COPENHAGEN BUSINESS SCHOOL
HANDELSHØJSKOLEN
SOLBJERG PLADS 3
DK-2000 FREDERIKSBERG
DANMARK

www.cbs.dk

ISSN 0906-6934

Print ISBN: 978-87-92977-64-9
Online ISBN: 978-87-92977-65-6

Web-Visions

PhD Series 26.2013

Copenhagen
Business School
HANDELSHØJSKOLEN

Web-Visions

Repurposing digital traces to organize social attention

Anders Koed Madsen

Doctoral School of Organisation and Management Studies

PhD Series 26.2013

Web-Visions

Repurposing digital traces to organize social attention

Anders Koed Madsen

Vejledere: Maja Horst, Anders Kristian Munk, Noortje Marres, Peter Kjær
Doctoral School of Organisation and Management Studies
Copenhagen Business School

Anders Koed Madsen
Web-Visions
Repurposing digital traces to organize social attention

1st edition 2013
PhD Series 26.2013

© The Author

ISSN 0906-6934

Print ISBN: 978-87-92977-64-9
Online ISBN: 978-87-92977-65-6

The Doctoral School of Organisation and Management Studies (OMS) is an interdisciplinary research environment at Copenhagen Business School for PhD students working on theoretical and empirical themes related to the organisation and management of private, public and voluntary organizations.

All rights reserved.
No parts of this book may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system, without permission in writing from the publisher.

Acknowledgements

Even though every potential flaw and vauge argumentation in this dissertation is solely my responsibility, it is clear that the achievement of writing a doctoral dissertation is something that involve more than one lonely scholar. In my case I have been so fortunate that I have spent the last three years together with inspiring and caring people that have offered their help in relation to discussing my ideas and formulating them in a somewhat understable manner. Such kindness need to be acknowledged and on the most general note I would like to thank all my colleagues at the Department of Organization at Copenhagen Business School. What a place to work! From the moment I entered the beautiful building of Kilen I have been met with a genuine interest in both what I was working on and an even more genuine interest in discussing reserach, teaching and life in general over cold beers at Svejk, Bartof and Café Intime. The vibe at the departent is truly special and I cannot imagine a better environment to have conducted this work in.

A more specific group of people that I want to give a big 'thank you' is my supervisors. First things first: Maja, you have been a source of never fading support and inspiration from the moment I walked into your office to ask for the possibility of doing a PhD at CBS. I bet that few docoral students have a main supervisior that is both perfect at guiding their work and kind enough to let them crach on their couch at BBQ nights. Thanks! Secondly, I want to thank my three aditional supervisiors for each giving the project a specific spin in the right direction. Anders Munk has been extremely important as a fellow companion with whom to enter the field of digital methods at a time where few other people in Copenhagen had an interest in it. Noortje Marres has been pivotal to the direction the dissertation ended up taking after she agreed to be supervisor about halfway through the project. I have never before had such a thougrough reading of my arguments and every supervision session was truly inspirational. Peter Kjær stepped in as a supervisior in the latter part of the project. The sessions we had concerning the organizational aspects of my dissertation were enlightning and refreshingy openmided regarding the boundaries of organizational analysis and the topics worth studying in this field.

Besides my supervisiors there are a list of people who have in different ways played a role in the process towards getting the dissertation finished in time. When the project was still in its infancy I was in Amsterdam where both Anne Beaulieu and Richard Rogers were kind enough to give comments on my first ideas and their suggestions sat an important direction for the project. Thoughout the last three years I have also had

two public 'work-in-progress' seminars where Lars Kai Hansen, Torben Elgaard Jensen, Signe Vikkelsø and Paul du Gay agreed to serve as opponents. Thank you for doing that! And thank you Paul for working with me on projects outside this dissertation as well. Another thing that has contributed greatly to the dissertation work has been my visits abroad and I am truely grateful to those who made it possible. A big thank you to David Stark for inviting me to the Center on Organizational Innovation at Columbia University, where I spent the autumn 2011 indulging myself in thoughts about economic sociology. And once again thank you to Noortje Marres who invited me to Goldsmiths University, where I spent the spring of 2012 getting more aquainted with the field of digital methods. Also thanks to the Danish Agency for Science, Technology and Innovation for giving me the elite reserach grant that made these trips possible. Thanks should also be given to Nick Haagensen and Thosmas Basbøll for helping to make my english somwhat readable and, of course to Mikkel Flyverbom, Annamaria Carusi and Evelyn Ruppert for agreeing to be on the assement committee and for providing me with stimulating and constructive comments that will auguably improve my future work.

