääntyminen tai vähentyminen on nähtävissä – tieteellisiä ja asiantuntijamaisia näkökulmia todellisuuteen saavutetaan entistä helpommin, mutta tiedon taso on alentunut, koska ammattitoimittajien rooli tiedon leviämisen portinvartijoina on heikentynyt. 3) Globaalilla tasolla käsitykset ja käsitteet ovat entistä enemmän yhteisesti jaettuja, mutta maantieteellisten ja

kulttuurillisten alueiden sisällä asenteissa ilmenee lisääntynyttä jakautuneisuutta – tämä johtuu siitä, että käsityksiä ja yhteistä identiteettiä voidaan rakentaa online-ryhmissä ilman tavanomaista kontaktia oman viiteryhmän sisällä. 4) Tabujen vaikutus on vähentynyt, koska anonyymi ja vaihtoehtoinen verkkomedia rikkoo tabuja ammattimediaa todennäköisemmin, ja verkkoyhteisöt ovat otollisia ympäristöjä normien muutoksille. Futurologiset pohdinnat sisältävät skenaarioita utopioista ja dystopioista, joissa nykyisten teknologioiden sosiaaliset vaikutukset ovat kaikenkattavia ja joissa teknologiat, jotka ovat nykyään harvojen käytössä, ovat yleisessä käytössä – erityisesti keskustelun kohteena on kokonaisvaltaisesti käyttäjän ympäröivä virtuaaliteknologia.

Vaikutukset sosiaalisten representaatioiden teorialle koskevat sen prosesseja (esimerkiksi kapeampi kuilu tieteellisen ja tavallisen ajattelun välillä) ja käsitteitä (esimerkiksi kyseenalaistaen liitännän kulttuurillisesti erottuviin ryhmiin sosiaalisten representaatioiden määritelmässä) sekä tapoja, joilla sosiaalisia representaatioita tutkitaan (esimerkiksi suurempi tarve tutkia median käytön tapoja sekä entistä laajempaa kirjoa sosiaalisia vaikuttajia). Tutkimuksen yleisviesti on, että kommunikaatioteknologioiden sosiaaliset vaikutukset ovat niin moninaisia, että muutokset näissä teknologioissa vaikuttavat siihen, mitä käsitteitä ja menetelmiä yhteiskuntatieteissä kannattaa käyttää – kokonaisvaikutus on samankaltainen kuin mikä tahansa merkittävä muutos sosiaalisessa kontekstissa. Tutkimukseni tarjoaa esimerkin reformista ja synteesistä. Tällä tarkoitetaan sitä, että olemassa olevia teorioita tarkastellaan kriittisesti ja yhdistetään sen sijaan, että muodostettaisiin uusia käsitejärjestelmiä tai teorioita sosiaalisen järjestelmän selittämiseksi.

ACKNOWLEDGEMENTS

This study reflects several individuals, research projects and institutes. I will now mention most of them and at the same time let you know how I ended up doing this study.

First, I was inspired by the research attitude on the theory of social representations to which I was exposed at the École des hautes études en sciences sociales and Paris Descartes University in a student exchange arranged by Professors Elisabeth Lage and Anna-Maija Pirttilä-Backman; the latter later became the supervisor of this study. My impression at that time, in 2005 and 2006, was that while we at the University of Helsinki mostly made sense and applied the theory of social representations, the scholars in Paris were more bold and active in trying to seek out new vantage points and research questions on the issue of shared knowledge. For example, Professor Michel-Louis Roquette provocatively suggested that in a *research*-orientated master's program, in which I studied, we should have studied the structures of social representations instead of merely applying the concept. Further, Professor Clélia Maria Nascimento-Schulze used historical notions and illustrations in a hypothetical but inspirational presentation on the concept of *themata* (which refer to dichotomies underlying social representations). This somewhat bolder attitude enabled me to ask research questions to which I knew I would not have very definite answers, but which might imply deviations from typical studies in the field; therefore, they might afford new knowledge and discoveries. As a result, when I later, as of the spring of 2008, studied the use of communication technologies at Helsinki Institute for Information Technology HIIT in Helsinki University of Technology (the latter is currently known as Aalto University), I at some point began to imagine how broad changes in communication technology might influence the processes of social representations. The research questions and the section 'The Development of Shared Ideas and the History and Future of Communication Technology' of this dissertation are the result of these ponderings and starting points around which the rest the work was written.

I thus had some initial ideas I was hoping to write about. There was one practical problem, however: in order to meet the formal requirements of a doctoral dissertation I was either to write a lengthy monograph or to use a number of journal articles in formulation of some shared theoretical arguments. I did not have enough funded work months to write the monograph and nonetheless the dissertation was necessary in the pursuit of a research career. Therefore, I decided that my thesis would be a compilation of articles; conveniently, I already had few written or under preparation that discussed communication technologies. I made this decision some months after the beginning of my PhD studies. They started in fall 2009.

On one hand, one might think that it is questionable to formulate arguments on social representations with studies that were not initially devised for this purpose. On the other hand, being forced to look at unexpected directions and considering studies that, when viewed superficially, have little to do with the theory, might allow atypical perspectives on the subject matter. Had I done otherwise, with a stable four-year funding or such, I might have submitted myself more to the existing and typical ideas of social psychology. For instance, perhaps I would have not tried to merge the social representations theory with thoughts on communication power in the network society, and it is certain that I would have not combined social representations with findings on virtual reality. My dissertation would have been very different – in better or worse.

The main source of these articles was the AMOVEO project, which was directed by Docent Antti Oulasvirta in HIIT. AMOVEO was funded by the Academy of Finland and it explored work practices and automation. In addition, one of the articles was based on a study that was funded by YLE, the Finnish Broadcasting Company. Anu Kankainen was my supervisor in this project. Furthermore, I had written the first of the articles already before my employment in HIIT, that is, when working in STAKES (currently known as National Institute for Health and Welfare THL) in a project called HospiTool. The project explored virtual reality and hospital space design and it was funded by TEKES, which is a Finnish funding agency for technology and innovation. My co-workers at this project were Miika Aittala, Helinä Kotilainen, Tiina Yli-Karhu, Janne Porkka, Esa Nykänen and Outi Räikkönen.

By the way, all this was a coincidence. At the time I was employed to the HospiTool project, which was in summer 2007, I had not yet expertise on study lines at the cross-section of technology and behavioural studies. I was simply looking for a job and was called upon to work since the behavioural scientist who was supposed to work in the project had found employment elsewhere and the social psychologists in STAKES already knew me from previous projects on health psychology. Without HospiTool at STAKES, I would have not sought employment in HIIT and my career would have taken very different turns.

In these projects on use of technology, I then worked with engineers and others with backgrounds different from mine. When young people with different identities interact, there are often identity negations involved and, in this case, they were discussions on right and wrong approaches to science making. Unsurprisingly, the natural sciences and the social sciences were discursively entrenched to different sides of the playfield. These informal lunch time and coffee break discussions in part inspired me to write a philosophy of science section for this study. It compares the natural and social sciences but emphasises commonalities rather than differences – it is implied that studies in either one can be situated either to Newtonian or to Einsteinian sciences. My colleagues at HIIT also read and commented draft

versions of the dissertation; you are being acknowledged Airi Lampinen, Antti Salovaara, Asko Lehmuskallio, Peter Peltonen and Vilma Lehtinen. Further, HIIT researchers Antti Oulasvirta and Antti Salovaara were distinctively influential when it comes to the section 'Societal Structure and the Development of Contemporary Ideas'. These cognitive scientists were not satisfied with a vague description of the theory of social representations. This encouraged to ponder and write about defining features of the theory in a higher detail, though flexibility and comprehensiveness are in the very nature of the theory. In a research group where the theory is taken for granted my writing would have been vaguer.

In 2010 I was accepted to SOVAKO, which is a Finnish doctoral program of social sciences. I was the first runner-up and thus gained only nine work months of funding, that is, the amount that remained from a student who could not to use her or his grant money due to some practical reason. Nonetheless, this grant, together with a three months grant for finalising a dissertation by the University of Helsinki, was essential for carrying out the study. The SOVAKO grant also permitted a three months research exchange, which I did to LACCOS, a Brazilian research institute of social psychology, communication and cognition. There I was hosted by Professors Brigido Vizeu Camargo, Andréa Barbará and Clélia Maria Nascimento-Schulze. It was a good working environment and the need to explain my work in a language that I did not master very well helped me to identify and express the main ideas of the study. Yet another research institute worth mentioning is VTT Technical Research Centre of Finland with which I collaborated when working both at HIIT and STAKES. Two of the articles used in this dissertation entail input from VTT researchers, of which Leena Salo has not been already mentioned. During writing this, I work at VTT myself in a research group led by Professor Leena Norros, with whom I also worked in the earlier mentioned AMOVEO project.

The 'Possible Futures and Avenues for Study' section of this work is a result of various issues. First, I was encouraged by my supervisor Anna-Maija Pirttilä-Backman to describe a possible research programme due to open questions, and I was later encouraged to expand this description by Professor Hannu Räty, who was one of the two pre-examiners of my dissertation (they are those whose opinions are taken into consideration when it is decided whether a dissertation is ready for public defence). Second, I felt that my dissertation manuscript was to a degree thin on background literature on social consequences of information technology but I was also reluctant to write a typical related studies section because, in my experience, they are often tedious for the reader. Consequently, I wrote about related studies in the form of open research questions. I wrote about social issues, brought forth by information technologies, that are both societally important as well as so basic and general that they undoubtedly permeate the processes of social representations; yet, these issues entail open research questions. In writing about these issues, I was inspired by research funding applications

that we wrote together with Professor Ilkka Arminen and others in the end of 2011 – from the applications I borrowed the rhetorical trick that research questions could be presented as possible futures: in some cases, a hypothesis with negative societal implications can be considered a dystopia.

Additional individuals of influence on my study were Professor Jaakko Suominen and Anna Shefl. Professor Suominen was the other pre-examiner and he encouraged letting the reader know about practical issues that influenced the dissertation making – grants, research teams and such. These acknowledgements would have been written differently without this suggestion. Shefl is a professional proofreader and communications expert whose services were used in three of the study articles that this dissertation incorporates. She also reviewed the language of the theoretical summarising part of the dissertation and made various useful remarks and suggestions on the content of the text, that is, she did more than reviewed the language. Many changes and additions were made after the proofreading, though, and she is therefore not to blame for linguistic mistakes.

The choice of cover art was a spontaneous decision that took place in an art gallery Kallio Kunsthalle, just few days before this work was put to print. The curator of the gallery, Petri Saarikko, photographed a worktable of the artist blacksmith Kari Honka, which was hung up as a piece of art.

One may also wonder why I ended up studying social psychology in the first place. This too was largely a coincidence. Initially, my intention was to study political sciences, but at that time, to enter to the Faculty of Social Sciences, one had to apply to two departments and to memorize a book or two on both of the disciplines. The book of social psychology was the most intriguing, so I then decided to apply for social psychology. In terms of scores, it was significantly harder to become a social psychology student than a political science student, and therefore I chose social psychology as my first option. I reasoned that most probably the scores would not be sufficient for social psychology, and I would hence study political sciences. Incidentally, the scores were high and, after meeting the other social psychology students of the class of 2002, I had no willingness whatsoever to change my major. Admittedly, however, I might have been unconsciously guided by the fact that both of my parents are psychologists. Indeed, as it is customary, one should ultimately acknowledge those who are of importance and influence for the author for reasons beyond scientific work. Friends are too numerous to be listed here, but Jyväskylän Lyseo and the student circles of the Department of Social Psychology (currently a discipline in the Department of Social Research) as well as of the Faculty of Social Sciences in Helsinki can be mentioned as the main sources of friends. Finally, let us mention the closest family members: Darja, Riitta, Jalle, Juppe, Atte, Otto and his family, Maire and Heimo.

CONTENTS

LIST OF ORIGINAL PUBLICATIONS AND RESEARCH INPUT

This dissertation incorporates research reported upon in four articles. The articles are as follows, with the research input elaborated on for those articles with multiple authors:

I Wahlström, M. Combining Overlapping Study Lines – An Integrative Mixed Methods Design for Studying Social Representations and Media Influence. Submitted to the *Journal of Mixed Methods Research*.

II Wahlström, M., Salovaara, A., Salo, L., & Oulasvirta, A. (2011). Resolving safety-critical incidents in a rally control center. *Human–Computer Interaction, 26,* 9–37.

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The article 'Resolving safety-critical incidents in a rally control center' was a group effort written and planned by all authors. The collection and analysis of data were carried out by Mikael Wahlström, Antti Salovaara and Leena Salo. Intellectual contribution to the article is in line with the order of the authors, with the most active contributors listed first.

III Wahlström, M. & Kankainen, A. (2011). Digital TV transition and the hard disk drive revolution in television-watching. *International Journal of Communication, 5,* 1606–1622.

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The article 'Digital TV transition and the hard disk drive revolution in television watching' was based on a research project planned mainly by Anu Kankainen but with participation also by Mikael Wahlström and others. Wahlström collected the data. The data analysis was performed mainly by Wahlström but with the participation of Kankainen. The research questions, results and discussion were formulated by Wahlström, who also performed the literature review. Kankainen wrote the first version of the methods section of the manuscript and commented on the work. Otherwise the article was written by Wahlström.

IV Wahlström, M., Aittala, M., Kotilainen, H., Yli-Karhu, T., Porkka, J., & Nykänen, E. (2010). CAVE for collaborative patient room design: Analysis with end-user opinion contrasting method. *Virtual Reality, 14,* 197–211.

The article 'CAVE for collaborative patient room design: Analysis with end-user opinion contrasting method' was a group effort and involved input from all authors: Data collection and analysis, both in planning and in the execution, were mostly the responsibility of Mikael Wahlström. The article itself was also almost entirely written by the first author (with the exception of the material on the issues mentioned below), who also conceived its main idea (i.e., the end-user opinion contrasting method). Miika Aittala modelled the virtual rooms, manoeuvred the study participants in the virtual rooms, and wrote about technical features of the CAVE system in use. Helinä Kotilainen chose/designed the modelled rooms, participated in the planning of the data collection methods and observed and took part in interviews in the hospitals. Tiina Yli-Karhu interviewed the nurses in the CAVE environment (also, in collaboration with others, planning these interviews) and organised the data collection sessions at the hospitals. Janne Porkka gave advice on the CAVE technology and its utilisation in construction projects and helped in editing the final versions of the manuscript. Esa Nykänen managed the work, observed the interviews in the hospitals and took the photographs. All authors observed data collection sessions in the CAVE context and commented on the article in its various stages. On the whole, the article reflects reciprocal discussions among the authors and therefore also reflects their expertise in differing fields – e.g., qualitative research methods (Wahlström), evidence-based design (Kotilainen), nursing science (Yli-Karhu) and engineering (Aittala, Porkka and Nykänen).

The publications are referred to in the text by their roman numerals.

1 INTRODUCTION

People communicate and think mainly with culturally defined meanings – that is, with words and other meaningful symbols, such as pictures and learned gestures. Hence, a central task for social psychology is to explain the evolution of this symbolic and conceptual whole harnessed by our thinking and communication. Consequently, the current literature does shed light on this issue. Another very fundamental feature of our species, however, is use and development of tools, many of which are utilised for communication. Very recently we have witnessed rapid progress in digital communication technologies, as we now use broadband Internet connections, smartphones, sophisticated Web search engines and so on. These changes have an impact on the overall dynamism of communication and hence also influence the development of common ideas. It is then pertinent to explore how the change in communication tools influences the way in which shared ideas change in a society.

This question will be addressed through exploration of the notion that, in the course of time, because of technological development, more and more communication devices continuously emerge, these also being increasingly sophisticated and versatile. This increasing number of communication options is, in turn, assumed to influence the development of shared ideas. The aim here is, therefore, to describe the influence of communication technology's change on the evolution of ideas. This is done by considering the influence of technological change on broad societal communication structures (e.g., by delving into how different societal actors are able to communicate their ideas) and specific practices and uses associated with certain communication technologies. The study draws conclusions with interpretations stemming from several sources, these mainly being survey-based statistics, ethnographic observations and interviews, historical reflection and literature on social psychology and communication research.

This paper is organised such that development of common-sense thinking and communication are discussed first, with reliance mainly on the theory of social representations. Then, I will specify my research questions and elaborate on the philosophy of science that is to guide me in providing answers to these questions – I will advocate epistemological flexibility and systemic theorising. Further, I will apply historical reflection to consider how differing technological settings might vary in how ideas develop and are disseminated. From this foundation, I will establish initial arguments (at base, it seems that, in the course of time, technological development manifests itself as incrementing of the viewpoints available and decentralisation of communication power). I will then iterate these arguments by exploring some basic phenomena brought forth by digital communication technologies. Case studies address the following issues: the

World Wide Web, the plurality of communication devices used, digitalisation of television and virtual reality. These studies further enrich the arguments: more varied description of factors leading to decentralisation of power will be provided, and it seems that technological change results in increasing sensemaking capabilities – that is, increasing ability to be in touch with others and assume various vantage points, some of which allow assuming the position of an expert.

Overall, the main arguments are that, thanks to technological progress and digitalisation, shared ideas develop with less adherence to centralised power structures, potentially with less distinction between expert and lay thinking, and with increased sharedness – arising from greater opportunities to be in contact with others but possibly also with increased polarisation (due to ability to choose and filter messages) and rapidity (as social phenomena are developed more efficiently). Conclusions are drawn on the consequences of these developments. The study contributes to two threads of social scientific discussion: the social psychological discussion of development of human mentality and the discussion of social effects of new media that is found in communication studies in particular. Additionally, the study has implications for futurology, since some of the findings can be considered to refer to trends that are going to continue hand in hand with technological change, and dystopias and utopias related to technological change are discussed.

1.1 SOCIETAL STRUCTURE AND THE DEVELOPMENT OF CONTEMPORARY IDEAS

The human mentality reflects human history, as in Wittgenstein's (1953/1986, p. 8) suggestion that '[o]ur language can be seen as an ancient city: a maze of little streets and squares, of old and new houses with additions from various periods and this surrounded by a multitude of new boroughs with straight regular streets and uniform houses'. In other words, similarly to cities as a product of gradual evolution with the outcome of combination of old and new, human thinking and communication gradually evolves hand in hand with introduction of new ideas. For instance, Moscovici (1984) emphasises that science in particular has been a source of change in the contemporary mentality. Indeed, many of the concepts with which contemporary people think, perceive and communicate were originally abstract scientific ideas or at least innovations stemming from scientific progress. Our conceptual inventory is replete with notions of this type, such as the car, mobile phones, the atom, psychotherapy, bacteria, peer pressure, gravity, gene manipulation and climate change, alongside 'primary conceptions' (Moscovici & Vignaux, 2000), such as those of woman and man, birth and death, deity and human, earth and sky and so on. To understand

the development of contemporary lay thinking, it is necessary then to explore how scientific ideas, innovations or new phenomena in general cross the border from being new and abstract to self-evident and concrete. The theory of social representations (Moscovici, 1981; Moscovici, 1984; Bauer & Gaskell, 1999; Wagner et al., 1999; Wagner & Hayes, 2005; Moscovici, 1961/2008) provides concepts via which this process can be understood.

Anchoring implies that foreign and new ideas are assimilated to the common sense through comparison, labelling and classification with existing concepts. This happens through generalisation or particularisation – that is, by asserting that a new phenomenon resembles or differs from an existing concept (Moscovici, 1981; 1984). An example is comparing computers with older devices, such as typewriters (Flick, 1995, p. 76). This process takes place in social interaction, for example, face to face and in mass media, and, in terms of cognition, it allows situating the new phenomenon in other categories in the larger space of symbolic thinking (Moscovici, 1984; 1961/2008, pp. 104–106). Since anchoring occurs through comparison, it also entails judgement or attitude (Moscovici, 1981). Labelling mental-health patients as 'nutters', 'tramps' and 'idiots' is an example of negative attitude of this type (Jodelet, 1991).

Further, *objectifying* describes the process of making the new notion part of concrete common-sense reality. It is assumed that metaphors, images, or tropes are the means by which objectifying takes place and the way in which this happens depends on the existing social realities. For instance, common understanding of conception adheres to stereotyped sex-role metaphors rather than scientific knowledge: sperm are perceived as active, dominating and hard, in contrast to a passive, submitting and soft ovum, although science does not substantiate these views (Wagner, Elejabarrieta, & Lahnsteiner, 1995). Similarly, shared ideas resulting from psychoanalysis entail 'concrete' ideas of the conscious and unconscious while the libido and sexuality, equally important in psychoanalytic theory, remain abstract, because they are taboo (Moscovici, 1984), or were at the time of objectifying. On the other hand, deliberately made images may serve as the means of objectifying. For example, the European flag, the anthem, Europe Day and EU citizenship are all symbolic expressions with the purpose of making the European Union more tangible and creating a common identity (Sakki, 2010, pp. 16–17). Another example is Bohr's atomic model. The atomic theory became popularised with an image of a ball-shaped thing with a hard core orbited by electrons, and now, after extensive dissemination in media discourse, atoms are part of concrete reality in accordance with the image (Wagner & Hayes, 2005, p. 208). Overall, the choice of the image or trope in objectification is not arbitrary but reflects the historical and social setting (Wagner et al., 1999).

As others have implied (Jahoda, 1988), the concepts described above are difficult to operationalise and verify, and they entail an element of vagueness. For example, it can be difficult to conclude with certainty whether or when

an issue is anchored or objectified, and additional vagueness might arise from the fact that these concepts involve both communicative and cognitive assumptions. As logical constructs for common thinking, however, they are coherent and their difference is clear-cut: our conceptual inventory features notions that 1) seem concrete and real for us and 2) are interrelated; that is, they have their place in certain categories created around other notions. As this cognitive idea content is a result of social interaction (though also modified in people's internal imagination), logic dictates that there *must be* some corresponding communicative processes that 1) objectify and 2) anchor these notions (which also manifest themselves in individuals' internal dialogue). Admittedly, though, these communication practices are too varied to be specified well; they are a matter of some debate and subject to research.

The processes of anchoring and objectifying are entwined with social entities of genres and repertoires. These two concepts used in social psychological literature reflect a concept for understanding the system of symbolic communication described by Wittgenstein (1953/1986), who coined the term *language game*. It suggests that meanings of words or other symbols are woven into wholes that make sense as parts of activity. There are myriad kinds of language games: descriptions, commands, riddles etc. For example, the utterance 'a beer' usually entails the meaning of ordering a beer in the 'rules' of the bartender–customer-interaction language game but would be understood differently, for example, as part of a description of events. *Communication genre*, on the other hand, can be defined as a relatively stable and coherent ensemble of communications in terms of means, meanings, vocabulary, themes, source and/or purpose that is a learned social convention and manifests itself in a particular social situation (for example, doctor–patient consultation) or socio-historical context (such as propaganda in polarized and conflicted societies) (Yates & Orlikowski, 1992; Marková, 2003, pp. 196–202). It is thus suggested that acts of communication are understandable as part of a larger whole. For example, politicians address the people with eloquent rhetoric, and parents interact with their new-borns with cuddles and high-pitched and simplified words, while in regular conversation acts of this type would not make sense – unless as ironic references to politics or baby talk. Somewhat similarly, linguistic, discursive, or interpretative *repertoires* (Potter & Litton, 1985; Wetherell & Potter, 1988; Steinberg, 1999) refer to relatively coherent and continually used entities of meanings, concepts and metaphors. People have been found to produce inconsistent or contradictory accounts by drawing from various repertoires when diverse identities, perspectives and positions have been assumed (Potter & Wetherell, 1987). Hence, unlike genres, repertoires are not assumed to be immediately attached to communication of a certain group or to a broad institutional or historical situation in a consistent manner. For example, it can be so that differing groups, even though they would be in conflict with each others, draw from shared discursive repertoires and elaborate upon them in dialogue by appropriating terms and meanings in

line with groups' needs (Steinberg, 1999). In line with this, differing repertoires may be applied in differing contexts by the same group of individuals: for example, Potter and Wetherell (1987, pp. 146–155) have found that scientists may draw from the 'empiricist repertoire' or from the 'contingent repertoire'. The former is expressed in the context of formal research papers and features dominance of data and impersonal rules as guidelines for laboratory behaviour, while the latter is expressed in informal interviews and, in contrast to the empiricist repertoire, explicates science-making with speculative insights, personal characteristics, social ties and group memberships. Overall, both of the concepts – genres and repertoires – speak for multiplicity of coherent entities, but they do so from somewhat different angles: the plurality of genres stems from diversity of groups and socio-historical contexts, but each genre may also draw from various repertoires. It is worth noting that the literature is not consistent in labelling these concepts. For example, Wagner et al. (1999) use the term 'discourses' for the entities here called 'genres', while I find that distinguishing between communication genres and discursive repertoires may, in principle, provide one with richer description of structures of communication. For instance, an advertisement, arguably a genre of communication, may include references to different culturally shared discursive repertoires.

The influence of communication genres and discursive repertoires in the social construction of shared ideas can be seen in the pioneering study of Moscovici (1961/2008) considering social representation of psychoanalysis as conducted in 1950s France, an environment in which psychoanalysis was under lively discussion. Different types of communication genres were identified. First, it was found that the communist press took a negative and strictly dichotomous approach to psychoanalysis because it was viewed as imperialistic American (rather than French/USSR-based) psychology. The consequent communication genre called 'propaganda' (pp. 284–341) seems to entail specific techniques of anchoring: Its discursive repertoire (though not conceptualised as 'discursive repertoire' in the original text) involves stereotypes that are exploited in a manner that is reasonable in a given societal context; for example, psychoanalysis was discredited by Communist journalists with references to America, the police and Nazism. Propaganda's method is oversimplification by placing unrelated elements into a single category: reflecting propaganda's attachment to a conflicted societal setting, psychoanalysis was coupled with phenomena that the generators of the communication opposed, such as America. Finally, these links are strengthened through repetition. In contrast, communication genre reformulating an issue in a less polarised manner was labelled 'propagation'; this described the attempt by Catholic press to portray psychoanalytic ideas in a manner acceptable to the Church (pp. 256–283). The following features described this genre: first, expression of the position of a clearly defined group, such as Catholics; second, partly accepting the phenomenon but simultaneously downplaying aspects incompatible with the worldview of this

group (as when psychoanalysis's materialism and view on sexuality were contested because of this incompatibility); and, third, the repertoire of concepts are formulated in such a manner that a suitable compromise is achieved – in the case described above, the concept of "affectivity," between (Christian) love and the (psychoanalytic) libido, was advocated. A third communication genre identified was called "diffusion" (pp. 215–255). This described non-coordinated writings in popular newspapers that as a whole featured non-involvement and a poorly defined image of psychoanalysis. This communication did not concern a specific group but tried to please the masses, at times, with humor and irony. Overall, Moscovici's study demonstrates that processes of social representations, hand in hand with the genres and repertoires involved, depend on a societal context – for example, on value structures, conflicts and societal actors, and their capability and strategies in dissemination of messages.

It is noteworthy that corresponding plural patterns of communication, differing coexisting patterns in thinking, can also be assumed. The term 'cognitive polyphasy' (Moscovici & Marková, 2000, pp. 237–248; Wagner & Hayes, 2005, pp. 233–236) reflects the notion that people use various and perhaps contradictory modes of thinking in differing contexts and moments. For example, scientific and commonsensical thinking have been suggested to have differing logic: the former is more systematic and involves attempts to establish explanations of what it considers to be facts, while the logic of the latter is more a result of consensus, negotiation and collective memory – yet it is unlikely that a scientist would constantly retain the scientific manner of thinking. One could cite the example of a frustrated scientist cursing the lab equipment (Moscovici & Marková, 2000, p. 241). Another example is the co-existence of traditional Chinese medicine and contemporary medicine. According to Jovchelovitch and Gervais (1999), Chinese émigrés apply both their traditional Chinese thinking and the thinking of modern medicine when considering issues of healing and diet. The resources of local health services were used, but old family recipes were used whenever reaffirming a Chinese identity was important, in these authors' experience. At the same time, when the desire for integration into the host country was salient, traditional Chinese perspectives on health were downplayed. Overall, lay thinking is not consistent, because it reflects situations and elaborations related to identities and social groups rather than facts (Wagner & Hayes, 2005, pp. 233–234). Though this is hard to prove empirically, one may argue that people's internal dialogue reflects the plurality of games, genres and repertoires.

One may now explain the idea of the concept of social representation. Its definitions typically imply societal and historical explanation of knowledge and communication. An example is the influential definition by Moscovici (1973, p. xx) according to which they are 'system of values, ideas and practices with a twofold function; first, to establish an order which will enable individuals to orient themselves in their material and social world and to master it; and secondly to enable communication to take place among the

members of a community by providing them with a code for social exchange and a code for naming and classifying unambiguously the various aspects of their world and their individual and group history'. In other words, social order is coded by social representations, which are historical and community-related, while otherwise the term remains open to interpretations. Indeed, Wagner and Hayes (2005, p. 127) note that the term itself does not explain anything, but they explicate that social representations refer to 'a whole set of statements related to one another as a theory-like construct' (p. 121). Thus social representations entail linked elements, such as attitudes, beliefs, discourses, metaphors, images and behaviour (Bauer & Gaskell, 1999; Wagner et al., 1999) while phenomena described with the label 'social representation' are theories of sorts, coherent constructs assumed by the researchers. The label 'social representation' attached to these concepts also implies some specific meanings. Wagner and Hayes (2005, pp. 121–122) explain that, in contrast to social cognitive approaches, social representations are not linked to perceived traits of objects in the experienced reality directly. Rather, they are linked to collective or cultural relations to these objects. For example, one's attitude toward cats does not depend only on whether they are perceived as, say, furry or dirty, since there are 'cats and holy cats' as Wagner and Hayes (p. 122) exemplify. In other words, objects represent social or cultural issues that are not physically present. In contrast to discursive psychology, which explores discourse but not cognition (Potter & Hepburn, 2008), it is emphasised that social representations entail both social discourse and knowledge content (Wagner & Hayes, 2005, p. 125). Actually, shared cognition is assumed, and in this sense not all ideas are considered to be social representations – only those that are to a degree shared by a group of people. Wagner and Hayes (p. 122) also explain that this sharedness implies not complete consensus but agreement regarding meaning that allows social interaction connected with the issue. Without cognitive sharedness, reciprocal discourse would not be possible. Further, Wagner and Hayes (p. 122) consider subconscious ideas not to be social representations, because social representations stem from social discourse and unconscious contents cannot be collectively elaborated. Overall, however, one may consider everyday knowledge to be constituted by social representations (Moscovici, 2005, p. xii) despite the existence of private and subconscious ideas.

In sum, the term 'social representation' can be considered an umbrella term for a set of concepts used in social sciences – those of discourses, attitudes and such – with the emphasis on these concepts as interrelated; inseparable from history, culture and society; and related to the processes of anchoring and objectifying. In turn, the key in the theory of social representations is that it ties together the phenomena of lay thinking (the common-sense that results from anchoring and objectifying), communication (because anchoring and objectifying are attached to communication genres and discursive repertoires) and socio-cultural factors

(because communication genres, repertoires, anchoring and objectifying are attached to, for example, social actors and groupings and to their aims and values).

Communication technologies are part of the above-presented social entities of games, genres and repertoires, which, in turn, take part in social construction of common-sense knowledge. Communication technologies' links with communication and thinking may be manifested in various ways. For example, analyses of interaction structures in workplace settings have exposed subtle manners of use of communication technologies (for a review, see Heath & Luff, 2000), as in a study of a London Underground line control room where it was found that workers rarely collaborate with each other with explicit utterance and instead do so with subtle gestures and glances directed at the tools used (Heath & Luff, 2000, pp. 88–124). In other words, contemporary language games entail meanings attached to subtle nods toward computer screens. The World Wide Web, in turn, has produced some new communication genres, such as personal homepages and WWW link lists (Crowston & Williams, 2000), and the Internet allows *mass self-communication* (Castells, 2007) or 'many-to-many communication' (Fuchs, 2008): with services such as blogs and wikis, individuals not working with traditional mass media may reach a wide audience with increased decisiveness. It is worthy of note that the creation of shared knowledge – that is, processes that anchor and objectify – is, rarely only about sporadic discussions between people or sporadic exposure to media discourses. It also entails people's active exploration of discourses and arguments, or 'sensemaking' of a phenomenon. New digital communication technologies, the Internet especially, could be part of this type of behaviour in particular because they provide a plurality of sources and search mechanisms with which these sources can be explored.

Actually, various lines of study explore communication via technologies. Ethnographic studies of interaction with technologies are done under several labels. Perhaps the best known are 'workplace studies' (Heath & Luff, 2000) and 'distributed cognition' (Hutchins, 1995), of which the former draws from ethnomethodology and conversation analysis while the latter emphasises the notion that differing work environments and tools – or 'cognitive artefacts', as they are dubbed in this approach to study – allow differing cognitive and communicative possibilities and challenges. In turn, research approaches such as genre analysis (Emigh & Herring, 2005) and discourse analysis (Herring, 2004) have been appropriated to exploration of online communications. Technologically mediated communication has been studied not only through exploration of the use of existing communication technologies but also via development and testing of new ones with users. The branches of study called 'human–computer-interaction' and 'computer supported cooperative work' (Grudin, 2008), of which the former is typically more focused on the individual than is the latter, include behavioural scientific enquiries as well as design and development. Moreover, sociologists

and communication scholars have explored the effects of new media with conceptualisations aimed at depicting contemporary societal phenomena in broad strokes. Most notably, 'network society' entails the notion that digital networks, the Internet in particular, have increasingly complemented face-to-face communication and traditional mass media (van Dijk, 1999; Castells, 2000). The social structures and ideas related to the network society or 'informational society' are too varied to be shortly summarized (Castells, 2000, p. 21) while a notion is especially relevant for my study. Castells (2011) argues that in the network society *communication power* – that is, capability to influence others, in particular with mass media (and with mass self-communication) – is related to the way in which networks and flows of communication are organised and hence also to capabilities to influence these networks. In other words, in a society where communication is largely mediated by ICT, capabilities to communicate and influence depend on how this mediation is organised. This, in turn, depends on features of used communication tools and on social actors' capabilities to manage networks, for example, by blocking and facilitating certain channels of messaging. According to Castells (p. 786) studying these structures will eventually allow to formulate a network theory of power. Another theoretical notion that will be discussed in my study is *technogenesis*. The term implies that the human cultural evolution is actually co-evolution with technology – technological evolution depends on humans but technology also takes part in cultural evolution as communication technologies take part in passing forward ideas (Hansen, 2006; Stiegler, 2009).

1.2 RESEARCH QUESTIONS

To sum up the elaboration above, it seems that games, genres and repertoires all tell of a social structure of thinking and communication of diverging, intersecting and overlapping entities that is not arbitrary but 'flows' hand in hand with socially relevant forces – i.e., groupings, institutions, concrete events, identities, values, ideologies and so on – and at times with attachment to communication technologies. This whole that constitutes the common-sense evolves as new social objects are given substance in interaction between people in accordance with relevant societal structures. My study addresses this broad field of phenomena, but, in contrast to a typical study in its field, the aim of this study is *not* to explore certain discourses, genres, representations or public considerations of social objects but to turn attention to the technological evolution in the development of the common thinking. More simply put, I will explore how ideas develop differently on account of the development of communication technologies; for example, lay thinking obviously evolves differently in a society of horseback couriers and handwriting in comparison to one of computer networks. The theory of social representations has depicted broad structures

in the seemingly random process of social construction of lay ideas. Correspondingly, there might be a structure in the way in which development of communication technologies takes part in the development of lay knowledge. The aim of this study is to explore and describe said structure, with focus especially on the consequences of the digitalisation of communication technologies, this focus being relevant since digitalisation is a current phenomenon. More specifically, two linked research questions are addressed:

1. How the change in communication technology influences the way in which shared ideas develop?
2. How do shared ideas develop in the context of digital communication technologies in contrast to a non-digital technological context?

1.3 THE PHILOSOPHY OF SCIENCE APPLIED IN THE STUDY

Given that it is particularly difficult to address these research questions with direct evidence – both technological change and social development of ideas are slow processes and challenging to operationalise, let alone to confine to laboratory settings – it is relevant to consider the philosophy of science with which I formulate interpretations. The stance taken is, first, that, instead of a clinging to direct experience or observations, scientific deductions and theories should be based on logical contemplation that considers also those elements relevant in the phenomenon under exploration that cannot be observed. Second, the aim is to explore dynamic patterns, systemic wholes and interdependence of phenomena. In consequence, theory-making should consider a system of interactions between entities that are flexible, varying in tandem with these interactions, rather than interactions or mechanistic causalities between rigid entities. These thoughts draw from Marková's (2008) explanations related to epistemology of the theory of social representations and are in line with general postulations on cultural psychology by Valsiner (2009), who also emphasises that sufficient abstractness of theories is necessary for the purpose of fitting into varying contexts. It is worthy of note that these guiding principles to science making are not specific to social sciences in general nor are they out of the question in the so-called hard sciences. Some social scientists emphasise observability; for instance, discursive constructionism, being radically constructionist in orientation, is sceptical of cognitive explanations of human communication and behaviour, and, instead of making assumptions as to mental representations, it argues for interactional evidence (Potter & Hepburn, 2008). In physics, on the other hand, the theory of relativity was based on reasoning about unobservable relations between time and space. One may also note that, in tying together phenomena of mass, energy, time and space, Einstein's view on physics was also profoundly systemic or holistic. Actually,

Marková (2008) argues for an 'Einsteinian revolution' in social sciences to replace 'Newtonian science' with its reflection of rigid categories and mechanistic causalities of the mainstream of behaviourist and social cognition approaches that isolate entities into dependent and independent variables. This implies considering a system that evolves as a whole.

One may also argue against empirically fixated and epistemologically restricted stances in science-making by contrasting social sciences to Darwin's theory of origins of species. Though Darwin's ideas stemmed from a vast empirical sample of wildlife and fossils, it is also worth noting that his theory has not been decisively confirmed empirically; it is common to speak of the 'missing link' between man and ape, and so-called 'macroevolution' (evolution to differing species) has not been confirmed in laboratory settings. The strength of the theory is, rather, that it is logically persuasive and so far the most convincing in its description of evolution of species. The theory of social representations, in its description of development of ideas, resembles Darwin's theory in some respects. It offers a plausible description of the dynamics involved in evolution of human thinking and communication even though some aspects of the description are challenging to perceive empirically in practice; for example, it is difficult to determine decisively whether or to what extent an issue is anchored or objectified in some point of time in a certain society. Also, neither of these theories is restrictive in terms of its means of explanation, as the theory of social representations has been explored with varying methods. When one considers Darwin's theory, this seems obvious: why wouldn't current scholars explore the evolution of species with an array of explanations ranging from different causes of mutation to natural selection? In social sciences, however, an all-encompassing approach is less self-evident: for instance, both positivists and constructionists seem typically to emphasise a limited array of means of investigation. In a similar vein, in today's social psychology, many fields of enquiry are defined by their methods rather than by problems (Moscovici & Marková, 2006) while many social-science scholars define themselves in terms of the methods used, by labelling themselves, for example, as conversation analysts, discourse analysts or experimental social psychologists (Marková, 2008).