Finally, an expression af gratitude that has nothing to do with academia as such. I am writing these acknowledgements on an S-train on the way back from Østerbro where I have just dragged my newborn son around the floor in a blanket to the tones of cheesy Danish 80´s ballads. That's happiness! Thank you so much Karen for being the solid rock in my life when things get shaky and for giving birth to a little human being that puts the importance of evey single argument in the next 250 pages into a much larger perspective :-*

Anders Koed Madsen,
Copenhagen April 2013

English Summary

In the late 1990s, Google pioneered the idea of scraping and repurposing digital traces as a new form of data with which to understand people's preferences and behaviour. This way of generating empirical sensitivity towards the world can be termed digital methods and the last five years have seen such methods gain influence beyond the field of Internet search. Organizations of different kinds are increasingly mentioning the need to harness the intelligence of 'big' digital datasets, and the social sciences have similarly been marked by suggestions to move away from established methods such as surveys and focus groups, and learn from the way Google and other companies have succeeded in turning big datasets into knowledge of social dynamics. By enabling new combinations of data and software and by providing new ways of searching, aggregating, and cross-referencing empirical datasets, it seems probable that the spread of digital methods will re-configure the way organizations, social scientists, and citizens 'see' the world in which they live.

This dissertation inquires into the epistemological and sociological characteristics of 'web-based visualizations', which is the most frequent outcome of the ambition to turn digital traces into useful depictions that organize the attention of their users. The empirical contribution of this dissertation consists of three papers, with each presenting an analysis of the construction and use of web-based visualizations in a distinct sphere of society. The first concerns the way organizations use web-based visualizations as a tool to scan their environment; the second concerns the way social scientists use them to understand the development of emerging technologies; and the third concerns the way the attention of the UK public is guided by such visualizations when searching for information about the issue of synthetic biology. These three papers are united by a common ambition to identify the actors and selection mechanisms that are involved in the construction of 'web-based visualizations' as well as to pinpoint the central

challenges and trade-offs that emerge from the attempt to align these actors into simple depictions.

The theoretical contribution of this dissertation is to use the empirical insights of the three papers to develop the concept of 'web-visions' and present it as a vocabulary through which one can theorize about web-based visualizations and suggest guidelines for their construction. The concept is grounded in pragmatist writings on experience, perception, and valuation, and it draws on these resources to revisit themes that are already debated within the field of digital methods. These themes concern the role of theory and a priori distinctions in the construction of visualizations; the extent to which visualizations are representative; the temporality of visualizations; and the extent to which their distributed character re-configure existing modes of ordering the world. The concept of 'web-visions' is argued to be a useful supplement to the way these themes have already been discussed by theories that highlight the performative aspect of digital methods. Moreover, this dissertation continuously pinpoints the specific additions that 'web-visions' is intended to make in this regard.

Table of Contents

Acknowledgements **3**
English Summary **5**
Table of Contents **7**
Introduction **9**
Chapter I: Background and Methodology **25**
1.1 Demarcating and Motivating the Subject Matter of the Dissertation 25
1.1.1 What Does 'Web-based Visualizations' Refer to? 26
1.1.2 Why Are 'Web-based Visualizations' an Interesting Object of Study? 36
1.2 Clarifying the Methodological Inspirations from Pragmatism 42
1.2.1 Tenet 1: Create Analytical Objects that Generate Problematic Situations 44
1.2.2 Tenet 2: Evaluate Analytical Objects as Heuristic and Coherent Interventions 49
1.2.3 Tenet 3: Engage with the World Through Experimentation 52
Chapter II: Four Prominent Themes in Contemporary Research on Digital Methods **57**
2.1 The Rise of Empiricism and the End of Theory 60
2.1.1 A Science Without Theory and Inferences 61
2.2.2 An Honest Data Source 65
2.2 Re-thinking Representation 69
2.2.1 Web-epistemology and Online Groundedness 72
2.2.2 Controversy Mapping and Second-Degree Objectivity 75
2.3 Handling a New Temporality 80
2.3.1 A Distinction between 'Liveness' & 'Liveliness' 83
2.4 Digital Methods as a Distributed Practice 86
2.4.1 Displacement and The Crisis of Empirical Sociology 86
2.4.2 Redistribution and the Revenge of Methods 91
2.5 Outro 94
Chapter III: Establishing a Theoretical Foundation for the Concept of 'Web-Visions' **97**
3.1 Three Sources of Theoretical Inspiration 99
3.1.1 Cooley: Experience and Communication Technology in the Late 19th Century 100
3.1.2 Gibson: The Ecological Approach to Visual Perception 102
3.1.3 Espeland: Commensuration and Valuation 105
3.2 The Ontology of 'Web-Visions': Systems of Experience in-between Practices, Technologies, and Human Intentions. 107

3.2.1 Systems of Selection and Environments of Experience 108
3.2.2 Affordances and the Perceptual System 112
3.3 The Epistemology of 'Web-Visions': Pragmatic and Dynamic Detections of Invariance 117
3.4 The Normative Aspect of 'Web-Visions': Segmentation and Valuation as Conditions for Social Organization 124
3.4.1 Variegation as the Condition for a Free Mind 125
3.4.2 Commensuration as a Condition for Functioning Algorithms 130
3.5 Outro 136
Chapter IV: 'Web-Visions' & Organizational Intelligence 139
4.1 Background on Paper One 140
..... 142
4.2 Discussion of Paper One 177
4.2.1 The Identified Continua as an Opportunity to Reflect on 'Second-Degree Objectivity' and 'The Rise of Empircicm' 177
4.2.2 'Web-Visions' and the Case of the Crisis-monitor in the UN's Global Pulse 186
Chapter V: 'Web-Visions' & Social Scientific Studies of Technological Development 196
5.1 Background on Paper Two 196
..... 200
5.2 Reflections on Paper Two 231
5.2.1 Micro-Differences Between Web-Sphere Analysis, Cross-Sphere Analysis, and Web-Vision Analysis 232
5.2.2 The Relation Between 'Web-Visions' and Economic Sociology. 239
Chapter VI: 'Web-Visions' of Synthetic Biology 244
6.1 Background on Paper Three 245
..... 250
6.2 Reflections on Paper Three 285
6.2.1 Distributed Selection Chains and their Connection to Situations and Events 285
6.2.2 Experimental Designs and the Role of Temporality 294
Chapter VII: Implications & Future Studies 301
7.1 Theoretical and Practical Implications Following from 'Web-Vision Analysis' 301
7.2 Suggestions for Future Studies within the Field of Organizational Analysis 315
Concluding Remarks 322
Bibliography 327
Danish Summary 339

Introduction

During the last three years, there has been an almost exponential increase in projects and white papers that discuss how the rise of so-called 'Big Data' can potentially transform areas such as business intelligence (McKinsey Global Institute 2011) and public governance (World Economic Forum 2012). It has even been suggested that the development could shake the foundations and logics of social science itself (Lazer et al. 2009). The concept of Big Data has been used in many ways, but it can broadly be argued to refer to the existence of massive new data sources that are often available in 'real time' as well as the availability of analytical software systems that can detect patterns within them in an automated fashion. These new data sources and software tools are of quite different varieties, and a closer look at examples of Big Data projects actually suggests that the data encompassed under this heading differ quite dramatically in scale. It spans from subsets of tweets about politics in the course of an election (Wang et al. 2012) to data repositories containing years of US census data (Press 2012). The latter source of data is larger than the former and this difference in size indicates that the attraction of Big Data may not be their quantity. New data forms are interesting because they create new modes of organizing compared to the types of data that were used before; therefore, the interesting characteristic seems to be the way specific combinations of data and software provide capacities for searching, aggregating, and cross-referencing datasets in new ways (boyd & Crawford 2012).