Perhaps this 'entrenchment' of social sciences can be understood by way of contrasts to natural sciences. Scholars of natural sciences may relatively often and readily share a mechanistic Newtonian view of reality while consensus remains even if Einstein's ideas are necessary, such as when particles reaching light speed are involved in the investigation. In contrast, the social reality or order is a more contested field that is viewed differently by differing theoretical approaches, and each of these approaches implies different vantage points on the phenomena. For example, Reckwitz (2002) argues that the social or cultural order is viewed differently from the positions of 'culturalist mentalism', 'textualism', 'intersubjectivism' and 'practice theory': the social structure lies in mental structures of knowledge,

in chains of symbols and discourse, in interaction between agents, or in blocks of practices that are carried by individuals, respectively. Overall, as there is no consensus on how 'the social' should be viewed, it is viewed from perspectives that are tied to certain distinct epistemologies and it is therefore possible for a phenomenon to be viewed not comprehensively but from the angle of a certain epistemology.

Actually, flexibility and lack of entrenchment seems to be a characteristic distinctive of the social representations approach. The theory of social representations lies in parallel with influential and well-known ideas proposed by Berger and Luckmann (1966) according to which the reality, as perceived by us the people, is constructed in social interaction and sociological (or, one may add, social psychological) enquiry should focus on these common persons' 'realities' instead of on, say, ideologies and 'isms'. In practice, however, Berger and Luckmann's thesis on social construction of reality, published five years after Moscovici's (1961/2008) original French language thesis on social representations, seems to serve as an epistemological manifesto for linguistically or discursively oriented social scientists – reality is constructed in interaction and it is hence interaction in natural settings that is to be studied – while social representations scholars address the issue of socially constructed common knowledge more flexibly, with a wide variety of methods: in addition to natural interaction and discourses, subjective realities are studied, with methods typically associated with cognitive- or positivist-orientation research approaches (for example, with questionnaires and analysis of word associations; see the work of Wagner et al. (1999) on methods of social representation). In principle, then, social representations scholars have a research question in common, the nature and social development of (subjective) reality or common-sense knowledge, but not methods or necessarily epistemology. Then again, using a combination of methods – some scholars (Bauer & Gaskell, 1999) actually advocate the use of a multitude of methods for studying social representations – does not contradict the above-noted interactional epistemology of social representations proposed by Marková (2008), as each piece of evidence collected with whatever method might provide a valuable vantage point on the whole under interpretation. Her view of epistemology too is flexible, as she takes the position that an epistemology should not restrict researchers' choices in interpreting their findings. This reflects Einstein's views; he can be considered a sort of 'epistemological opportunist', not restricted by a certain epistemological system (Howard, 2010).

Overall, following the approaches of Moscovici and icons of science such as Darwin and Einstein, scientific enquiry should begin with posing of a complicated question that is elaborated upon flexibly and creatively through holistic imagining of relevant vantage points (i.e., by considering an overall evolving system) with not too much concern for the possibility that some aspects of this elaboration might entail issues that are difficult to observe or operationalise. Holism has quite similarly been emphasised in, for instance,

cultural psychology (Valsiner, 2009). My own argument has referred to Einstein and Darwin because their works are well known and they have most undeniably shown that, through logical deduction and abstract systemic theorising, questions with many unobservable elements can be resolved coherently.

1.4 THE STRUCTURE OF THE WORK

In summary, the philosophy of science adopted in this study assumes the following: 1) scepticism toward both restrictive epistemologies and 2) strict reliance solely on observations in inference of phenomena; 3) the insufficiency of mechanistic explanations based on fixed operationalisations; and 4) emphasis on abstract and logically coherent descriptions of complex, multifaceted and evolving phenomena. My study is guided by these philosophical underpinnings in varying ways. First, for flexibility, arguments are gathered from different angles and levels of analysis – that is, with reference to individuals' capabilities when they are interacting with technologies as well as to broad societal structures in communication. Second, although I do use empirical research data, my study also entails a considerable amount of inference substantiated with anecdotal examples rather than with empirical scrutiny. Third, with these means I hope to formulate a description that is at least to a degree holistic and offers a fair number of relevant vantage points: I consider both past and future, both communication and cognition, and both the way in which people make sense of the world and the dissemination of messages although my focus is more in present technologies, in communication and in the way in which people access representations. In line with this, the following sections of this study, though they are interrelated, address the research questions from somewhat different angles.

First, the section 'History and Future of Communication Technology and the Development of Shared Ideas' explores the research questions from a historical–evolutionary perspective. I will demonstrate ways in which changes in communication tools influence the development of shared ideas by considering broad historical turning points in communication technology. The aim here is to illustrate that technological change has influenced who is able to communicate what to whom and how and that this change is a continuing process. Technological change is described as 'evolution' to emphasise that the change is not a random but a cumulative process.

Second, the section 'Case Studies' presents studies that I have conducted together with my colleagues on digital communication technologies. The empirical notions relate to the issues of making sense of the world with digital technologies and the changes new technologies may elicit in communication power. The case studies will illustrate the efficiencies and

possibilities elicited by the Internet, plurality of communication devices and immersive virtual reality. Additionally, it is exemplified that a new device, featuring a change in usability rather than a drastic change in functionality in comparison to an older previously used system, may influence common people's practices and, in turn, also change communication power structures. Overall, all of the case studies elaborate people's interaction with digital communication technologies.

Third, in the section 'Implications for Social Representations' I will infer the consequences of digitalisation on the processes described by the theory of social representations. In doing this I will further infer the observations made in the case studies by contrasting them to theoretical assumptions and terminology. I will also generally consider concepts, methods and the philosophy of science of the theory of social representations. Additionally, although my case studies do not exemplify this issue, I will infer some mechanisms involved when social actors outside the attention of mainstream media bring forth social change over the Internet. This is done by considering some of the assumptions of the theory of social representations and by drawing an example from the current political situation in Finland.

Fourth, the section 'Possible Futures and Study Avenues' features a review of some of the main questions related to the social consequences of plurality of media sources and communication possibilities brought forth by digitalisation. In doing so, I will challenge some of the interpretations made in the previous sections. Both positive and negative social consequences related to digital communication technologies are considered.

The elaboration presented below is organised chronologically: I begin with the far historical past by taking into account the development of ideas in societies largely without communication technologies and end by considering futurological scenarios related to the increasing technological communication possibilities. I strive to formulate a rich and plausible description of some general outlines of the influence of communication technology's change on social evolution of shared ideas. This description entails a series of notions and theoretical assumptions rather than a unifying idea or theory. In the final section of this study 'Conclusions: Change in Communication Technology and Social Scientific Theory', however, my study is considered with an elevated level abstraction. I will ponder on the ways in which the change in communication technologies can and should be taken into consideration in social scientific theorising. The first argument that will be made is that the change in communication technology paves way for new theories by eliciting new research questions and by rendering some aspects of the reality more relevant for the social scientific inquiry. This might not be surprising for those acquainted with the existing literature, but my study demonstrates a reformist approach, which is likely to be less common: instead of creating new theories that address the features of the current technological context my study elaborates an existing theory – the theory of social representations. This is done by considering whether the assumptions

and concepts of the theory are suitable in the current situation and by combining it with theories that are especially relevant due to the current communication technologies. This approach differs from the also common approach of applying an existing theory for understanding the current technological context. Overall, different ways of ‘adjusting’ social sciences for the change in communication technology are discussed.

2 THE DEVELOPMENT OF SHARED IDEAS AND THE HISTORY AND FUTURE OF COMMUNICATION TECHNOLOGY

In the material below, I will address the first research question – on the influence of communication technologies in general (i.e., not only digital technologies) – by considering broadly relevant turning points in communication technology, from oral tradition, through writing and mass communication, to the current digitalisation. This also serves as additional introduction as some initial interpretations are introduced and exemplified – these being that the technological communication possibilities are increasing in an evolutionary manner and dispersing communication power structures – and the discussion of the case studies contrasts their results to these notions.

2.1 FROM ORAL TRADITION TO WRITING SOCIETIES

By 'oral tradition' one may refer to a phase in history in a certain society without writing. These societies were largely, though not necessarily entirely, without communication technologies; cave paintings, musical instruments and such were made. Sperber (1985) has pointed out features of representations that reach cultural level in societies without writing and literacy. The argument goes that without communication technologies, formation of ideas is distinctively filtered by human cognitive capabilities – that is, by innate disposition to develop concepts according to certain schemas. This is to say that in oral tradition, representations that remain and reach significance at a societal level are those that are easily remembered. If they are complicated and hard to remember, they will be transformed into easily remembered ones. Sperber supposes that tales and myths are optimal for human cognitive capabilities and that ideas are distributed within the society and from one generation to other by these means. Three assumptions are made. First, the story is the format that is simplest and most memorable for humans. Second, people are susceptible to myths and religions because these draw attention by being rich in content that reflects common everyday experiences while also being ultimately impossible to judge since their depictions are contradictory to rationality and immediate human experiences. Third, he supposes that humans have an innate disposition to learn zoological concepts: they 'hook' the human memory, and it takes little experience for children to develop them and apply them appropriately. This assumption that some concepts are easier to comprehend than others because they correspond with features of the human evolutionary past is supported by patterns in the content of dreams. In comparison to adults,

children commonly have animal-oriented dreams, quite typically with frightening and wild animals even though these are seldom or never encountered in waking life. The assumed reason is that children's dreams reflect the human ancestral environment while adults have been socialised away from this, with dreams more reflective of actually lived environments; children's nightmares serve as mental training preparing for threats that were relevant in our hunter-gatherer past (Revonsuo, 2000). Reflecting this, tales quite typically feature (anthropomorphic) animal characters. Though animal tales and myths from our oral traditions represent the past, they retain echoes in our contemporary cultures by providing concepts and discursive repertoires that are still in use.

By being able to write things down, whether on clay or paper, a society is freed from particularities and restraints of human memory in development of shared thinking. In contrast to language acquisition, however, writing and reading are skills that are acquired through education. Without a common schooling system, writing is an expert skill, and writing in the absence of a printing system requires time. Accordingly, immense resources, including expert scribes, along with their upkeep, libraries and materials, were needed if an institution wished to write down more than a sporadic piece of literature. Some of our current meanings and concepts still reflect the notion of great infrastructure and funds being needed to pass literature on from one generation to another. Jones and Ereira (2007) have wondered why our common view of history is so consistent with the purposes of the Roman Empire. Competing societies are referred to as 'barbarians', a word with a negative connotation. An example can be found especially in the term 'vandalism'. It comes from the Vandals, an East Germanic tribe who, in contrast to the current meaning of the term in myriad languages, apparently were not particularly violent or destructive – but they were enemies of the Roman Empire. Jones and Ereira explain that our view of history reflects the influence of the Catholic Church on Western thinking and that the Catholic Church continued the tradition of the Roman Empire. Much of the writing was done by Catholic priests and monks, which readily afforded propagation of messages consistent with the Church's views.

2.2 FROM MASS COMMUNICATION TO MASS SELF-COMMUNICATION

From the above, it should be unsurprising that printing technologies and television too enable centralised production of meanings. For example, as noted above, in Moscovici's (1961/2008) pioneering study of social representations conducted in 1950s France, it was found that descriptions of psychoanalysis in the Catholic press and in the Communist press were in line with needs and aims of the Catholic Church and the Communist Party, respectively. Many political newspapers have now become politically

independent; a phenomenon that can be seen in Finland is that the main newspapers are no longer owned by political parties and individuals with key positions within political parties no longer influence in the administrative bodies of these newspapers (Salminen, 1988, pp. 147–168). Adherence to central power structures, however, may be seen also in other ways. First, freedom of the press varies between countries, with some governments applying coercive force toward critical journalists. For example, two large and influential countries, China and Russia, have been assessed as relatively non-free (Reporters Without Borders, 2010). Second, governments may influence the media indirectly. In the United States, the government manufactured positive views on the war in Iraq through military analysts who were superficially independent journalists working for the main television networks but in fact were tied to the military in that they had a background in the military, they were working for military contractors (criticism could result in loss of the contract with the military) and they regularly met with the Department of Defense (Barstow, 2008). Third, adherence to centralised power structures due to corporate ownership of media can be assumed. According to Arsenault and Castells (2008), the strategy of massive global media conglomerate NewsCorp – which owns several newspapers, studios, broadcasting companies and Web sites – includes mutually enriching operations in politics, business and communication. For example, certain politicians are endorsed with the aim of media deregulation, influence and increased revenue are gained through the business's expansion, and public opinion is influenced through suppression of politically or economically damaging news content – with journalists being pressured to withhold and bury stories of this type. Overall, Entman (2007) estimates that US media are somewhat biased in favour of conservatism over liberalism partly because of corporate ownership of media.

Castells (2007), however, argues that new communication technologies enable so-called mass self-communication – that is, provide horizontal networks that, in turn, enable alternative social movements and grassroots actors to have better opportunities to spread their arguments and points of view. This is first because the Internet offers a means of widespread broadcasting and distribution for independent journalists who do not work for government- or business-influenced mainstream media. According to Castells, Internet-based pirate radio and television stations as well as the Indymedia movement (a network of independent journalists reporting on political and social issues) are concrete examples of this. Second, social networking sites, such as YouTube, MySpace and Facebook, allow user-driven distribution of ideas. For example, they have reduced political campaigns' control over images of political candidates (Gueorguieva, 2008). Third, mobile phones make it increasingly difficult for governments to manipulate or hide information, as people may distribute their perspective on an event in a spontaneous manner horizontally for each other. For example, the Spanish government tried to promote the perception that the

Madrid train bombings were carried out by Basque terrorists. This would have assured re-election, but widespread campaigning via SMS by Spanish youth spread the view that Al-Qaida was behind the attacks, and eventually – perhaps with the aid of this campaign – the largest opposition party won the elections (Castells, Fernandez-Ardevol, Qui, & Sey, 2004). In parallel with this, WikiLeaks, a publisher that uses the Internet and cryptographic information technology to obtain anonymous leaks from whistleblowers, inhibits governmental and corporate control over media by reducing the ability to hide issues. For example, WikiLeaks has released a classified military video depicting soldiers indiscriminately killing people in Iraq, two of the persons killed being Reuters news staff. As of this writing, the video had been viewed more than 12 million times on YouTube (Sunshinepress, 2010).

2.3 THE FORESEEABLE FUTURE OF COMMUNICATION TECHNOLOGIES

Since digital communication technologies are based on computing, their capabilities will, to a certain extent, improve apace with improvement in computerised systems in general. Moore's law states that the number of transistors that can be placed inexpensively on an integrated circuit increases exponentially. This has, quite possibly, served as a self-fulfilling prophecy, as the industry strives to keep up with the exponential curve (Schaller, 1997). This exponential development suggests that communication technologies that are currently expensive and hence out of the reach of many, such as high-end smartphones, will become more prevalent and that the capabilities of future systems and devices will exceed the capabilities of the current devices in terms of computing power. Alongside this development, given the heated competition between manufacturers of communication technologies who strive to provide more and more attractive products, it is foreseeable that the usability of these devices will improve as well and that individuals will grow more and more habituated to use of these devices. In sum, trends in use of communication technologies found among pioneering users or 'early adopters' have potential to become common in the near future. For example, there has been strong growth in broadband Internet subscriptions and rapid take-up of use of Third Generation (3G) mobile telecommunications standards (ITU, 2010) that assure faster data rates and, as a consequence, better and more usable mobile Internet access, among other possibilities.

The future of use of communication technologies is foreseeable also because the development of these technologies is publicly supported in part. Hence, the results of these development endeavours are publicly reported. As mentioned earlier, new systems are orchestrated and tested with users in the fields of human–computer-interaction and computer-supported co-operative

work. If study shows an interaction system to be applicable or useful in a research setting, it is possible that, thanks to technological developments and decrease in price of the computer required for arranging that interaction system, that system will later proliferate and enter common use. Currently there are several developments that have been investigated in research settings but serve relatively small or even non-existent customer groups. These include, among others, fully immersive virtual realities (i.e., room-sized cubes in which 3D projections may be experienced from several or all surfaces) (Cruz-Neira, Sandin, DeFanti, Kenyon, & Hart, 1992; Cruz-Neira, Sandin, & DeFanti, 1993), large multitouch displays (i.e., touchscreens that allow interaction by multiple people simultaneously) (Peltonen et al., 2008) and augmented reality (i.e., integration of 3D virtual objects into a real environment via, for example, smartphone camera and display) (Bier, Stone, Pier, Buxton, & DeRose, 1993; Morrison et al., 2009). Some developments fleshed out and explored by researchers are already in common use and were studied more fully before their popularity became widespread, examples being location-based services (i.e., a mobile device service making use of geographical positioning) (Benford, 2004) and microblogging (such as Twitter) (Oulasvirta , Petit, Raento, & Tiitta, 2007). In other words, studies of this type, exploring use of emerging or wholly new technological systems, serve as windows to possible futures of communication technologies.

2.4 INITIAL INTERPRETATIONS OF TECHNOLOGICALLY EVOLVING COMMUNICATION CONTEXT

Overall, communication technologies have unbound the restraints of human cognition in creation of meanings but with the consequence that this creation is linked to access to technologies and therefore also to centralised power structures; communication technologies have been a rare commodity. At the same time, this connection between power and messaging has been changing and dissolving on account of technological progress. For further summing up the historical reflection above, one might note two issues arising from the changes in communication technologies: multiplication of the number of alternative points of view available to an individual and increased freedom from central production of meanings. To concretise the first of the two, one could state that the progress of communication technologies has 1) complemented myths and tales with content less suitable for human cognition, 2) increased the number of information sources and 3) provided qualitatively alternative ways of presenting information – such as dynamic 2D presentations complemented with 3D virtual reality. The second issue, decentralisation, is understandable when one considers the constant decrease in resources an individual or a social actor needs for dissemination

of messages: from the upkeep of trained scribes to printing machines to personal computers with homepages, blogs and social media.

All in all, I propose that the progress of communication technologies makes possible an increase in the number of viewpoints available and a decrease in centralisation over the course of time. Admittedly, there is an element of obviousness in these arguments. For an engineer in the business of providing new products for the people, some of the above assertions might seem self evident. After all, one explicit aim is to provide new possibilities. The existing research already emphasises that technologies change in an evolutionary manner as variations to existing tools are made in the course of time (Basalla, 1998). However, it is less evident how this change is inferred by social scientists. To make sense of societal differences, social scientists have been keen to categorise societies. For example, some societies are seen as individualistic whilst others are considered more collectivist (Triandis, 1995; Hofstede & Hofstede, 2005). The categorisation I am assuming is chronological and on a continuum: the past is associated with fewer technological communication possibilities while the future is associated with more. These types of categorisations are not ends in themselves. They also serve the general theoretical discussion of social sciences. This is because the universality of methods and theories in the social sciences has been criticised, for example, with the assumption that 'Eurocentric' social sciences might not be suitable for exploring, say, African or African American realities and perspectives (Reviere, 2001). Similarly, methods and theories used for one point of time may not be suitable for another if the incrementing of communication possibilities creates methodological and theoretical considerations. Hence, an interpretation of the influence of technological change on communication and development of ideas is beneficial.

It would be simplistic to assume, however, that time inevitably brings increased possibilities along with technological progress. The latter assumption can be considered to be true, first, only if engineering, physics and mathematics are practised also in the future and if people are relatively free to harvest the fruits of these disciplines. In the current free-market societies companies strive to harness scientific and technological progress so as to supply more and more attractive products, which people may use pretty much in the way they wish, but this might not be the case in a restrictively authoritarian setting or society. For example, Heath and Luff (2000, pp. 31–57) report a study of use of computerised clinical records in general medical practice in which the new technology actually was more restrictive than its predecessor: with the digital system, practitioners could not annotate as flexibly as with paper and pen. Hospitals are hierarchical organisations, and in freer settings people might not even use a technology of this type. Second, the development of new possibilities as technologies are appropriated by people in varying ways is largely contingent on non-technological circumstantial factors. For instance, WikiLeaks, certainly an actor that may distinctively influence global communication power structures, has been

made possible not only through the Internet and cryptographic technology but also by innovative activists and in view of legislative developments – in this case, changes in Iceland's legislation that made that country a global safe haven for whistleblowers (IMMI, n.d.). While the future of WikiLeaks actually seems uncertain at the time of this writing, since conflicts within the organisation have been reported (Domscheit-Berg, 2011) and currently the WikiLeaks Web site (n.d.) is not accepting leaks, one may note that any evolutionary process, in technology or biology, entails an element of unpredictability. The asteroid that apparently wiped out the dinosaurs was a random event but did not affect the actual principles of biological evolution. Mammals filled the void as the dominance of giant reptiles ended, just as the idea of WikiLeaks may endure; there are now other actors, such as OpenLeaks (n.d.), that may enter the scene.

The historical–evolutionary reflection above reflect the ideas of Boulding (1979) according to which different types of evolutions, such as physical and societal, influence one another and thus features of the evolutions change. More specifically, my reflection lies in parallel with the ideas of 'epiphylogenesis' and 'technogenesis' (Hansen, 2006; Stiegler, 2009). The former refers to the exteriorisation of human evolution: in addition to the biological evolution, the evolution of humans involves passing on knowledge in cultural evolution. Epiphylogenesis features technogenesis, that is, our co-evolution with technological change. As Hansen (2006, p. 300) puts it, 'humans have always evolved in recursive correlation with the evolution of technics'; humans do not only elicit the evolution of technology but the process is reciprocal. Technogenesis thus involves the idea of mediated development of shared ideas. This is sometimes called 'memory's industrialization' by Stiegler (2009. p. 99) as television industry, for instance, plays role in passing forward ideas. The term technogenesis, however, is unnecessarily 'technocentric', since in contrast to the meaning of the term, in my view, technology mediates rather than creates ideas. It is also quite abstract; I would prefer a concept that is more readily congruent with the existing social scientific vocabulary. Hence, instead of immediately applying the concept of technogenesis, this study asserts that technology changes the context in which the processes of anchoring and objectifying of shared ideas take place.

Overall, reconfigurations in overall patterns of communication take place as technological communication options increase in the course of time. I would suggest that this process can be called a *technologically evolving communication context*. It is a less abstract and less technocentric term than technogenesis and more dynamic as it implies changes in the way in which technology mediates communication. 'Evolving' seems to be a suitable term in this concept. Other possibilities would be 'changing' or 'progressing' but change does not imply a structure or direction while progress implies change towards being better. Evolution implies a sort of prediction without the claim that the future would necessarily be better. In this case the future features an

incrementing number of possibilities. In the following sections of this study, I elaborate on the consequences of this evolution and, while doing so, take into consideration the possible near futures in addition to the present situation.

3 CASE STUDIES

Any new communication device that entails new functionality, as new communication devices often do, provides a new communication context or mutates the existing one. Hence, exploring new technologies and the phenomena they bring forth should be a suitable method for studying changes in the overall communication context. In examination of overall changes associated with digital communication technologies, four phenomena, among others, are distinctive: The first is the Internet and capabilities it provides in information search. Second, is an increased plurality of technologies employed; for example, television and printed text have now been complemented with digital devices, such as computers and smartphones. Third, new possibilities have been introduced as some of the previously non-digital communication devices have been digitalised, with the most noteworthy examples being televisions and telephones. Fourth, as mentioned earlier, dynamic 2D pictures (e.g., film and television) have been supplemented with the possibility of dynamic 3D pictures as in virtual reality.

Four case studies, presented below, explore these phenomena. Two – somewhat contradictory – principles describe the selection of the cases: distinctiveness and commonness. The former refers to the phenomenon in question as being studied in a circumstance in which it manifests itself especially distinctively – more distinctively than in a regular setting in two ways: first, in study of technology that is currently (but may not necessarily remain) inaccessible to common people in practical terms and, second, in study of a context in which the issue is otherwise especially salient. This enables elaboration on the predictive aspect of the idea of technologically evolving communication context by considering possible technological futures and comprehensibly exploring phenomena that are in principle ubiquitous but that would be exhibited relatively seldom in observation of common people. Commonness, on the other hand, quite simply refers to selection of cases that allow exploring the phenomenon from a common person's perspective, in a context that features common persons' regular involvement and with samples from the general population. At the same time, the cases were selected on the basis of convenience. In line with the needs of this study, I have studied and written about use of various digital technologies in the course of my career as a project researcher. The case studies draw from a study that is currently under peer review (Article I) and from three studies published in scientific journals (Articles II–IV).

The first case study compares the impact of different information sources – the World Wide Web being one of them – on people's perception of a public issue, in this case the automation of a local metro system. In the second case, the use of multiple communication tools on account of

proliferation of devices resulting from new digital technologies is arguably an especially salient phenomenon. The setting is a rally control centre where paper maps, booklets and landline telephones are accompanied with computers, mobile phones and GPS-supported electronic maps. The third case involves the phenomenon of digitalisation, with the study considering a technology in common persons' regular use. The issue studied is the digital television transition in Finland and the phenomenon of many converter boxes being accompanied by a hard disk drive that enables easy storage of transmitted broadcasts. The final case study examines capabilities of 3D visualisation with a system that is the epitome of technological development, not so much in its actual technological novelty as in its provision of immersion perhaps in a greater extent than any other technological arrangement. The system in question is the CAVE Automatic Virtual Environment (CAVE), a cube-shaped virtual-reality theatre with display screens that surround the viewer and thus enables an individual in practice to enter a virtual depiction (Cruiz-Neira et al., 1992; 1993). In the study, the system is used for collaborative evaluation of hospital spaces.

The overall strength of these cases is that they differ considerably from each other, exploring differing contexts and technologies in differing manners. Hence they are able to reveal differing aspects of digital communication technologies. Additionally, these case studies are particularly suitable because, to the best of my knowledge, they are all pioneering either in exploring unexplored contexts or technologies (a rally control centre and hard disk drive (HDD) converter boxes) or in their use of new methods for studying technologies (virtual reality and the Internet).

The first and third cases feature statistics for the purpose of generalisation, while the second and the fourth case study encompass qualitative interview and observation methods only but it is also assumed that general notions may be abstracted from qualitative studies that concern specific contexts. Fine and Fields (2008, p. 132) illustrate the possibility of generalisation from a single case by stating that '[a]n account of the actions of a Little League baseball team on one warm June afternoon stands for many gatherings in many communities on many days'. In a similar vein, it is assumed that findings from a rally control centre or from evaluation of hospital wards in a virtual-reality space may be generally revealing of communication with multiple tools or with immersive virtual reality.

In addition to each of these cases being looked at in terms of its specific method(s), the cases are analysed as a whole, with contrasting of the findings against the initial notions of the technologically evolving communication context and the dynamics described by the theory of social representations. Themes that overlap in the cases will be interpreted, for greater understanding of general consequences of digitalisation in view of the research questions. In other words, the overall reflection involves considering the findings of the case studies with an elevated level of abstraction – that is, with broad interpretation of the social mechanisms or

processes identified in the studies. The method used, then, is a sort of a more-abstract-than-usual version of qualitative content analysis. As they are in a typical qualitative content analysis (Flick, 2009), observations with commonality are bundled together; however, here observations do not refer to direct findings in a relatively specific setting but reflect inferences drawn from different studies. At the same time, however, the case studies serve a second purpose – in addition to identifying broad mechanisms and tendencies, they exemplify how these mechanisms are manifested.

I will first introduce the individual methods and general content of the four case studies. Three of these studies, those concerning the World Wide Web, plurality of devices and virtual reality, have to do with the standpoint of communication technologies assisting in making sense of the world in particular. The case study of digitalisation of television, in turn, is related to the notion of changing communication power structures. After each case study is introduced, their results are discussed further by considering the second research question of this study.

3.1 THE WORLD WIDE WEB

The fourth case study compares the effect of the Web to that of other information sources in public understanding of a social issue – in this case, the future automated metro of Helsinki. For studying this, a Web-based questionnaire (n = 913) was created via which individuals living in the Helsinki metropolitan area could indicate their thoughts on the automated metro and through which relevant background variables were measured. Among these variables, the source of information was assessed and comparisons were made in terms of finding information. The Web was compared to other sources. Additionally, Finnish media writings on the issue were studied by exploring the argumentation concerning automation. This served the purpose of measuring the level of knowledge on the issue: the questionnaire included items measuring individuals' exposure to arguments and notions found in the media.

When starting to fill in the questionnaire, respondents did not know that it was about the automated metro – they were informed that it was about Helsinki or public transport in Helsinki when they were persuaded by e-mail and Web-site advertisements to respond to the questionnaire. First, demographic information was gathered. Then respondents were prompted to think about the automated metro for a while; to enter the five thoughts they associated most strongly with the automated metro when considering it; and to rate these thoughts as positive, negative, or neither. Further, respondents were asked whether they preferred the automated metro or conventional metro and additional background variables were measured; these included orientation toward technology in general, with items consistent with those of a Eurobarometer survey on Europeans' views on science and technology

(European Commission, 2005). With these background variables it was calculated that the sample of my study consisted of individuals who were slightly more interested in and positive toward new technologies than a random sample. There were also slightly more young adults and females in comparison to the general population of the Helsinki metropolitan area. Other features were that the sample mostly (63%) preferred the conventional metro and reported, on average, 1.1 more negative than positive thoughts about it.

Most importantly here, however, is that in the questionnaire the respondents were asked about the sources of information and knowledge concerning the automated metro. It was asked whether they had heard/read about it from newspapers, radio/television, the Web and/or personal communication. In assessing their knowledge, the respondents could indicate whether or not they knew of 12 notions and claims concerning the automated metro made in the mainstream media. The media articles were sought via online search engines, with search terms referring to the automated metro used on the Web sites of the three biggest newspapers in Finland, these being *Helsingin Sanomat*, *Ilta-Sanomat* and *Iltalehti*. All articles in the paper version of *Helsingin Sanomat* from recent years may be found in this manner, since there is a full digitised version of the broadsheet. Similarly, much of the content from the conventional version of *Iltalehti* and *Ilta-Sanomat* can be found, with many articles published both on the Web sites and in the paper version. In total, 25 articles were found in this manner, the majority from *Helsingin Sanomat*. From these data and a brief initial media analysis, the following notions and arguments were formulated and enquired about from the respondents with the questionnaire: 'the first automated metros were in use in 2000' (this was the only statement that was categorically not true; claims countering instead of confirming it had been made in the Finnish media), 'automated metros are in use abroad', 'sensors may cause problems, such as unnecessary stops, due to vandalism', 'automation eliminates the possibility of human error', 'automation enables shorter service intervals', 'almost unanimous political decision was behind the automation', 'an automated metro is to be in use in 2013', 'doors to trains will be built on platforms', 'it is unknown how the sensors will work in harsh Finnish weather conditions', 'Siemens will execute the automation project', 'none of the drivers will be laid off' and 'the automation will be either more secure (as claimed by the transport company) or more insecure (as claimed by the metro drivers) than a conventional metro'.

According to the results, about 83% of respondents had read about the automation in newspapers. More than half reported radio/television (53%) as a source, and an equally common source was the World Wide Web (53%). Roughly one third (32%) had found out about it through personal communication (face to face or by e-mail, phone, or other personal electronic means). On average, the respondents reported having knowledge of 5.3 of the 12 media arguments concerning the automation that were presented with the

questionnaire (whether or not they agreed with the arguments – i.e., irrespective of whether this knowledge was in line with or in contrast to claims made in the media). Reflecting the largest beta in the linear regression model, the source that contributed most to the number of acknowledged arguments was the Internet, as seen in Table 1. When use of the Internet was introduced to a regression model featuring the other three variables pertaining to information sources, the predictive power doubled as R2 increased from 0.12 to 0.25.

The results entail thus an element of paradox: although newspapers were the most prevalent source of information, the Web was the one that most reduced ignorance of the issue. This is most likely due to search engines, since with them one may relatively effortlessly explore various aspects of a phenomenon. With older media, an individual is typically exposed to the arguments chosen by a single journalist, but browsing the Web allows multiple perspectives to be accessed, depending on the individual's motivation and information retrieval skills. It is thus understandable that the Internet is the most efficient medium as suggested by this case study.

Table 1. *Linear regression analysis showing the contribution of source-of-information dummy variables to the quantity of acknowledged arguments concerning the automated metro (n = 886)*

	B	**SE B**	**β**	**T**
Constant regression	1.255	0.394		3.185**
Newspapers	1.641	0.383	0.141	4.289***
Internet (Web)	2.504	0.221	0.370	11.326***
Radio/television	1.211	0.222	0.179	5.464***
Personal communication	1.312	0.231	0.186	5.675***

$F = 59.742$, $P < 0.001$; $R^2 = .250$; adjusted $R^2 = .246$.

* p < .05; ** p < .01; *** p < .001.

Note. Adapted from Article I.

3.2 PLURALITY OF COMMUNICATION DEVICES

The context in which the phenomenon of plurality of communication devices is explored is the rally control centre (RCC) of Neste Oil Rally Finland that I studied together with my colleagues Antti Salovaara, Leena Salo and Antti Oulasvirta. The setting entails a collection of communication devices from different phases in the technological evolution. Landline phones are used along with cell phones and with a radio communication system borrowed from the Finnish authorities. Printed wall maps and foldable hand maps

accompany electronic maps: a large video projector displays the positions of rally cars with the global positioning system (GPS) provided by the World Rally Championship host organisation, this map being also viewable from several laptops. Various manuals include the safety manual – a 230-page book with maps of the stages of the rally, recommended viewing areas, the positions of emergency response units, phone numbers of different representatives and so on – and the road book, which features drawings of crossroads of the rally track. Some of the information in manuals is replicated also in an electronic form. The rally schedule, for example, may be viewed from the laptops in the room. The RCC was first observed in 2004 by Antti Salovaara and then in 2008 by Leena Salo and me. Between these times the setting had changed: a large video projector based map indicating emergency response vehicles' locations had been taken into use. Overall, the RCC is an example of a setting in which the number of communication devices have increased in the course of time: various digital and non-digital tools exist side by side. The RCC personnel comprise a manager and a vice-manager, one or two medical doctors, up to four dispatchers who work two or three at a time, a police officer and contact persons. A photograph of a dispatcher's desk is provided in Figure 1.

Figure 1 Dispatcher's desk at the rally control centre.

It was of interest to explore the way in which the RCC operates and makes sense of situations of ambiguity and potential danger because in resolving events like this, the capabilities of the RCC and the usefulness of multiplicity of technologies are put to the test and made manifest. With about 300,000 spectators – the rally is one of the largest annual events in the Nordic countries – and with rally cars travelling up to 210 km/hr (130 miles/hr) on narrow and gravel roads accidents and other incidents are bound to occur and the RCC has to form an understanding of the nature and location of these incidents. An additional challenge is that besides ensuring and maintaining security, the RCC has to keep the rally going and on schedule, which, in turn, also promotes security by keeping the audience satisfied. The RCC must decide whether it is necessary to get the emergency response vehicles to the scene and whether this requires bringing the race to a halt. It also has to resolve how to direct the emergency response vehicles to the accident scene, and which vehicles are to be sent. Due to safety measures, some emergency personnel have to been kept in guard at the track, that is, sending them away may involve discontinuation of the race.

The observation of the two rally events, 2004 and 2008 rallies, featured passive video camera recording from selected vantage points, with focus especially on the dispatchers. In total, 66 hours of activity were shot. The data analysis was based on interaction analysis (Jordan & Henderson, 1995) – that is, on detailed analysis of sequentially ordered verbal and embodied interaction. Of all the video footage, six episodes, ranging from 15 to 53 minutes in length, were chosen for the in depth analysis. In line with the idea of studying challenging situations, the episodes that were selected included both potential danger for the competitors or spectators (thus requiring quick decision making) and elements of ambiguity (the location, the nature of, or the access to the event was not certain due to either conflicting or lacking information).

Of all the practices found in the RCC, we concentrate here on the use of the multiplicity of communication tools. It was first noted that the multiplicity of tools applied in the RCC produce 'representational redundancy' (Cabitza, Sarini, Simone, & Telaro, 2005); that is, the same information can be represented in several places and externalisations. For example, as mentioned earlier, in the RCC the same information may be represented both in non-digital (as when an accident location is written by hand on dispatchers' logs) and in digital forms (such as when an accident location can be seen as a spot on the GPS-map). The representational redundancy was made use of in two very basic responsibilities of the RCC: in acquisition of information about incidents and in making understandable commands for external partners such as emergency response vehicles.

Various information sources are used by the RCC during incident resolution. These include managers of the rally stages, different emergency response vehicles, the GPS systems and the regional emergency centre. These provide information about incidents in different manners and with varying

degrees of accuracy and trustworthiness. The GPS map provided by the rally organisations, for example, offers information in an automated manner as the map shows the cars' locations but also with lack of reliability. This is because a colour coding of the cars, used for signifying cars' statuses, are partly indicated by drivers, who may forget to do the signalling, and because the map is connected to the GPS system via an airplane that occasionally has to land for refuelling. The regional emergency centre, in turn, may acquire its knowledge from the audience, which may also be an unreliable and unspecific source. Due to unreliability the message may have to be double-checked. Additionally, reformulations may be necessary since ambiguous oral explications originating, for instance, from the audience or the drivers has to presented in a manner that is understandable by, say, the emergency units. Thus, 'translation work' of sorts is necessary to integrate

Table 2. *Translations of incident location and accessibility information, using different communication tools*

Phase	Time	Source	Information	Reaction in the RCC
1	0 min	Regional emergency centre delivering the news provided in a phone call from a spectator	'Some kind of patient at the special stage, 3 km from the start'	Starting double-checking of the news with the special stage manager. Starting finding out of how the spectators are probably positioned in the 3 km area.
2	4 min	Contact person with local knowledge in the RCC	'There is an officially recommended spectator area at 3 km'	-
3	5 min	Special stage manager at the track	'Directional signing manual, page 2, box 18'	A comment within the RCC that this information is hard to interpret since the manual has not been designed for use in the RCC.
4	5 min	Special stage manager at the track	'3.14 km from the start'	Replying by asking the manager whether he knows what has happened.
5	6 min	Physician in the RCC consulting the wall map	'It is at leg 5 of that special stage'	-
6	6 min	Special stage manager at the track	'Only accessible by driving along the rally track, leaving from the start'	Order to the manager and two ambulances positioned at the start: ambulances to drive to the 3.14 km spot, pick up the patient and leave the rally track at safety point 1 at 13 km.