The reason for starting this dissertation with a short note on Big Data is that its subject matter—digital methods and web-based visualizations—has increasingly been discussed under this heading. A detailed discussion of the types of analytical tools that are referred to by these concepts will be provided below, but for now it is sufficient to describe each concept in a few words. *Digital methods* is taken to refer to an emerging tendency to repurpose the digital traces that people leave on the web as a data source

from which to generate knowledge about the social world. This is done by programming software agents to capture these traces and turn them into useful depictions of the social world that organize the attention of their users and provide them with useful empirical sensitivities to the social dynamics of their interest. It is these depictions that are referred to as *web-based visualizations*, and this dissertation will discuss their role as a new tool of social inquiry that can potentially influence the way organizations, social scientists, and citizens guide their attention to the world in which they are embedded.

At the organizational level, for example, the United Nations is currently visualizing patterns in real time streams of tweets as a way to reconfigure the empirical foundation that guides their attention to crisis signals (Global Pulse 2011). This potential shift in the practice of crisis-management will have important organizational consequences. It will, for instance, require different techniques of data-gathering and analytical skills than those that have previously been structuring the analytical work in the organization, where crisis signals have mostly been captured through household surveys. The UN case is in that sense an illustrative example of the way people's empirical engagement with the social can be reconfigured with the introduction of digital methods and web-based visualizations. This dissertation will focus on such potential reconfigurations in different contexts and it will trace the tendency to use digital methods and web-based visualizations back to Google, which has been pioneering the idea of using pattern-detection in digital traces to guide the attention of web-users since the late 1990s.

The few details given about the UN example above is sufficient to illustrate why digital methods and web-based visualizations have been discussed as examples of the Big Data movement. If the dataset harnessed by the UN is seen in relation to the kind of datasets they have previously used to spot crisis signals, it is evident that the suggested visualizations of Twitter data exemplifies a move towards Big Data as

defined above. Whereas data about emerging crisis-situations were previously produced actively by prompting people to answer a household survey, it can now be scraped from the web, which is getting increasingly populated with dynamic user-generated traces (Latour 2007; Cormode & Krishnamurthy 2008; OReilly 2007). To put a figure on the quantity of this data, it has, for instance, been estimated that Google receives ten million search queries, Facebook users share around three million pieces of content, and Twitter users send over 500.000 tweets every five minutes[1]. Compared to previous methods and data forms that have been used by the UN to guide attention and provide empirical sensitivity to the social world, it is clear that these data forms satisfy the characteristics of Big Data. They are larger in quantity and faster in pace, and their binary character makes it possible to search, aggregate, and cross-reference these data forms though the use of automated software (Marres & Weltevrede 2012).

This brings us to the general ambition of this dissertation, which is to analyse contemporary uses of digital methods and web-based visualizations in order to discuss and conceptualize the ways in which they influence the attention structures and empirical sensitivities of their users. At the most general level, it does this by asking the following question:

Which actors are involved in the construction of web-based visualizations that create manageable depictions of social reality, and what are the central challenges and trade-offs facing producers of such visualizations?

To what extent do existing methodological vocabularies capture the epistemological and normative characteristics of the realities that digital methods and web-based visualizations produce?