Note. Adapted from Article II.

and reformulate knowledge. Table 2 exemplifies translation work by describing one of the studied episodes in chronologically ordered phases. In Phase 1, an estimation of location and type of incident is learned. Further understanding of the location is adopted with different tools in phases 3 and 5. In the final phase 6, the perception of the incident location becomes more precise and is transformed into practical directions for the emergency response vehicles. The information thus changes it form and by being represented with different communication tools.

Translations of this type are enabled by a multiplicity of communication tools. They also allow flexible and perhaps efficient intake of information as the tool that is the most convenient in a specific situation can be applied. Having various tools available also allows control centre workers to entertain different viewpoints on the situation. This implies a richer interpretation on the incident.

In addition that reformulation of messages is beneficial when information enters the RCC, reformulations can be needed for presenting information when communicating with remote partners, such as, rally drivers, emergency response vehicles and so on. The messages sent outwards have to be presented in a manner that is understandable to these remote partners. The aim is then to view the circumstances from the vantage point of a partner that does not have the same perspective on the situation as the RCC does. Here one may either use descriptions that are generally understandable or one may refer to a medium that is shared by both the RCC and the partner. Descriptions that can be understood by looking at any regular map of the area exemplify the former case. A non-regular medium, in turn, that is useful and shared by both the RCC and external partners is the road book. It features specific knowledge relevant for the rally by naming the driven roads unambiguously. In one of the episodes it was necessary to get an ambulance carrying a patient off the rally track at the earliest exit possible. In ensuring that the ambulance does not miss the crossroad, a dispatcher, following the commands of the vice-manager, instructed a safety car that led the way for the ambulance. The road book was used as a common point of reference in this communication between the RCC and the safety car. This can be as seen in the excerpt below (adapted from Article II):

	Dispatcher:	Can we soon let the zero zero [a safety car driving before the first competitor] onto the track?
	Vice-manager:	Zero zero to the track, carefully.
	Dispatcher:	Yeah?
	Vice-manager:	Then they do so that, they drive – do you have the road book? OK here. ((flips through pages))
	Dispatcher:	Zero zero, go carefully, RCC. ((speaks to the radio))
	Vice-manager:	Zero zero carefully, until Pena [driver of another safety car that here has been asked to drive with the ambulance] says the track is clear, then faster and
=>		drive so that they exit the special stage at box 8. Page 88, box 8. Zero zero exits there. Pena drives the whole track to the finish, one zero drives to the finish.

Delivering this message required the use of the road book with the purpose of giving unambiguous instructions. Having different tools available presumably facilitates this communication as location-related information can be quickly transferred from one tool to another.

In sum, the multiplicity of communication tools and their redundant characteristics is a benefit as the RCC needs to reformulate the incoming messages and adapt to the information processing characteristics of the external partners. Having a variety of devices from different stages of the technological evolution seems beneficial due to the increased options in communication. Using only one type of digital device might be problematic: it is not realistic to assume that all external partners could be given a computer with all relevant instructions, maps and communication possibilities. Moreover, this 'unifying device' might not be sufficiently reliable – with the computer not working, the RCC could no longer operate. A feature of redundancy is error tolerance (Cabitza, et al., 2005). One may also doubt the flexibility of this device in terms of usability: paper can be annotated with a pen, which would not necessarily be as easy with a digital device (Heath and Luff, 2000, pp. 31–57). Although RCC's communications are almost totally mediated by digital technology when it comes to messages leaving and entering the room, these communications are at times mediated also by paper. This 'double mediation' is understandable because paper is inexpensive, reliable and practical to use.

3.3 HDD-ACCOMPANIED CONVERTER BOXES

The second case study paraphrases a study that I conducted together with Anu Kankainen and draws from a trend taking place in various countries, this being conversion to digital television broadcasting. More specifically, the study explores the changes in television-watching due to a phenomenon seen in Finland of many converter boxes being accompanied with a hard disk drive that enables easy storage of transmitted broadcasts. The HDD converter box liberates individuals to view broadcast shows when most suitable by providing a relatively effortless means to record shows and to watch them afterwards, and it allows individuals to skip over or fast-forward through broadcast advertisements. In other words, it changes general communication patterns by increasing individuals' freedom of choice and by reducing advertisers' capability to promote via television.

Methodologically the case study follows the idea of data synthesis – that is, combining different data sources that unaccompanied provide incomplete findings but put together present a convincing whole (Matusov, 2007). In the study, this is done by combining an interview data set, collected by me, with public statistics and publications that rely on statistical data. The Finnish

statistics used are Statistics Finland's Consumer Survey and TV Audience Measurement conducted by Finnpanel, the company that measures the use of television and radio in Finland. The former set of statistics involves random samples of about 1,500 people (Statistics Finland's Consumer Survey, n.d.) while the sample size for the latter is 3,000 (Finnpanel, n.d.). Both sets of statistics are collected four times a year.

The qualitative data was based on interviews with 30 people recruited by a commercial research company. The recruitment criteria aimed at heterogeneity in terms of age, family situation and geographical location in the Helsinki metropolitan area. The aim of the data collection was to explore social practices associated with any type of broadcasting and videos in different forms (including DVD, VHS, television broadcasting and Internet videos, plus other broadcasts and mobile video but not games and cinema visits) in general terms – i.e., the initial aim was not solely to study use of HDD converter boxes. The interviews were semi-structured as interviewees were encouraged to talk freely about the following issues, which were covered in all interviews: what kind of video or broadcasting content is viewed with various devices, watching television with others and alone, watching video content via the Internet together and alone, sharing video content with others via different devices and comparing different devices and Internet services.

The interviewees were consistently asked to describe why and how they used a certain device in a certain manner. The aim of the interviews was to discover and understand different types of practices and cases; i.e., the interview questions varied very much between study participants, depending on the topics introduced by those interviewed. One third of the interviews were transcribed in full, these were the interviews conducted first. The interview data analysis involved pinpointing different practices of use of household devices for watching videos and broadcastings and individuals' explanations regarding these practices. This annotation was done by hand for the transcriptions and with ELAN, software for annotating video and sound materials (Language Archiving Technology, n.d.), directly on a presentation of the audio file. The interviews were conducted in autumn of 2009.

In the data provided by Statistics Finland (2010), almost half of the households had an HDD converter box in the middle of 2010, this number having considerably increased after the digital television conversion. In the interviews, as many as almost all programmes were described as viewed from the HDD, while in the statistics of Finnpanel (2009) 13% of all broadcasts were watched from an HDD converter among those households with this device. In other words, the statistics portray fewer changes in television-watching habits than the interviews do. Possibly the use of the HDD varies greatly between households and the qualitative interview sample might have included individuals who use the device very frequently. The methods used by Finnpanel, however, also hide the actual prevalence of HDD use somewhat. In the method of Finnpanel (n.d.), an individual is to report being

a television viewer when both in the same room as a television set that is turned on and able to watch the television. This is to say that even an individual not actually watching the television should be noted as a television viewer. This type of mere presence with a television set turned on without actually watching it should be less common where recorded programmes are concerned, since playing of recordings was preceded by the slight trouble of choosing the shows. This implies that the 13% of viewing that is time-shifted includes more active watching than the 87% non-time-shifted watching. The measurement of Finnpanel also does not include programmes viewed after seven days from their initial broadcast. Overall, although the actual percentage of time-shifted viewing is not known, the average figure is somewhere above 13% and can be quite high among some individuals, as in this depiction by a middle-aged woman (adapted from Article III):

> *Mostly nowadays, when we watch television, we watch recorded shows. Very seldom do we watch anymore when the show comes.*

The outcome of HDD-based television-watching is that advertisements are watched less than before, since they may be skipped over or fast-forwarded through. For example, one interviewee said that he had learned to estimate the length of advertisement breaks, which allowed directly jumping over them with the HDD system's user interface. To exemplify the scope of the change for some persons, one may refer to another interviewee, a high-school teacher who regretted that she did not know what kinds of advertisements are being broadcast anymore, since in her profession being knowledgeable of them would be part of useful all-around knowledge.

It is notable that, in a sense, the HDD converter boxes have changed quite little in terms of technology: the very prevalent VHS system enables saving of shows as the digital systems do. Despite the seeming superficiality in the technological evolution, the digital transition has induced changes in television-watching – even to the extent that an interviewee (who was accustomed to use of VHS) depicted the change by uttering that the 'recording converter box liberates from the chains of the broadcasting company'. The case of HDD converter boxes thus exemplifies the effect of effortlessness and better usability in bringing forth distinctive changes in media use habits because for these issues HDDs outsmart VHS. They allow easier recording of television programmes than the less usable VHS devices do in many respects: Only broadcasts of very limited length may be recorded to a VHS cassette, whereas the HDD may contain many hours of programming; HDD converter boxes are accompanied with more sophisticated user interfaces – lists of upcoming programmes are presented on the television screen, and with a click or two they may be chosen to be recorded to the HDD; and VHS cassettes have to be bought while using the HDD is free of charge once the device has been acquired.

This change in television-watching habits varied, depending on television programme genres. In the interviews, sports, song contests, popular reality television shows and national celebrations were mentioned as programmes that it was not ideal to watch afterward from the HDD. The Finnpanel statistics are, by and large, in line with these statements, with fiction and films being the programme types most commonly watched from the HDD while sports, current affairs and news were very seldom recorded (Sandell & Lamberg, 2010). It may be postulated that any type of event that has collective cultural significance might be preferably watched live. These events may be long-established traditions (e.g., major sports events) or fairly new program-types hyped in the media (e.g., popular reality shows). Some explanations were provided by the interviewees. First, when it comes to sporting events, the excitement of the event was lost if the results were known beforehand. Second, watching an important event simultaneously with others, even when the others weren't necessarily physically present, produced an experience that could be interpreted as a feeling of togetherness of a certain type. An interviewee, a middle-aged man, explained this in the following way (adapted from Article III):

> *It happens right now and you are taking part in it. […] Well, in that atmosphere, now moment, you are taking part in it and you know that millions of others are also, so it is somehow a nice feeling.*

In line with this, some interviewees noted that live viewing of sports is preferred even if the result of the match is unknown. Ways in which social identity is connected with emotions might explain this. It has been found that emotional responses to losses and wins when an individual is viewing sports events depends on the viewer's level of identification with the ingroup – i.e., with the supported team in question (Crisp, Heuston, Farr, & Turner, 2007). When one is watching, say, a match afterwards, the other members of the ingroup have already experienced a loss or a win and the feelings associated with it. Thus, in watching of an event from the HDD, the implications of the viewed events are less significant for the ingroup, since past emotions and experiences are likely to have less importance than current ones do. This implies that the events are less important also for the one identifying with the ingroup. In other words, watching a match later inhibits experiencing emotions that otherwise would have been associated with the event. Not watching a match or national celebration live would also be inconsistent with the behaviour of other ingroup members; in other words, watching the event live is encouraged by group norms.

In sum, the case of HDD converter boxes is a case of change in underlying structure determining who is able to communicate what to whom because of better usability and easy avoidance of commercial messages. The case of HDD converter boxes additionally exemplifies that the way in which new technologies influence this structure may depend on the existing cultural

determinants: events with collective cultural significance were preferred to be watched live, not from the HDD. Further, the case exemplifies that the technological evolution may elicit unexpected changes in the communication context. Hellman (2010) has considered that the digitalisation of television was a means of liberating and marketising the broadcasting industry in Finland: the digitalisation allowed commercial broadcasters to establish several new channels. It is unlikely that commercial broadcasters anticipated a diminution in their communication power, and they were most likely involved and consulted with when digitalising television was decided upon by the Finnish government.

3.4 IMMERSIVE VIRTUAL REALITY

The CAVE Automatic Virtual Environment (see Figure 2) quite possibly allows the closest imitation of reality with a computerised system, as it may be used to cover an individual's entire field of view with three-dimensional presentation and it allows an individual to manoeuvre relatively freely in this virtual space. I had the opportunity to study CAVE together with a research group consisting of engineers Miika Aittala, Janne Porkka and Esa Nykänen, an architect Helinä Kotilainen and a health care specialist Tiina Yli-Karhu. Studying the device drew from the notion that optimally a virtual presentation should be able to present at least those features that are relevant in actual environments (although it might also feature capabilities that go beyond those of the reality), as otherwise the virtual presentation is limited when compared to the reality. Correspondingly, in this third case, the capabilities of CAVE are then evaluated with a method that includes collection of qualitative data in actual, non-virtual environments and then contrasting this data to features of a virtual-reality system, which, in turn, can be inferred by exploring people's use of the virtual reality.

The capabilities of CAVE were explored with the rationale of this method in the context of participatory evaluation of patient rooms and patient room plans for hospital use. It was explored which features relevant in actual patient rooms for the end users (nurses and patients) could be evaluated with CAVE. In other words, three linked questions were examined: 1) What issues are evaluated by end users in the actual wards? 2) What issues may be presented for end users reliably in CAVE? 3) What issues are evaluated in the actual wards but cannot be presented in CAVE? The third question is the main research question, with the goal of revealing whether the functions and elements identified by end users on the actual wards could also be evaluated with CAVE.

Figure 2 *CAVE used in the study.* Reprinted from Article IV with permission from Springer Science+Business Media.

Eleven nurses and 11 patients participated in the study by evaluating a bathroom and/or four patient room plans modelled in CAVE and the actual hospital wards. The patients and the nurses evaluated the environment in the wards where they were treated or worked. The patients were interviewed by the researchers. During the interviews, patients' opinions were elicited on the following features: a) colours, b) lighting, c) placement of furniture, d) surface materials, e) size of the room, f) windows, g) pleasantness, h) aesthetics and i) the practicality of the room in general. My colleagues and I chose these topics because an association has been found between these issues and patient well-being and safety (Ulrich, Zimring, Joseph, Quan, & Choudhary, 2004). The interviews were semi-structured as the topics listed above served as starting points, and the discussion that followed was allowed to flow freely. The nurses, on the other hand, evaluated their ward in pairs in accordance with instructions given to them. They were also given a digital camera to photograph the features they discussed and a digital recorder for recording their discussion. They were instructed to discuss and photograph the rooms and environments, noting which details they found a) relaxing or stress-inducing, b) aesthetically pleasing or not, c) pleasant or unpleasant, d) well implemented or impractical for working, e) well implemented or inconvenient for patient well-being or f) well or poorly functioning. They were additionally instructed to explain why the environments or features in the environments could be described with some of the above-mentioned

adjectives. The patient interviews in CAVE covered the same topics as, and were also carried out according to the same principles as, the work on the wards. Furthermore, the patients were asked about their perceptions of CAVE. The nurses' interviews in CAVE comprised the following topics: the quality of the room in terms of a) performance of nursing tasks and procedures, b) the expected influence on patients' ability to function on their own and c) the pleasantness of the room. The methods used were inspired by studies by Douglas and Douglas, wherein semi-structured interviews were used to study patients' perceptions regarding hospital environments (Douglas & Douglas, 2004) and in which respondents were able to photograph hospital environments (Douglas & Douglas, 2005). Similarly, our study explored end users' views about the environment in the actual hospital wards and, in CAVE, with which depictions of patient room plans were made in the virtual world.

In line with the main research question, the data were analysed by categorisation of the comments made in the actual hospital wards according to whether they referred to 1) a feature that can be evaluated in CAVE, 2) a feature that cannot be evaluated in CAVE, or 3) a feature for which evaluation in CAVE is not certain. Also, however, to allow this categorisation, the interviews in CAVE were used to examine instances of respondents reporting some aspects of the environment that could not be observed correctly or reliably in CAVE or in which they were uncertain about their observations.

The results indicate that CAVE was convenient for evaluating most issues identified by the study's participants in the actual hospital wards. These were aesthetics; correct location of equipment, the supplies and materials; distraction by or good companionship with other patients, window position and size and the living/work space. It was not possible, however, to evaluate with full certainty the possibilities for bracing against grab bars or other objects in the VR, and this was found to be relevant to the independent functioning of patients with limited mobility. Furthermore, issues related to room size, furniture and moving about might not be evaluated perfectly in CAVE, because respondents did not seem able to be sure of all of their observations regarding sizes. At times, nurses were not certain of the sufficiency of space where ability to support patients was concerned. However, no reason was found for respondents' inability to evaluate the relative size and location of objects in the modelled room. One can consider the correctness of the location of equipment, supplies and a television set to have been evaluated in CAVE rather well. This is to say that the end users could say whether or not objects were roughly in the correct place in the room, though the model used was not ideal for assessing precise fittingness in terms of sufficiency of space. Also, in view of the relatively low luminance levels of the screens forming the walls of CAVE, evaluations regarding lighting were considered unreliable.

Other findings were that CAVE produced a strong illusion of being inside a modelled room; for example, some patients who sat in a chair during the interview covered their knees while they were manoeuvred with a joystick through modelled objects such as chairs and beds, as if they would collide with actual objects.

Overall, the case study demonstrates that CAVE is a useful tool when it comes to communicating and making sense of ideas related to physical spaces. The system clearly worked in harnessing the end users' perspective and know-how in the participatory design of patient rooms, as, in many respects, being inside the virtual presentation resembled being inside an actual room: most issues evaluated in the actual wards could also be evaluated in the VR environment. Promising results for the use of VR in communicating ideas with end users have been obtained also in previous studies. Some of these studies suggest that a CAVE-type virtual environment works better than a 3D desktop environment (Dunston, Arns, McGlothlin, 2007) or even better than a full-size physical mock-up (Seron, Gutierrez, Magallon, Sobreviela, & Gutierrez, 2004) when one is attempting to elicit people's perceptions of design issues. Because of the methodologically novel approach used, the case study presented here, however, adds to the discussion of the issue by illustrating that the usefulness of VR depends on subtle relations between features of the VR system and the task at hand. In the case of participatory design of spaces, it depends on what type of space is being evaluated – i.e., which features in an actual space are relevant for end users and whether or not it is possible to evaluate these features with the VR system used.

3.5 OVERARCHING PHENOMENA

Overall, two issues of commonality can be inferred when the case studies are contrasted against each other and examined in view of the issues relevant for social development of shared ideas. The results of the case studies are discussed, in light of these two issues, which are 'increasing sensemaking capabilities' and 'dispersing communication power structures'. The generalisation of results to other contexts is examined in particular depth.

3.5.1 INCREASING SENSEMAKING CAPABILITIES

Sensemaking can be defined as a process during which understanding is gained and that may involve, for example, finding information; solving ill-defined problems; learning about new domains; engaging in dialogue with others; and inventing ways to find, organise and interpret information (Foreman-Wernet, 2003; Weick, 1995; Pirolli & Russell, 2011). The studies of

the Internet, the rally control centre and virtual reality all describe a common phenomenon: technology assisting in sensemaking. The Internet was the most efficient medium for reducing ignorance surrounding the future automated metro in Helsinki; in the rally control centre, multiplicity of tools provided increased flexibility and reliability in making sense of accident situations; and CAVE made it possible to evaluate many aspects of premises quite similarly to a real-world physical space. Since sensemaking is largely about finding and exchanging information and given that many technological inventions support exactly these functions, it seems commonsensical that one feature of technological progress would be a change in human sensemaking capabilities. The idea that this capability increases in tandem with technological progress is not wholly new; it reflects, for instance, the thoughts of Douglas Engelbart (1962), a computer pioneer known for inventing the computer mouse, who calls for 'augmentation of human intellect', by which he means better and more rapid comprehension of complex situations alongside better and speedier solutions and which 'would warrant full pursuit by an enlightened society' (p. 1). To the best of my knowledge, however, the current literature has not considered the impact of technologically increased sensemaking capabilities on societal development of lay ideas.

Once a new phenomenon enters public discussion, people absorb ideas related to the issue(s) sporadically when exposed to media and in daily discussions but, if having a sufficient level of interest, also through active figuring out and enquiry. In other words, sensemaking takes part in the evolution of thinking and communication as described by the theory of social representations. Two theoretical possibilities arise in connection with the idea of increased sensemaking capabilities. First, as digital communication technologies make sensemaking more efficient, it seems plausible that the evolution of ideas would be quicker – that is, it would take less time for a new abstract and alien idea to be decisively anchored to people's existing values and concepts and perhaps to be perceived as concrete or real. A second theoretical possibility, reflecting Engelbart's (1962) visions, is that digital technologies afford a more 'expert' feel in this process; that is, a common person's view on a new issue may, in the less mediated presence of expertise, take on greater resemblance to these, employing the concepts and terms of scientific disciplines etc. I will discuss these possibilities by considering the phenomena explored in the case studies.

The findings on efficiency of the Internet in discoveries of perspectives and arguments seem to imply increased speed of the process – e.g., the Web was the source of information that most reduced ignorance surrounding the automated metro. One may imagine an individual finding out about something new and bemusing, then, through Internet searches, quickly and relatively effortlessly building his or her position and opinions on the issue by browsing through and evaluating varied media discourses. The possibility of an increase in at least people's seeming expertness or scientist-likeness

also seems plausible in view of the current possibilities of the Internet. This is because the World Wide Web features sites accessible to laypersons where phenomena are explained in a scientific or semi-scientific manner. For example, Wikipedia, the collaborative encyclopaedia of 365 million readers (West, 2010), explains various phenomena with references to scientific literature. Additionally, common people and researchers now have more equal access to scientific publications, which can be sought online: scientific libraries, often with restricted access policies (Finland being an exception), are less relevant than before. The Web also offers pedagogically relatively persuasive information on research methods, enhancing the common person's possibilities for adopting the researcher's perspective. Moreover, the impact of the Internet in promoting sensemaking capabilities is further increased by the fact that people are increasingly accessing the mobile Internet, which enables online searches at almost any time, anywhere.

The study of sensemaking in the rally control centre explored a phenomenon familiar to any of us, this being the plurality of communication technologies, of several types. Two ways in which this plurality promotes sensemaking were inferred: it allows communication with external partners by means of the most suitable communication tool for the situation at hand and allows integrating information from sources with differing 'representational features', which, in turn, provides a many-sided view of the situation, via which increased coherence is gained. In broad terms, these findings seem generalisable to other contexts and everyday life. First, as the control centre workers did, common people seek dialogue with others with a multitude of tools and services, such as landline and mobile phones, social media and Internet chat. Hence, the multiplicity arguably increases the common person's potential to communicate in a suitable and efficient manner, considering the differing features of the tools. For example, a mobile phone allows one to reach others almost anywhere whenever needed while with Facebook it is possible to reach remote friends whose contact information cannot otherwise be found. Instead of calling, sending an SMS can be more suitable, such as when it is not certain whether the recipient might be sleeping or when posing a question to which the recipient might not make up an answer immediately. When it comes to synthesis of differing representations of the same issue (that is, when an issue is made sense of with a combination of, maps, tables, free-form talk etc.), it is obvious that common people engage in actions of this type; however, the individual tools might not always be an issue or chosen specifically – the computer is a single tool through which one may access the fruit of many tools, a multitude of representations in varying forms, such as sound, text and pictures.

There is clear potential in considering how the benefits of the plurality of tools in sensemaking might influence the dynamics of collective creation of ideas. First, the plurality is probably manifested in increased speed and efficiency of this process, due to the increased flexibility and possibilities in communication, although it is not certain to what extent the multiplicity

results in trade-offs between different means of communication (e.g., replacement of face-to-face interaction with social media) or in an actual increase in dialogue among common people. On use of the Internet, Katz and Rice (2002) have found, from quantitative surveys, that Internet users tend to interact with others offline more than non-users do. Similarly, a time-diary study by Robinson, Kestnbaum, Neustadtl and Alvarez (2002) indicates that Internet users are slightly more active in family communication and home phone calls. On the other hand, another time-diary study, by Nie, Hillygus and Erbring (2002), suggests that time spent on the Internet reduces time in face-to-face interaction – each minute on the Internet correlated with a reduction of one third of a minute with family members.

As for integration of different types of representations, from numerous tools, this phenomenon probably occurs mainly such that the Internet complements the other tools. An individual may access sound, maps, pictures, statistics, text etc. with television and newspapers, but the World Wide Web provides better possibilities to seek material with the desired form of representation. For example, after reading an article in a physical newspaper, one may search the Web to see a picture of the phenomenon the article discusses. In other words, the Internet provides increased access not only to varying opinions and arguments but also to varying vantage points in terms of the form of representation (picture, sound and so on), which, in turn, promotes one's ability to make sense of a phenomenon.

Currently fully immersive virtual realities such as the CAVE environment seem unlikely to have much influence on the overall processes of evolution of ideas, because these technologies have not spread to common use. One purpose of my study, however, is to consider possible futures in which some of the present technologies have further evolved or proliferated. It is possible that the future will see the CAVE system, or some version of it, in common use. That 3D monitors and television sets have recently entered into common markets is one subtle development in this direction. One could expect the spread of CAVE to influence the evolution of shared ideas because evolution takes place as new and perhaps abstract issues become concrete for people, and the way in which people interact with these new issues, or otherwise experience them, could be new or fuller in virtual space. The effectiveness of CAVE-like virtual reality in this process would depend on the nature of the new phenomenon: some abstract and complex issues such as 'gene manipulation' or 'psychoanalysis' might not benefit from immersive virtual presentations, while capability to immerse oneself could be influential if the matter could in principle be objectified with a physical space. For example, being inside a virtual depiction of the European Parliament might concretise the European Union in a new manner for people.

Additionally, as the virtual-reality systems seem to offer means to represent things in a manner that provides a good sense of space and of physical objects, they also have potential to reduce the distinction between common people and scientists or other experts if perception of these features

is relevant for accessing an accurate view of a phenomenon. Virtual reality provides access to spaces that are inaccessible or that exist only in plans, the imagination or the comprehension of an expert. For example, in addition to 'going inside' architects' plans of hospital wards, it would in principle be possible to enter, say, a spaceship or a drum at a nuclear waste repository. It is worth noting, however, that if virtual-reality systems were widespread and in common use, these virtual worlds would not necessary be scientifically accurate. As any media may, they could serve as a means of advertisement or propaganda: a nuclear power company's virtual depiction of nuclear waste repositories could differ considerably from a presentation created by, say, Greenpeace. It is also worth emphasising that, as seen with the use of CAVE for presenting hospital wards, the usefulness of virtual reality depends on its capability of representing those features of the environment that are relevant for people in the real environment. This implies, for example, that if it is crucial that a new phenomenon be tasted or touched, as in the case of a novel food or a novel hand-held device, a virtual-reality presentation not being able to produce taste or haptic feedback (touch) might not assist in concretising an issue especially effectively.

Overall, digital communication technologies seem to promote sensemaking capabilities and, as a consequence, a quicker and more 'expert-like' process of development of ideas in varying ways: the Internet, including its powerful search engines, provides easy access to points of view on a phenomenon; the multiplicity of information tools aids in choosing the most convenient one for a given situation; and virtual reality makes it possible to be immersed in dynamic 3D presentations. The case of immersive virtual reality exemplifies the notion that technological progress is not at its end where enhancement of these capabilities is concerned. Currently, CAVE is costly and bulky so lacks potential as a feasible communication tool for common use. We are also far from combining elements of the flexibility of the Internet and the immersion of CAVE – that is, browsing through almost endless streams of information presented as immersive spaces, rooms or worlds (a vision that reflects the notion of 'cyberspace' formulated in science fiction). Yet technological progress may be heading in this direction, as concepts of a 3D Internet have already been established by scholars of telecommunications (Alpcan, Bauckhage, & Kotsovinos, 2007).

3.5.2 DISPERSION OF COMMUNICATION POWER STRUCTURES

As already noted, it seems plausible that the progress in communication technologies may result in change to power structures that stems from reduction in the resources an individual needs for widespread dissemination of messages. We have seen a historical shift in how different actors may induce social change as the Internet and mobile phones provide new opportunities to distribute and broadcast news content horizontally without

the traditional gate-keepers of mass communication: government- or business-influenced media (Castells, 2007).

While social movements and actors in alternative politics now have better opportunities to spread their points of view and act as a counter-force to corporate media and mainstream politics, the case of HDD boxes exemplifies that shifts in the power to communicate may also be manifested through the media use of non-activist common people that come about as a result of greater usability of technologies. This is to say that digital technologies influence power structures not only by enabling dissemination but also by creating avoidance of commercial (or political) messages. Common people's search for comfort through the use of new technologies may manifest itself in changes to underlying communication power structures: with the HDD, it is simply less effort to skip over the advertisements than to watch them. Political or ideological motives are thus not required. One may also note that the Internet brings forth similar phenomena by allowing free (but often illegal) download of advertising-free content, such as movies. Actually, the Internet is a contested sphere in this respect, as advertisements are embedded in numerous Web sites but they may be avoided with ad-blocking software (e.g., extensions to Web browsers that prevent advertisements from being downloaded and displayed). Some online content-providers, in turn, are sidestepping these measures by serving adverts from the same hostname as the provider of user-desired content.

Overall, phenomena are now discussed in a less centralised manner because the discourse of strong societal actors that permeate the conventional mass media can be contested in Internet networks and because there is a greater challenge than before in getting people exposed to advertisements. Who can initiate and be part of social change has been altered, and people's freedom to choose messages has been increased.

Worthy of note too is that the plurality of choices and ability to filter information also implies a possible diminution in power to create cultural unity with mass media. Societal fragmentation is possible if individuals decide to rely predominantly on news content supportive of their ideology (Sunstein, 2001). Contra this assumption, studies on browsing of political news online do not suggest that the Internet would create 'echo chambers' or 'cyber Balkanisation' – i.e., cutting off from dissenting opinions through non-exposure (Garrett, 2009; Kobayashi & Ikeda, 2009; Gentzkow & Shapiro, 2010). It is not yet clear, however, how this issue may unfold in less political domains, such as entertainment-driven television use. Increased freedom to choose does not necessarily encourage individuals to broaden their viewing habits from their normal fields of interest: those interested in sports might watch more sports shows, and those interested in nature might watch more programmes on nature. In contrast, watching conventional television encourages compromise, since some shows might be watched simply because they are broadcast at suitable times. Most likely this is not an issue for a majority because people rely on multiple sources of information and are

interested in a variety of issues, but for some HDD television or Internet-based watching of broadcastings might bring forth a more 'tunnelled' habit of media use. In other words, the increased freedom of choice might manifest itself as increased self-chosen ignorance of some areas of knowledge, which, in turn, might imply societal fragmentation due to a decline in shared representations among people.

One may additionally note that common person's increased sensemaking capability also has potential to alter the power structures of communication. As, in principle, any adept Internet user is a potential researcher, a common person now has better chances to contend with experts or those referring to expert knowledge. Science, or expert knowledge in general, typically involves multiple views and interpretations of a certain state of affairs, and it is arguably easier than before to argue with experts by seeking out opposing views from the Web. This, again, implies decentralisation of communication power structures: if a common person is potentially more 'expert' than before, access to expert knowledge is, or at least seems, less a rare commodity.

Somewhat counter to the decentralisation argument, however, it is notable that new technologies obviously serve only those who have access to them. For example, in Africa in 2010, only 9.6% of the population were Internet users (ITU, 2010). The term 'digital divide' is used to refer to unequal use of ICT due to differences in skills, motivation and/or resources (e.g., the devices needed and time available to use them) (van Dijk, 2005). According to Fuchs (2009), understanding the determinants of this divide is complex, as access to ICTs is shaped by interactions of socio-economic, political, cultural, social and technological factors. Fuchs does not expect drastic diminution in the digital divide globally, because one of the factors associated with that divide is income inequality, which has been on the rise. The fruits of technological progress are first collected by those wealthy, skilful and motivated enough to take the position of an early adopter. If the Internet of the future features, for example, immersive 3D spaces in common use, the common person's ability to take part in Internet discussions with these spaces would be compromised until doing so is made easy and inexpensive. Establishing a blog is easy today, thanks to blog services; similar services for dynamic 3D spaces would be needed to provide decentralisation of communication power in the possible future of a 3D Internet.

3.6 SUMMARY OF RESULTS

Explorations of some essential phenomena of digital communication technologies described above overlap considerably with the deductions I had established in the preliminary interpretations based on the historical reflection, these having to do with the multiplicity of viewpoints available and with decentralisation of power structures. The case studies, however,

shed more light on these issues by leading to interpretations for some of the consequences of the increased number of viewpoints – more efficient sensemaking – and concerning factors that lead to decentralisation in communication power, these being the common person's increased capabilities to attain expert perspectives and freedom in filtering of messages.

To summarise and directly address the first research question – of the way in which change in communication technology influences with the way in which common-sense ideas develop – my thesis suggests a changing structure in social creation of knowledge, of 1) increasing the number of alternative points of view available, 2) decentralising communication power structures and 3) increasing sensemaking capabilities. In view of the second research question – of the difference in the development of ideas when the current digital communication context is compared to that of analogue devices and the printing press – I argue that ideas in the former develop 1) more rapidly, 2) with greater resemblance to science and 3) with increased multivocality (or at least 'multisource-ness') 4a) and cohesion / shared awareness or 4b) lack of cohesion, depending on the situation or issue under consideration. Some of these arguments are more certain than others. Increasing possibilities, sensemaking capabilities, speed and decentralisation/multivocality seem reasonable suppositions in view of the case studies and the literature reviewed. In contrast, the idea of an increased 'scientific' element reflects features of technologies, the Web and its content, and the potential uses of virtual reality, but it is uncertain whether or to what extent people actualise this potential. The conditions in which greater possibilities and freedom of choice might manifest themselves as social cohesion or non-cohesion also remain uncertain. Below, I will discuss these insights further by contrasting them to two lines of social scientific enquiry: studies of social representations and of social effects of new digital media. In my discussion of the latter, I will also elaborate upon the possible consequences of the increased communication possibilities elicited by digital communication technologies and future avenues for enquiry.

4 IMPLICATIONS FOR SOCIAL REPRESENTATIONS

Since the theory of social representations explains the development of ideas, it is possible to address the second research question further by considering the processes described by the theory and the implications in view of the consequences of digital communication technologies. I will also discuss the theory more generally by considering its concepts, methods, and philosophy of science.

A first remark is that the basic mechanisms in the social representations theory – anchoring and objectifying – can operate more quickly because people are more efficient in making sense of phenomena, as indicated by the study on public understanding of future automated metro, and more capable of being in touch with each other. These notions complement the general observation that news circulates more quickly than before as stories break and disperse rapidly over the Internet (Pavlik, 2000). Overall, common-sense thinking develops more swiftly than before, as the world is now more filled with information, which is also made sense of more efficiently. It is not clear, however, how to interpret this in a cognitive sense – that is, whether people now manage more ideas than before or whether human thought is simply more fleeting in its focus, with new ideas quickly emerging and forgotten. Both of these interpretations probably have an element of truth.

Second, the theory of social representations assumes a distinction between a 'domesticated' reified and logical scientific sphere and 'wild' lay thinking, which relies on metaphors and other features of anchoring and objectifying, with a considerable number of new ideas and concepts adopted in the latter from the scientific or expert sphere (i.e., lay persons' knowledge develops through creation of lay versions of scientific knowledge) (Moscovici, 1981; 1984; Moscovici & Marková, 2000). This model is not immediately applicable for two reasons. First, as already discussed in the introduction of this study, the scientific sphere entails many of the same features as the lay sphere (Potter & Wetherell, 1987, pp. 146–155; McKinlay & Potter, 1987; Bangerter, 1995). Second, instead of two distinct spheres there are 'intermediary groups' in between; for example, mental-health professionals are an interface between common people and scientists in the field (Morant, 2006). Digital communication technologies imply further overlap between these spheres in the sense that common people might attain 'expert-like' or 'scientific' vantage points on phenomena – such as when being immersed to architects plans or while browsing (semi-)scientific websites. In other words, people not working as academics or other experts might have a greater chance to perceive and evaluate issues in terms of, say, precise measurements, scientific models, or expert imagination, instead of, for

example, simplifications and via reformulation in political or commercial propaganda.

Third, the digital networks imply changes to the way in which social representations are associated with groups. Typically, group-relatedness is emphasised, as in a definition proposed by Wagner and Hayes (2005, p. 122). In their prominent review of the theory, they suggest that '[i]deas should be considered social representations only if they are predominantly, but not necessarily entirely shared by the members of a group that is culturally distinct in a society'. This definition seems valid in the sense that 'private' ideas held only by single individuals or by small non-distinctive groups do not take part in the overall societal development of common-sense ideas. On the Internet, however, ideas may circulate without much regard for group boundaries and, in principle, can be influential without being predominantly shared by certain distinct groups. The possibility of performing Internet searches renders it more common than before that an individual accesses representations that are not typical for his or her usual ingroup and thus shares and develops ideas with individuals with whom he or she does not share group identity. On the other hand, digital communication technologies in particular allow representations that are shared by a distinct group but that are not public. For example, secret company memos or discourses in restricted online forums for distinct groups superficially adhere to the definition proposed by Wagner and Hayes and yet one may argue that representations of this type are not part of societal dynamics of human mentality unless, of course, they are disseminated in public discussion. Therefore, publicness and general distinctive sharedness of representations seem more relevant than group-relatedness when defining features of social representations are considered. As people nowadays are more networked across group boundaries, a group-related definition might unnecessarily restrict researchers who are willing to understand phenomena through the lens of the theory of social representations. Moreover, one may note the suggestion by Bauer and Gaskell (1999) that one who is studying social representations should specify appropriate segments of society and consider the groups that organise themselves in relation to the phenomenon under public consideration. Digital technologies have produced new relevant group types and generally changed the way in which groups are organised. Ideas are now discussed within online groups and through networks enabled by social media and physical distance is less relevant than before.