These are the overall guiding questions of this dissertation, and before continuing into the details of the way they will be answered, it is important to emphasize that they will

[1] See: http://www.domo.com/blog/2012/06/how-much-data-is-created-every-minute/

be approached with an eye on history. This dissertation recognizes that the feeling of being in the midst of information explosions ignited by new technologies is not something that is unique to the present age (Blair 2003). The aforementioned questions have accordingly been asked before, when previous technologies promised (or threatened) to reconfigure the organization of knowledge. The most ancient example is perhaps the way Plato discussed the epistemology of the written word, and the way the construction of ancient libraries to contain written information reorganized scholars' access to this new form of information (Blair 2003). A more modern example is the way the printing press was accompanied by innovations in indexing technologies and standardized reference systems that led to new ways of understanding the logics of knowledge production (Febvre & Martin 1976).

These similarities make it illustrative to look at how previous technologies have reorganized the way their users *focused their attention* on information and knowledge when exploring issues of interest, and to allow lessons from the past to inform the questions asked about digital methods and web-based visualizations. For this purpose, this dissertation will particularly draw upon discussions about the epistemological and political consequences of the rise of electrified information-technology in the late 19th century. One reason for this choice is that these technologies were offered as answers to pressing questions about fundamental aspects of American life that bear similarities to some of the questions discussed in contemporary society (Marvin 1988). The telegraph was, for instance, perceived as an answer to the question of how American citizens could possibly maintain a feeling of national identity in a situation where new railways had led to a radically dispersed nation. It was simply argued that it transmitted feelings across the continent and 'wired' the public together through new modes of social organization such as centralized price setting and standard time (Carey 1989). The hopes and fears surrounding the introduction of electrified information-technology and the struggle to find a vocabulary to make sense of its epistemic and normative

characteristics resembles some of the discussions around Big Data that will be central to this dissertation. Even though the dissertation is not presenting a historical analysis it does take inspiration from how theorists that wrote about, for instance, the telegraph, raised questions that are similar to the ones posed about digital methods above.

Another reason for considering the late 19th century is that the discussion about electrification was most prominently taken up by scholars connected to a pragmatic line of research, which has provided the methodological foundation for the studies in this dissertation. The details of this inspiration will be outlined in detail in section 1.2, but it requires a few comments here. One aspect of the pragmatic approach to social research that fits the overall question of this dissertation is the emphasis on practices of search and inquiry as central to the way people and organizations experience society and act within it. The idea that 'searching questions' (Stark 2008) are some of the most fundamental questions to pose when one want to understand how epistemological orders are produced is echoed in the research questions of this dissertation. An additional relevant aspect of the pragmatist's conception of this issue is their focus on the interplay between practices of search and inquiry and the material characteristics of new technologies. They emphasize that such characteristics, and the way they are appropriated by specific actors, are important influences on the way people experience the world and the way social order is achieved. This is another idea that is reflected in the overall research questions above and it will be commented upon much more thoroughly upon in Chapters I and III.

In relation to the research questions formulated above it will be clar throughout the dissertation that the first question is inspired by assumptions that flourished among the early American pragmatists. It assumes that web-based visualizations are the outcomes of a process where a distributed set of actors are involved in the practical work of turning new data sources into something manageable. The work involved in the effort to differentiate a social phenomenon into data points that can subsequently be

coordinated into a depiction of the social is therefore not taken to be a simple task. It is a process that is filled with dilemmas and trade-offs. The first research question illustrates the first ambition of this dissertation, which is to make it more clear which actors, dilemmas, and trade-offs are at play in the construction of web-based visualizations and how they are handled across different contexts. It sets out to answer this question by looking at the use of digital methods and web-based visualizations in three spheres of society, that each has specific practical problems with their engagement with digital methods and web-based visualizations. The empirical analyses in this dissertation are therefore divided across three papers, with each providing different empirical inputs to answer the first research question. The first provides an analysis of the way organizations use web-based visualizations to understand the environment in which they are to act; the second provides an analysis of the way such visualizations have been used in social scientific studies of emerging technologies; and the third provides a study that simulates the way the British public experience the issue of synthetic biology through Google.

This way of organizing the empirical contributions of this dissertation also means that it does not provide an in-depth study of a single case. If the reader is looking for a comprehensive study of Google´s filtering mechanisms, the complete story about the way the a specific organization like the UN uses digital traces or if one is looking for insights into the regulatory and political mechanisms that influence the way data is produced by such actors, the next 250 pages are bound to disappoint. Such studies have already been very successfully carried out elwhere and the aim of this dissertation is not to mirror what has already been done successfully (for good examples see, for instance, Vaidhyanathan 2011; Ruppert 2011 and Savage and Ruppert & Sage 2011). This dissertation uses cases like Google and the UN as small empirical focal points among many others, and the priority has not been to give detailed contextual descriptions of such cases. In relation to the first question, the research strategy is

simply to use these different empirical focal points to pinpoint reoccurring choices and dilemmas involved in combining web-technologies, digital traces, analytical vocabularies, software packages, classification systems, and other actors into simple visualizations that can potentially guide the social attention of publics, scientists, and organizational decision makers.

The broad scope of the empirical analyses is also closely related to the second research question posed above. It asks a conceptual question of whether existing vocabularies adequately capture the epistemological and normative characteristics of the realities that digital methods and web-based visualizations produce. This question is only interesting because it is answered negatively, and the second ambition of this dissertation is, accordingly, to use the empirical findings of the three papers to argue for the need for a new theoretical framework with which to understand and conceptualize web-based visualizations as tools of empirical inquiry. It suggests looking at such visualizations as 'web-visions'[2] and it illustrates how the metaphor of a vision can be used as a foundation from which to interpret and construct web-based visualizations in novel ways. The concept of 'web-visions' takes specific theoretical inspiration from Charles Horton Cooley´s work on experience, James J. Gibson´s work on perception, and Wendy Espeland´s work on commensuration. This dissertation will argue for the relevance of their work as inputs to the field of digital methods by discussing the findings of the three papers on the basis of concepts drawn from these

[2] In order not to cause any confusion it should here be made clear that the concept of ´visions´ is used in a specific sense throughout this dissertation. It refers to the scope of the world that is visible to an attentive human being and it is, accordingly, not used to denote, for instance, a vision of the future of a vision of how the world should be. This will be evident throughout the dissertation but it is helpful to bear in mind that it is used as an equivalent to ´sight´ or ´field of vision´.

writers and comparing the vocabulary of the proposed 'web-vision analysis' to existing vocabularies within digital methods.

The central contribution of this dissertation is, accordingly, to develop the concept of 'web-visions' on the basis of the findings of the papers and the theoretical lineage back to Colley, Gibson, and Espeland. In line with pragmatist methodologies, it presents this concept as both a descriptive and prescriptive term. It uses the empirical findings of the papers to describe the phenomenon of web-based visualizations in a way that differs from existing vocabularies and the theoretical questions they ignite. However, this description carries with it prescriptive elements because a shift in the conceptualization of an empirical tool also carries with it shifts in the guidelines for producing it. Since a 'web-vision' is not considered to be a representation of the world, it is, for instance, debatable whether statistical conventions for valid data sampling should be part of the guidelines of its construction. This is just one example of the way this dissertation supplements the descriptive concept of a 'web-vision' with a prescriptive framework of 'web-vision analysis', which should be read as a heuristic attempt to figure out how to do social inquiry on and with web-based visualizations.

The distinction between the concept of 'web-visions' (used as a description of web-based visualizations) and the framework of 'web-vision analysis' (used as a prescriptive guideline for their construction), serves to highlight that this dissertation engages in both analytical and practical problems concerning the role that web-based visualizations are increasingly playing as an empirical tool of social inquiry. Its analytical contribution is twofold: First, it introduces the concept of 'web-visions' and highlights the way it points analytical curiosity towards aspects of web-based visualizations that fall without the existing vocabularies. Second, it introduces a framework of 'web-vision analysis', which provides a new basis for reflecting on the dilemmas involved in the actual choices that go into producing web-based visualizations. It thereby offers new guidelines for practitioners that are engaged in

constructing and using web-based visualizations as techniques of social analysis. The structure of how this dissertation aims to make these contributions and answer the two research questions is outlined below.