Fourth, if social representations are now elaborated distinctively over the Internet – even such that the Internet is the most efficient medium – one may argue that 'network' is a concept with relevant explicative power over the subject matter. The way in which new phenomena are attached to the existing mentality depends on the networks between people, while the ways in which these networks are formulated are more varied than before. This implies that, by creating and influencing networks, one may influence the development of shared ideas. In other words, in addition to considering how

certain discourses, metaphors, opinions and such are linked to societal actors, one should also consider the networks that enable the communication in which social phenomena are explored. Castells (2011) has created vocabulary for addressing 'network-making power' – that is, power to make and influence networks. In his suggestion of a *network theory of power* those establishing networks are called 'programmers', and those connecting different networks and ensuring co-operation between them are called 'switchers'. These programmers and switchers are social actors but not necessarily identified with one particular group or individual. Instead, they often operate at interfaces between social actors; that is, they are networks themselves. For example, a broadcasting company – not necessarily a unified social actor but an entity within which actors compete – can be considered a programmer since it establishes a process of communication and regulates rules of this process. Programmers display gate-keeping power in particular by blocking messages or societal actors not in line with their aims or values. I would suggest the two following examples: Apple is not solely a technology provider; it is also a cultural gate-keeper – in 2009, it rejected an iPhone application by industrial rock band Nine Inch Nails for reasons of 'objectionable content' (Matyszczyk, 2009). For similar reasons, Facebook has banned pictures of breast-feeding mothers, although recently the ban was lifted (Belkin, 2011). More generally, in an authoritarian society, a state-owned broadcasting company is likely to block the political opposition. Another form of networking-making power of programmers that is noted by Castells is creation of efficient flow of communication. For instance, an online discussion forum may be established for like-minded individuals or in academic circles a new journal may be established in order to promote a certain branch of science. An example of a switcher, in turn, is Rupert Murdoch and the media conglomerate NewsCorp, which he steers. As already noted, NewsCorp seems to promote politicians who reciprocally promote media deregulation; that is, NewsCorp is capable of aligning political networks and media networks for serving business purposes (Arsenault & Castells, 2008). Moreover, in the vocabulary suggested by Castells, 'metaprogramming' refers to influencing the underlying rules or ways in which networks may connect with each other. This can be accomplished by influencing legislation. For example, connections between corporate business and the political system may be influenced by regulation of campaigning finances. Indeed, Castells emphasises that metaprogramming is a means of resisting dominating power structures. Additionally, the digital television transition in Finland resulted as a certain type of a metaprogramming of networks. Converter boxes integrated with hard disk drives offered common people easier means of gate-keeping which, according to my interviews, they willingly applied to block commercial messages. Commercial networks now have less access to influence people in Finland. Overall, processes of social representations are, in principle, not solely immediately attached to the values and goals of social actors and the public who develop phenomena;

they are linked also indirectly to the aims and values of switchers, programmers and metaprogrammers influencing the overall flow of communication.

Fifth, as mainstream media have lost or at least shared some of their communication power, the mechanisms via which alternative online groups or actors take over by gaining voice and public attention should be considered. As stated earlier, new phenomena plunge into common knowledge through the processes of anchoring and objectifying, which reflect existing metaphors, values, groupings and taboos rather than scientific facts. Anchoring and objectification processes are thus explicable by both encouraging (e.g., discourse that reaffirms group identity) and discouraging factors (e.g., taboos). In consequence, a phenomenon can be related to potential anchoring and objectifying processes that are 'bubbling under the surface' but remain largely non-actualised because mainstream media are unwilling to address taboos – professional journalists do not aspire to risk their credibility or career. The new multi-voiced digital communication sphere, however, is likely to feature fair numbers of writers not deterred by social prohibitions. Typically, blog-writing is not a profession and can be done anonymously; i.e., compromising one's career is less of an issue. Additionally, amidst multiple voices, bloggers and such might seek attention more aggressively than does a professional journalist writing or broadcasting from platforms with a more established audience. Breaking taboos is a means to gain attention. When considerable numbers of people access, participate in and agree with the taboo-breaking discourse, which can be done easily online, the social prohibitions might lose their strength: people have been found to infer group norms from the behaviour of typical group members (Reicher, 1984). Online forums or blogs can be fertile settings for the change in norms: Ristolainen, Hankonen and Lehtinen (2007) have inferred that in online discussions group identities are especially salient due to known social psychological mechanisms associated with anonymity – as one does not need to express an individual identity, the group (and its norms) becomes more important. On the other hand, socially acceptable presentation of self is less important than usually; for example, anonymous taboo related discussions on the Internet feature negative blaming that would be unlikely in ordinary face-to-face interaction (Kokkonen, 2009). All these social mechanisms together suggest attractive hubs of taboo breaking interaction. Further, as arguments in social media gain sufficient attention in public, mainstream media are likely to steer their attention eventually to the proposed discourse, which serves to expand public knowledge of the discourse further. Three phases, which overlap, may be identified, therefore: 1) an issue bubbling under the surface, 2) diminution of social prohibitions in online discussions and 3) proliferation to mainstream media. For example, in Finland, bloggers criticising immigrants and immigration policies have recently gained public attention. There has been an issue bubbling under the surface, related to both encouraging and inhibiting social determinants: criticising immigrants

may elicit satisfying feelings of being better among some Finns – through downward social comparison (Gibbons & Gerrard, 1989) – but it may also be readily associated with racism or Nazism. A leading figure, Jussi Halla-aho, has gradually progressed from blogger to generally known pundit and politician. In 2008, he was considered an intellectual nonconformist by the leading Finnish newspaper, *Helsingin Sanomat* (Luukka, 2008), and in 2011 he was elected to the parliament by a landslide with the agenda critical of immigration. One may assume that if a certain cultural context both prohibits and encourages certain processes of anchoring and objectifying, the relative significance of the prohibiting forces is less on account of the Internet. That is, taboos and other inhibiting social factors are less efficient deterrents than before in the development of shared ideas.

Overall, the communication context of digital communication technologies implies methodological challenges to studying social representations. Where media analysis is concerned, this is more difficult to do comprehensively than before, because of today's plurality of forms and sources of media. In other words, if the aim is to understand the overall field of relevant discourses, exploring certain discourses in mainstream media – such as print media or television – is insufficient, because alternative online discourses can be influential. Identifying and exploring relevant Internet actors, such as influential Web sites or bloggers, is to be encouraged. As people now have increased liberty in filtering and selecting the messages through which they are influenced, it is also more pertinent than before to examine media use habits. In contrast, socio-cultural inferences based on comparison of different regions or nations are more problematic than before, as global information networks complement geographically defined determinants such as national television broadcasts, local newspapers and daily face-to-face interaction. Moreover, in this methodologically more challenging and uncertain situation, the mixed-method design used in the study of the future automated metro – exploration of whether media arguments are acknowledged and agreed upon – is arguably welcome: the relevance and impact of the media arguments found are measured rather than assumed.

Finally, it is noteworthy that, although my study has implications for issues elucidated via the theory of social representations, it does not immediately fit into what could be considered the paradigm of social representations. Wagner et al. (1999), for instance, claim that social representations researchers study talk and action related to a social phenomenon or object. Broadly, this has been done also in my case studies, as almost all of their talk and action, in fact, is related to a social object in the sense that the subjective reality is socially constructed. In practice, however, social representations scholars typically focus on a specific social object, 'the social representation of X', under public consideration. This was done in only one of the case studies. In my view, the theory of social representations predominantly provides a plausible description of connections among

society, communication and thinking and should not be considered a line of study that mostly concentrates on examination of public elaboration or understandings of different social objects. Somewhat in line with this, Wagner (1996) criticises the above-mentioned formulation often used in titles of studies ('social representations of X') because social representations are not features of 'object X' but inseparable from the people who live and reproduce them. That is, people's life worlds and the processes of social construction should be kept in the focus of consideration. Additionally, as discussed above in relation to the philosophy of science in the theory of social representation, as proposed by Marková (2008), research should be epistemologically flexible. In other words, connections among society, media, communication and thinking should be explored with any means possible – for example, through a focus on changing features of communication as done in this study – and not only through work concentrating on specific social objects, the latter seeming to be the most common method in current studies of social representations. While social representations scholars address the issue of socially constructed common knowledge flexibly, with a wide variety of methods, a weak point of this branch of study today might be found in a paradigmatic and restricted concentration of those 'social representations of X'. To complement studies of this type, a productive approach might be to explore 'X of social representations' where 'X' refers to broad tendencies in features of communication. The 'digitalisation of social representations' is one such tendency: the communicated content of social representations is increasingly presented on digital platforms. Another that could be considered might be 'polarisation of representations', such as during the 'War on Terror' and similar phenomena, as in the declaration by US President George W. Bush in 2001 that '[e]ither you are with us, or you are with the terrorists' (The White House, 2001).

In sum, considering the current digital communication technology context entails a handful of implications that are relevant for the theory of social representations. These suggestions have to do with the processes of social representations (possibly taking place more swiftly, with less of a gap between the scientific and lay sphere and more often over physical distances than before), the concepts with which they are understood (with less emphasis on strict attachment to 'distinctive' social groups in the definition of social representations and perhaps with consideration of the way in which different networks, digital and others, are organised), and how they are studied (with attention to a more varied set of social actors and media sources).

5 POSSIBLE FUTURES AND AVENUES FOR STUDY

Increasing sensemaking capabilities and decentralisation of communication power structures can be considered trends. Both are spreading on a global scale as current technologies gain more use and users. Sensemaking capabilities also develop in tandem with communication technology as new innovations provide new vantage points and possibilities for people. Overall, considering these trends is useful for inferring possible futures alongside other trends, such as urbanisation or population ageing. In the discussion that follows, I will discuss possible outcomes associated with digital communication technologies. In doing so, I will also review some of the main issues related to new digital communication technologies – my study has introduced a few issues to this general discussion. Some of the interpretations made are elaborated upon further but at the same time challenged, through contrasts to the ongoing social scientific discussion of social consequences of digital communication technologies. In reflecting on the possible outcomes associated with increasing media and sensemaking possibilities as well as with the change in communication power structures, I further address the second research question although the consequences considered, while closely related to the issue of development of shared ideas, extend somewhat beyond it: democracy, 'human intellect' (i.e., sensemaking capabilities and the quality of information), societal unity and sociability are discussed.

A current issue directly related to dissolution of communication power is whether or not the Internet and other new communication technologies may help to bring down or shake distinctly authoritarian or corrupt governments. The influence of new media on the recent 'Arab Spring' developments has recently been analysed in communication research literature. Wilson and Dunn (2011) have analysed survey data according to which social media use was not dominant in relation to the demonstrations in Egypt – overall, Facebook and the like were the third most significant media type, after the phone and face-to-face interaction – while Twitter and Facebook were deemed to be the most motivating sources and did play an important role in connecting protesters. Eltantawy and Wiest (2011) have analysed a variety of media sources originating inside and outside Egypt, including published news reports and messages posted via social media such as Facebook, Twitter and (other) blogs. They argue that social media played an instrumental role in the success of the Egyptian anti-government protests. Overall, Allagui and Kuebler (2011), editors of a special issue on the subject, note that more time and research into the events is needed but it also seems certain that popular depictions such as 'the Facebook revolution' or 'the Twitter revolution' overestimate the influence of new media – underlying reasons for the

popular uprisings have been corruption, humiliation and deprivation, 'toxic' dysfunction of the state. It is uncertain whether new communication technologies bring about political reform in countries where toxicity is less salient but where there nevertheless exists relatively limited or partial democracy. Future political reform is an open question in, for example, Russia, which has been depicted as a 'hybrid' regime, between authoritarian and democratic rule, on account of curtailment of media and other civil liberties (Kekic, 2007). In 2008, about 25% of Russians used the Internet daily or several times a week (Levada Center, 2008, p. 100). Even if this number rises in the future, political reform by means of the Internet might be restricted through the inhibiting policies of the Russian government. According to Castells (2009, p. 247), these policies include, first, laws that allow surveillance of the Internet and their enforcement for the purpose of spreading intimidation, as in a case wherein a law against anti-Semitic content was applied for the purpose of arresting an individual who had criticised the police online. Second, Internet service providers and webmasters are recruited to surveillance activities, as they are deemed responsible for punishable content on their Web sites. Third, state-owned companies have bought popular Web sites in order to ensure that their managers keep political matters under control. An example is Gazprom media buying RuTube, the popular Russian equivalent of YouTube. Indeed, in addition to liberating people, digitalisation entails a counter-phenomenon. Ball, Lyon, Wood, Norris and Raab (2006) argue that all rich countries of the world have in place a complex infrastructure for gathering and processing personal data. Our behaviour is pervasively monitored with, for instance, CCTV cameras and via credit and loyalty cards. Constant monitoring can be detrimental also in countries that are typically considered democratic, such as when civil rights have been compromised in the United States during wars and the 'War on Terror' (Ball et al., 2006, p. 3).

In this study, I have argued that digital communication technologies allow 'expert-like' or 'scientific' vantage points on phenomena alongside efficient sensemaking capability. This implies a sort of 'augmentation of human intellect' – that is, drawing a definition from Engelbart's (1962, p. 1) visions of what technology should offer to people, more rapid and better comprehension of reality. Rapidity seems plausible at least when accessing of multiple vantage points and arguments is considered. When it comes to 'better', this issue has been supported by studies on 'collective intelligence' (MIT Center for Collective Intelligence, n.d.), which measure group performance and strive to support innovation of 'Wikipedias and Googles' of the future. They have demonstrated, for instance, that humans together with computer models make better probability predictions than computer 'agents' or humans alone (Nagar & Malone, 2011). When the issue is conceived in terms of shared knowledge content within a society, however, counter-arguments should be considered. Keen (2008) argues that much of the content online is produced by amateurs, in contrast to expert journalists as in

traditional media, and thus the Internet spawns misinformation or trivial non-information. In other words, without expert gate-keepers, the quality of knowledge degrades. He, for example, considers ideas circulating online that call into question the official truth concerning the 9/11 terrorist attacks to reflect the Internet's misinforming nature (pp. 68–70). Dutton (2009), on the other hand, notes that, although there is some validity in Keen's concerns – the non-journalist-based online content entails both valuable information and misinformation – the problem should not be exaggerated. This is because he assumes that the amateur-produced content does not substitute for but complements the traditional media: many Internet users read online newspapers or news-service material. Dutton also argues that many online sources, such as bloggers, may provide valuable independent and competing alternative to the traditional media. He illustrates this with the example of Salam Pax, the 'Baghdad Blogger', who presented a local Iraqi perspective on the war in Iraq and thus possibly helped to change the media agenda on the war. Remarks by Keen and Dutton contain and give rise to valuable insights, but it is also problematic to argue that the online content either improves or worsens the overall quality of information by citing anecdotal examples of the content itself. This is because whether content is considered misinformation or valuable competitive information depends on the worldview and beliefs of the one who considers it. For example, those who doubt the official truth on 9/11, 29% in a global survey (WorldPublicOpinion.org, 2008), might regard controversial ideas circulating online as valuable alternative insights while some might consider Pax's blog to be biased propaganda understating achievements of the US military. It is then, in principle, better to explore whether or not new technologies enable and inspire people to acquire expert perspective on issues. This too might be problematic, however, because of challenges in determining which perspective or sensemaking practice reflects an expert or scientific approach. On the other hand, even though it might be determined, say, that Internet users rely more on scientific literature than do non-users – an issue that future studies could address – it is not clear that amateurs infer and use this information in as socially responsible or productive a manner as journalists. For example, properly collected statistics might indicate that some minority groups exhibit higher than average crime rates while it is not certain whether disseminating this information widely is beneficial to society or not – depicting a minority group as criminals might weaken employment possibilities and worsen the situation. This description reflects the already mentioned political situation in Finland in which blog-writers put the issue of immigration policy on the political and media agenda and in some cases put themselves in Parliament by coupling anti-immigrant rhetoric with statistics of this type. An additional counter-argument cited to claims of 'better comprehension of reality' refers to new learning being inhibited in consequence of increased possibility of self-chosen ignorance or 'tunnelled'

media viewing, which might result from easier-than-before access to media content corresponding to the individual's existing interests.

Whether the expansion of the possibility space brought by new technologies, especially the Internet, brings about social unity or stratification is a matter of debate. First, it has been assumed that the Internet universalises culture globally, as suggested by McLuhan's (1964/1994) well-known concept of the Global Village. It implies an increased sharedness of ideas irrespective of physical distance. This influence of communication technologies may be defined as an increased likelihood that physically distinct individuals comprehend a certain phenomenon in a relatively similar manner. This arguably holds true particularly where awareness of characteristics of phenomena within areas that share a common language is concerned, such as within Spanish- or English-speaking worlds. Beneath this layer of increased global sharedness, however, there may remain divisions along which attitudes toward phenomena are increasingly differentiated irrespective of physical distances. As argued earlier, the increased freedom of choice and the vast amount of content now available may lead people to choose to access mainly that news content supporting their ideology (Sunstein, 2001), yet empirical studies do not support the view that 'echo chambering' or 'cyber Balkanisation' would take place through non-exposure to ideologically opposite content (Garrett, 2009; Kobayashi & Ikeda, 2009; Gentzkow & Shapiro, 2010). However, the latter studies, based on surveys and tracking of browsing behaviour, do not expose the plausible phenomenon that within online communities negative or suspicious attitudes toward opposing ideologies are formulated in reciprocal discussions. In other words, in a world of practically endless news sources, stratification might take place through suspicious attitudes toward certain sources. For example, mainstream media might be considered biased while alternative sources, such as blogs and discussions forums, might be viewed as truth-bearers, and, indeed, it has been found that conspiracy theorists hold a radical view of the mainstream media as a servant of dominant power structures (Ballinger, 2011, pp. 63–73). Therefore, more empirical studies of cyber Balkanisation, with more varied methods, are needed.

Another relevant issue is whether new communication technologies elicit social alienation or increased positive sociability. One may view this question from several angles. First, one may consider whether technologically mediated interaction alienates people from the usual non-virtual exchange. While there is no real evidence of this (as noted earlier, Internet use has been found to be associated with both increased (Katz & Rice, 2002; Robinson et al., 2002) and decreased (Nie et al., 2002) social interaction beyond the Internet), absence of a general association with reduced face-to-face interaction does not mean that some individuals do not use the Internet excessively. This phenomenon has usually been described as 'Internet addiction' (Byun et al., 2009) and as having at least three subtypes of excessive behaviour: 1) gaming, 2) sexual preoccupations and 3) messaging

(Block, 2007 as cited in Block, 2008). While currently no clear definition seems to exist (Byun et al., 2009), it may be considered to include excessive use (often alongside with a loss of sense of time and a neglect of basic needs), negative feelings when a computer is inaccessible, and other negative consequences, such as, lying, social isolation and fatigue (Block, 2007 as cited in Block, 2008; Beard & Wolf, 2001). There is still no definitive knowledge of the prevalence of Internet addiction, on account of problems in sampling and operationalisation (Byun et al., 2009), but, for example, 1.2% in a UK-based study (Morrison & Gore, 2010) and 2.1% of a South Korean sample (Choi, 2007 as cited in Block, 2008) have been considered to meet criteria for addiction. Conversely, Fuchs (2008, p. 251) argues that Internet addiction is a misnomer, as it conveys a sense of the technology itself being addictive. Instead, he adds, so-called Internet addicts are not addicted to the Internet itself but eager to communicate with others and to establish social ties over the Internet. Internet addiction has been found to be associated at least with depression (Morrison & Gore, 2010). While current studies of the subject do not address causality and consider correlation only (Byun et al., 2009), it would seem plausible that individuals who feel alienated are prone to seek interactions and feelings of connectedness over the Internet. It should be noted that the Internet may foster positive social interaction and positive feelings in general. Mitchell, Vella-Brodrick and Klein (2010) have reviewed studies of online positive psychology interventions (interventions that promote intentional cognitive and behavioural activities, such as practising gratitude, performing acts of kindness, processing positive life experiences, engaging in mindfulness and setting goals) and conclude that the indications are promising: three of the five studies demonstrated increases in well-being and reduction in depression. Preece (1999) has found that interactions in online support groups are empathetic, as most of the postings reflected either emphatic discourse (45%) or personal narratives (32%). Additionally, according to findings by Tidwell and Walther (2002), people make more intimate self-disclosures in online communication than face to face. In sum, mediated interaction may thus entail both alienation and supportive social exchange. In line with this, Fuchs (2008) argues that the matter of alienation depends on the type of online interaction: 'cyberlove', 'a romantic relationship consisting mainly of computer-mediated communication' (Ben-Ze'ev, 2004, p. 4), is an example of positive and beneficial cyberculture, while 'cyber-bullying' – instilling fear and emotional distress, threatening or causing damage in social processes online (Bocij, 2003) – exemplifies alienating cyberculture.