The structure of the dissertation

Writing up a dissertation after three years of work inevitably entails a construction of an overall narrative that does not necessarily reflect the order in which the theoretical and analytical work was actually carried out. This is also the case with the present dissertation. The concept of 'web-visions', for instance, was not part of this dissertation until later in the process, where it emerged from a suggestion to interpret the findings of the empirical analyses on the basis of the writings of Cooley, Gibson, and Espeland. The introduction of these writers as part of the analytical framework was, accordingly, something that happened halfway through the dissertation work, and the arguments presented throughout this dissertation are therefore the outcome of an iterative process where different narratives and analytical points have been tried out. Furthermore, some of the three empirical papers were written before the concept of 'web-visions' was coined, and the specific research questions that guide the individual papers are therefore only implicitly tied to the overall research questions formulated above. These overall questions are, accordingly, an a posteriori reflection on the work that has been produced, submitted, and published during the last three years.

This has the consequence that this dissertation will be "double-headed" in terms of the formats in which it presents the analytical work conducted. One format of presentation is academic papers written for specific journals and this dissertation contains three such papers. Each of them has a coherent argumentation that can be read without attending to the overall research questions formulated above, and each of them use

different methods to analyze different empirical manifestations of web-based visualizations. As mentioned above, it is the findings of these papers that have served as the foundation from which to develop the concept of 'web-visions' and each of them play a central role in the argument for the relevance of talking about web-based visualizations as 'visions'. But the fact that they are printed in the form in which they were submitted for review or published, means that parts of them have been written before the concept of 'web-visions' even entered the research process. This also means that they occasionally contain elements that are slightly at odds with the final formulation of the concept. In that sense, the papers reflect a progression of research interests and they illustrate the iterative and explorative character of the research process.

The overall narrative of this dissertation is therefore ensured by a second format in which the analytical work is presented. This format is the frame around the papers that presents an a posteriori reflection on their findings in the light of the research questions formulated above and the ambition to carve out 'web-visions' as a distinct analytical object. The present introduction is the beginning of that overall frame and each following chapter will include a certain amount of framing text. Some of the chapters will solely consist of a posteriori reflections, such as discussions of methodology and theory, whereas Chapters IV-VI will be a mix of the two formats of presentation. They will each have an empirical paper as their core element, but this paper will be preceded by a short introduction and followed by a longer discussion that relates the contribution of the paper to the general research questions formulated above. The specific contributions of the individual chapters in this dissertation are as follows.

Chapter I is entitled 'Background and Methodology´ and it consists of two sections. The first section is called 'Demarcating and Motivating the Subject Matter of the Dissertation'. This section provides the promised definition of what this dissertation

means when it refers to web-based visualizations as an empirical tool connected to digital methods, and it motivates why this is a relevant subject matter for a social scientific study. It does that by providing examples of web-based visualizations and by relating them to the research of Bruno Latour and Annamaria Carusi, who have previously studied the way technologies can influence modes of cognition and modes of seeing as well as how such influences pose epistemological and normative questions. The second section of Chapter I is called 'Clarifying the Methodological Inspirations from Pragmatism', and it illustrates how the methodological approach of this dissertation is grounded in the philosophy of science of the early American pragmatists. This is done by highlighting three methodological tenets that were central to the works of Charles Sander Pierce, William James, and John Dewey. The first tenet is that the social sciences should aim at writing analytical objects into being that can bring out problematic aspects in existing practices and theoretical vocabularies. The second is that analytical vocabularies should be evaluated as heuristic objects that contain both descriptive and prescriptive elements. Lastly, the third is that such objects can productively be known by attending to their effects through experimentation. As will be seen below, all of these methodological tenets have influenced the way this dissertation conducts empirical analysis and the way it argues for the relevance of introducing 'web-visions' as a new analytical object.