Overall, one may distinguish four dichotomies associated with technological changes in communication power and in communication and sensemaking capabilities. These are presented as positive and negative futures in Table 3, which perhaps reflect some of the main research questions related to the new digital media. Some of the labels in the table are self-evident or have already been mentioned, while others might need explication. First,

Table 3. *Possible outcomes associated with digital communication technologies*

Factor influenced	Positive futures	Negative futures
Democracy	*Digitally assisted democratisation* Political reform in countries with corrupt or undemocratic governments with the aid of common persons' increased communication power.	*Big Brother* Ubiquitous and authoritarian digital surveillance of citizens.
Human intellect	*1. Increased sensemaking capability* Rapid access to different opinions, arguments, and forms of presentation. *2. Zeitgeist utopia* Scientific and researcher-style approaches to making sense of the world among common people.	*1. The Cult of the Amateur* Lower quality of knowledge in the absence of expert journalist gate-keepers. *2. Tunnelled use of media* Lack of novelty in information, due to easy access to content corresponding with existing interests.
Societal unity	*Global Village* Global unity due to increased shared awareness of phenomena.	*Cyber Balkanisation* Societal fragmentation in a given geographical area through online reference groups.
Sociability	*Supportive cyberculture* Positive social exchange over digital networks.	*The Matrix* Lack of positive interaction with relevant others, due to excessive computer use.

'Big Brother' is a reference to George Orwell's famous novel *Nineteen Eighty-Four*, in which people are under almost complete surveillance by the authorities. Second, 'Zeitgeist utopia' refers to the Zeitgeist Movement's (n.d.) view of the desired future in which the scientific method is ubiquitous and replaces the financial or money-based approach to the problems of the world. Third, the 'Cult of the Amateur' is derived from the title of the book by Keen discussed above (2008), according to which the Internet reduces the quality of news content. Fourth, the science-fiction film *The Matrix* depicts total alienation from reality: the life-world that humans think they are experiencing is actually a computer simulation while in physical reality humans serve as sources of bioelectrical energy for intelligent machines. The Matrix entails elements of addiction as the choice between pleasant simulation and truth is not evident, some characters preferring the illusion. These possible outcomes can be considered utopias and dystopias if they are manifested in full or as 'pure forms'. They are more likely, however, to manifest themselves partially within societies and even within individuals: an

individual can be a political online activist foraging for scientific knowledge one day and an alienated viewer of irrelevant online videos on another.

More research would be needed to explore the extent of these issues and the conditions in which they arise, as well as their consequences. Both empirical and conceptual clarifications are necessary. Arguably, however, whether digital technologies have positive or negative impact on society depends on how technologies are used and on what kinds of new technologies are designed in the future while more knowledge would be useful when these issues are discussed. Despite there being only partial evidence concerning several issues, my overall view is that the proliferation and development of digital communication technologies convey predominantly positive effects – there is lack of scientific evidence regarding the existence or emergence of the negative elements in a widespread manner and the positive aspects seem to outweigh the negative ones. Although it seems plausible that addiction and alienation affect many people, it is not certain to what extent they are caused by the Internet or to what extent the Internet is actually a cure – that is, a means to avoid alienation. Governmental big brothers certainly monitor Internet activity to a degree but communicating on the Web is also a means to promote democracy. More generally, although people can feel social pressure to apply certain devices or online services, such as, mobile phones and social media, digital communication technologies also assist people enormously in work life and in other daily activities and supposedly this is the prime reason why these inventions are used in a widespread manner. New communication technologies provide efficiency and new beneficial ways of presenting as illustrated by my case studies. Taken on the whole, this implies that it is justified to narrow the digital divide and hence to address also this issue in future studies.

In line with the systemic and holistic philosophy of science advocated in this study, the phenomena noted here should be considered as evolving and interrelated and should be explored without discipline-aligned or epistemological restrictions. In principle, then, it does not suffice to explore cyber Balkanisation *per se* so much as the interrelations between, say, the Matrix, the Cult of the Amateur, Balkanisation and the horrendous combination of them all. Though not too many conclusions should be drawn from actions of a single deviant individual, one may note that Anders Behring Breivik, the perpetrator of the massacre in Norway on 22 July 2011, displayed all of these elements: he states that he 'took a year off' (Breivik 2011, p. 1408) to play an online computer game and that he relies on online sources rather than the mainstream media, which he considers a source of multicultural propaganda (e.g., p. 372), while the acts of violence themselves and the overall polar anti-Muslim ideology expressed throughout Breivik's 'manifesto', which he distributed online upon making the attacks, reflect Balkanisation. If nothing else, the case of Breivik exemplifies that it does not suffice to pinpoint averages with quantitative methods but it is also necessary

to explore whether or not some individuals adopt norms and practices that differ drastically and dangerously from the mainstream through the possibilities provided by digital communication technologies.

It need not be stated that there are other, related social scientific issues to consider in addition to those noted here – the review above, which is summarised in Table 3, covers only the main issues related to the consequences of the overall plurality of media sources and communication and sensemaking possibilities. For example, another question distinctive of communication technology and social sciences, related more to features of specific services than to the overall plurality, is that of privacy and its management with social media services such as Facebook (e.g., Lampinen, Lehtinen, Lehmuskallio, & Tamminen, 2011).

To conclude, it is safe to say that a multidisciplinary research approach is needed to address the open questions relating to social influences of communication technologies. My case studies along with the discussion on social representations feature findings and suggestions that, to the best of my knowledge, entail novelty in this broad field of inquiry. Some of the insights introduced still require empirical exploration these involving increased elements of 'science' and 'expertness' in the development of the human mentality as well as questions regarding online groups, networks and Web-based alternative media in social representations along with the possible threat of 'tunnelled' media viewing habits.

5.1 WEAKNESSES AND LIMITATIONS

I hope to have formulated a plausible and rich description of some general outlines of the influence of communication technology's evolution on social evolution, contributing to the basic research of communication studies and social psychology. On one hand, my study has contributed to the broad field of study on social effects of communication technologies within social sciences but at the same time, it is pertinent that the theory of social representations was discussed from the perspective of change in communication technology. Since the theory considers fundamental issues related to communication and the human mentality, these issues should be contrasted to an essential change in the context of communication. Admittedly, however, my study has its weaknesses and limitations. First, my research questions were especially broad while my case studies explored only some aspects related to the questions, these being, sensemaking capability and dissolving power structures. Dissemination of messages on digital networks remains unexplored by the case studies with the focus having been on sensemaking and filtering. The Internet was explored very generally – through comparison of the impact of the Web with that of other sources of information – though the Internet actually entails differing relevant

phenomena; social media in particular could have been explored empirically to understand why and how some ideas quickly become viral on digital networks. On the other hand, the case study on the Web was the only one that explored associations between media use habits and people's knowledge base on a societally shared idea. For example, my argument on the effect of the hard-disk-drive-based television watching would have been much stronger if I could have more decisively demonstrate that in comparison to non-users the users of HDD converter boxes feature different understandings regarding issues propagated by advertisers. Additionally, despite the scenarios presented in Table 3, the futurologist aspect of communication technology's evolution was explored only narrowly, with examples, rather than comprehensively, where possibly influential technologies of the future are concerned: there are many in addition to CAVE-like immersive virtual reality and 3d Internet, and the use of CAVE itself might not proliferate in the near future, on account of the great cost of its infrastructure.

Overall, a study programme would be needed for genuinely comprehensive understanding of the effects of the technologically evolving communication context on the development of shared ideas as it is conceptualised by the theory of social representations. By addressing the research questions in Table 3, the research programme proposed, which I shall sketch in brief, would address important real-world issues. It would include at least three types of studies.

5.2 SUGGESTION FOR A RESEARCH PROGRAMME

First, to address the questions of Balkanisation and societal fragmentation, one may imagine studies in line with typical social representation studies – that is, studies addressing 'social representation of X' where 'X' refers to issues that divide opinions within a given society. In Finland, some of the issues that currently divide people might be integration with the European Union and immigration. In other countries, such as the United States, questions currently associated with societal division might include abortion and the Occupy movement (along with related questions of economic inequality). Panels of experts, such as social-science scholars and journalists, could be consulted for identification of the societal issues that might mobilise and divide people. The research programme would explore causes and threats related to these disagreements within a society. Where possibly contributing factors are concerned, the Web and the plurality of information sources would be addressed in particular. It would be explored whether those with differing views also display differing media-use habits and attitudes toward various media sources. Hence, the aim would be to identify 'chambered' online groups or clusters of interactions wherein shared opinions are strengthened and in which negative or suspicious attitudes

toward media sources that present opposing opinions are expressed. Finding distinct clusters of this type would be an indication of overall societal fragmentation – that is, existence of factions that do not engage in proper reciprocal dialogue within a society in relation to certain issues. Further, it should be explored whether this possible fragmentation is associated with undemocratic means of influence and hostility toward those with differing opinions in terms of discourse and action – needless to say, if hostile groups are found, even if only in terms of rhetoric and language, threat of societal violence exists. The threat of political or ideological terrorism renders it necessary also to identify fringe groups as well as reasons as to why certain individuals adopt the ideas of deviant groups (on the Web) in addition to identifying broad societal fragmentation lines.

Secondly, the processes of social representations should be explored at the meta level; that is, the network structures that enable or inhibit communication should be explored, in a manner somewhat similar to that employed in my study of HDD-based television-watching. This, indeed, reflects the suggestion of Castells (2011) on attempts to formulate a network theory of power. By exploring the power to communicate and to influence flows of communication, one may, in principle, identify undemocratic distributions of communication power. Arguably, if relatively few individuals influence who is able to communicate what to whom, the society lacks democratic communication; new communication technologies should enable democratic dialogue.

We may note that studies of the types described above are linked to the questions of 'digitally assisted democratisation' and 'cyber-Balkanisation' (see Table 3). It is worth noting, however, that these phenomena are somewhat similar: both imply deviations from mainstream media communication – that is, communication that is not in line with the aims and values of the government and the most influential media outlets. The difference is that Balkanisation reflects lack of dialogue with others that results from negative attitudes or is due to lack of exposure to the media distributing opposing views. A researcher should be aware of her or his own ideological views when considering which non-mainstream (online) discussions reflect dangerous fringe groups and Balkanisation or increased democracy. More generally, clear-cut labels might not be fitting. One can again consider the current political situation in Finland. The immigration-criticising discourse that has circulated on the Web might entail certain elements of both democratisation and Balkanisation: while, on one hand, the discussion might be hostile, it seems, on the other hand, that there has been public demand for talk about the immigration policy, which was not initially fulfilled by the mainstream media.

The studies of social representations and of communication power would be closely interrelated. The communication power that new technologies or online platforms provide could be explored somewhat similarly but in a more refined manner, as employed in my study of the proposed automated metro:

the way in which certain online services or sources are associated with people's views could be measured. For example, those who actively read certain blogs might exhibit attitudes and views that diverge from those of people not reading them. With studies of this type, which would explore the impact of different media forms and sources, one could also explore the questions of increased efficiency and researcher-style approaches related to digital technologies. Some sort of survey instruments could be developed for exploring the extent to which people's views resemble or draw from the views of science – associations between this metric and media-use habits would be studied, or the use of (semi-)scientific sources could be one of the media-use habits examined. In studies exploring the elements of science in lay thinking, the social object under examination would not need to be an issue that divides society; it might be a scientific idea or a new technology. Often these issues overlap, however; politically activating issues are typically related to (social) scientific claims while views on new technologies or scientific ideas may be related to political or ideological notions.

The third type of studies in the study programme would include qualitative studies of the use of novel communication technologies. Some of these could be theoretically driven (re)interpretations of existing studies typically labelled as human–computer-interaction or computer-supported co-operative work studies. Interaction with communication technologies would be viewed with consideration of societal consequences. This is to say that it would be inferred what consequences the mechanisms found may have (in communication and sensemaking) if these mechanisms were present not only in the study contexts but also commonly. This approach reflects my interpretation of the studies related to the rally control centre and virtual reality. Interpretations of this type would allow hypothesis creation and new vantage points on the consequences of technological development, of the sort employed when it was suggested that virtual reality has potential to bring lay thinking closer to scientific knowledge. These insights would be derived from qualitative studies in particular, since they are to reveal aspects of phenomena in a less restricted manner. Insights of this type might then be considered when people's views are examined statistically. For instance, reflecting my interviews on HDD-based television-watching, a questionnaire item might measure the use of this new technology – its correlation with people's views could then be measured. Additionally, new research questions might arise; there may be many related socially relevant issues in addition to those presented in Table 3.

In line with the discussion above, the proposed research programme would employ a mixed-methods approach. It would entail qualitative studies for identifying 1) different practices in use of communication technologies and media, 2) media discourses, and 3) types of attitudes toward media sources. These qualitative findings would then be used in formulation of questionnaire items. This would allow exploring how these media-use practices, media contents and attitudes may be associated with opinions and

knowledge content. Social network analysis could also be applied, to identify the relevant hubs of interaction and to describe the general online discussion of the issue under examination. The central sources of certain discourses could then be analysed in detail – if the question of Balkanisation were addressed, a central issue under investigation in these analyses would be the possible hostility in the content of communication. If, in turn, the assumption of increased element of science in lay sensemaking were addressed, a central issue under investigation would be the use of scientific sources and notions. The selection of methods could follow these suggestions in broad terms, although many others can be imagined.

Overall, in contrast to the many socially relevant issues related to the research questions of my work, the case studies have provided only a set of vantage points. A non-conflicted, dialogical and informed society should be one of the main goals of social sciences, and these issues are related to how a society communicates and makes sense of phenomena, which, in turn, is associated with the communication networks and technologies enabling these networks. Therefore, a research programme at the intersection of social representations, communication and new-media studies might be beneficial.

6 CONCLUSIONS: THE CHANGE IN COMMUNICATION TECHNOLOGY AND SOCIAL SCIENTIFIC THEORY

The social consequences of the evolution of communication technology are varied, and technological change hence opens various new and relevant avenues of research for social scientists. This study entails a range of arguments related to this change, while the overall theoretical notion in my work is that the technologically evolving communication context may elicit reconsideration of social scientific theories. It is commonly thought that social scientific theories are contextual – i.e., not applicable in every society but relevant in specific societal contexts. For example, a central idea of the theory of social representations is that lay thinking develops through reformulation of scientific ideas, but this describes contemporary societies and those of the recent past rather than all societies that have existed through time (Moscovici, 1984). One may argue, therefore, that the technological change in communication is so varied, ubiquitous and profound that some social scientific conceptualisations or presumptions might become outdated. In principle, then, applying social scientific theories and concepts without regard for the technological change is somewhat dubious, in an echo of the questionable approach of applying concepts and theories describing Western European or North American societies for understanding, say, indigenous people in Lapland or South America. More simply put, the world is changing rapidly, and social scientists must keep up with this change, so one should also consider carefully how to do so. As noted earlier, several ways of doing this are possible. First, one may apply theories that address or are inspired by recently developed communication technologies. Second, we may consider the existing theories and perform conceptual or other reconsideration related to technological change if necessary. Two approaches – discovery and reform – are possible for 'adjusting' social sciences to technological change. The former attempts to invent or apply theories that are suitable for the current technological situation, while the latter strives to consider whether or not the existing theories are affected by the technological change.

The present work has demonstrated the reformist approach, as it has strived to enhance the theory of social representations. Newer digital communication technologies have brought with them subtle implications for social representations. Most importantly, the way in which groups are considered under the existing theory seems problematic and restrictive because of the current possibilities of networking and communication across group lines. In addition, the theory has been synthesised with other existing theories, these being the 'network theory of power' (Castells, 2011) and the

idea of 'technogenesis' (Hansen, 2006; Stiegler, 2009), although the latter was reconceptualised as 'technologically evolving communication context' for increased conceptual preciseness and to emphasise that technological mediation is an evolving process. All in all, the reformist approach may manifest itself in two forms: *criticism* of an existing theory and *synthesis* of an existing theory with other theories.

The network theory of power in itself seems to be an example of proposing a theory that corresponds with the existing technological setting. Castells (2011, p. 1) introduces the theory by stating that '[p]ower in the network society is exercised through networks'. Thus he grounds the theory in the notion that people currently are connecting with ICT. In addition to inventing a new theory, however, scholars sometimes reintroduce a theory that was ahead of its time but now helps to describe the existing technological context. McLuhan's (1964/1994) concept of the Global Village exemplifies this. The idea that technology decentralises and 'makes smaller' the social structure seems to be especially relevant in current times in contrast to 1964, the year in which McLuhan's book was first published and when the Internet had not yet been created. Yet another form of 'discovery' is application of a theory whose purpose originally lay elsewhere and in other types of contexts, for understanding of the current technological setting. This type of reuse of a theory seems relatively commonplace in the existing literature. The social identity theory, for instance, has been applied for understanding the use of recent communication technologies in some studies; in my work, this was done in the discussion of HDD-based television-watching. Thus, the discovery approach may manifest itself in three ways, as *invention*, *reintroduction* and *reuse*.

It is worth emphasising that theoretical adjustment to the technologically evolving communication context is a subtle process. It seems that technological change inspires and encourages us to emphasise certain aspects of reality instead of recognise that some social scientific theories and concepts are strictly applicable only in certain technological contexts (unless, of course, the concepts address some specific technologies). Karvonen (2001) discusses the concepts of knowledge society and information society, which have been used to emphasise that today's society is especially dependent on knowledge and messaging, and remarks that actually every society has been a knowledge society and an information society: people have always needed knowledge and transmitted messages. In a similar vein, although Castells (2011) argues that a network theory of power is needed for describing the network society in particular, we may note that actually power has always been exercised through networks. Political power struggles between nations, for instance, depend not only on military and economic capabilities but also on negotiation and diplomacy – that is, on flows of communication in networks. Moreover, although I have, through the lens of the Internet, criticised the way in which social groups are considered in the theory of social representations, it is noteworthy that this aspect of the theory is

somewhat problematic also irrespective of the change in communication technology. The suggestion by Wagner and Hayes (2005, p. 122) that only those ideas that are shared by culturally distinct groups in a society are social representations seems to be somewhat problematic in itself: when should we assume that certain groups are culturally distinct? Groups and group identities are always important, but, since this issue remains unaddressed, it seems unjustified to emphasise the 'distinctiveness' of groups. In principle, small groups as well as mixed or subtle group identities can be central in certain societal discourses. The problematic emphasis on distinct groups quite possibly reflects the focus of early works such as Moscovici's (1961/2008) pioneering study of psychoanalysis in 1950s France, where distinct groups and media associated with groups were identified. Given that the study by Moscovici is very central in the line of study considered here, this problematic conceptualisation is probably not limited to the review by Wagner and Hayes but descriptive of the line of study as a whole. In line with this assumption, social representations scholars' manner of presupposing relevant group categories has been criticised by Potter and Litton (1985), who argue that in some studies the actual relevance of group categories has been uncertain even though the categories were superficially distinct. Overall, the evolution of communication technology does not necessarily require clear-cut reforms or revolutionary discoveries in social scientific theories but inspires new ideas and elicits subtle changes.

On the whole, my study exemplifies, along with the theories referred to, that social sciences may be kept contrasted with the technological change by at least five distinguishable means: by criticising and synthesising (these belonging to the reformist approach) and by inventing, reintroducing and reusing theories (as in the discovery approach). The reformist approach is probably less commonplace but nevertheless is relevant for development of a comprehensive and up-to-date view of social reality.

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