Chapter II is entitled 'Four Prominent Themes in Contemporary Research on Digital Methods' and it functions as a literature review that establishes the 'existing vocabularies' on digital methods, which the concept of 'web-visions' is discussed up against. The chapter is divided into four sections that each presents state-of-the-art theories about a specific theme within the field of digital methods. The first theme concerns the role of theory and outlines recent hopes for using digital traces as a foundation for a new form of empiricist social inquiry that does away with theoretical inferences. The second theme concerns the issue of representation and presents

different views on the extent to which web-based visualizations can be said to be representative. The third theme concerns the manner with which the temporality of digital data can be handled and the extent to which digital methods should be focused on scraping digital traces in real time, and thereby prioritize visualizations of the present. Lastly, the fourth theme concerns the distribution of actors involved in the production and analysis of data within digital methods, and it outlines discussions about the way this distribution can reconfigure the role of professions that have traditionally claimed data literacy in relation to the topics visualized. The findings of the empirical papers and the concept of 'web-visions' will throughout the dissertation be discussed up against these themes and literature.

Chapter III is entitled 'Establishing a Theoretical Foundation for the Concept of Web-Visions' and it introduces central concepts from Cooley, Gibson, and Espeland. It provides an argument as to why these writers will be used as a theoretical foundation for constructing the analytical concept of 'web-visions' and for suggesting the framework of 'web-vision analysis'. The chapter is divided into five sections of which the first gives a general historical introduction to the three writers. The second draws on selected concepts from Cooley and Gibson in order to propose an ontology of 'web-visions' that suggests interpreting web-based visualizations as systems of experience located in-between situated practices, technological infrastructures and human intentions. The third section presents an epistemology of 'web-visions' by drawing on selected aspects of Gibson´s writings. It proposes seeing 'web-visions' as dynamic devices that generate knowledge by allowing their users to experience invariants within data flows rather than providing representations of an external world. The fourth section uses selected writings from Cooley and Espeland to emphasize the normative aspect of 'web-visions'. It argues that such visions enable social navigation through the creation of situations in which things and events can be (quantitatively) evaluated and given meaning. Finally, the fifth section summarizes the main points of the chapter and

outlines how they will be used in the subsequent discussions of the empirical papers in Chapters IV-VI.

Chapter IV is the first of three chapters that contains an empirical paper in journal format. The succession of the three empirical chapters is organized as a 'funnel' that moves from descriptive insights into general conditions for constructing web-based visualizations, to prescriptive attempts at producing 'web-visions' and extracting insights from them. Chapter IV is entitled 'Web-Visions & Organizational Intelligence' and it belongs at the beginning of the funnel because it analyses the conditions for constructing web-based visualizations across a broad range of organizational contexts. The paper at the centre of this chapter is called '*Between Technical Conditions and Epistemic Assumptions*', and it presents an analysis of eight projects engaged in repurposing digital traces as a way to guide the attention of their respective organizations towards relevant social dynamics.

Despite being carried out in response to different problems, the paper shows that these projects face two common challenges when constructing visualizations. One concerns the necessity to distribute data formats to third party actors, and the other concerns the need to balance machine intelligence and human intuition. For each challenge, the paper identifies two opposite approaches to meet them, and it shows how these different approaches are legitimized through different framings that align them with specific epistemic assumptions in the organizational and societal contexts in which they are to be used. Without explicitly mentioning the concept of 'web-visions', the paper provides empirical reasons for the need to develop a theoretical framework that can make sense of the trade-offs it identifies. The discussion after Paper One argues that some of the existing vocabularies within the field of digital methods are ill-suited to make sense of these trade-offs, and it illustrates why the concept of 'web-visions' is better equipped to describe and understand some of the choices made by specific

project leaders in the paper. This potential is predominantly discussed by linking the findings of the paper back to Cooley and Gibson´s thoughts on ontology and epistemology.

Chapter V is entitled 'Web-Visions & Social Scientific Studies of Technological Development' and it is the second chapter that contains an empirical paper in journal format. As the name of the chapter suggests, it is focused on the use of web-based visualizations as an emerging empirical tool within in social sciences. The paper at the centre of this chapter is called *'Web-Visions as Controversy Lenses'*, and it is limited to looking at recent social scientific studies that attempt to repurpose hyperlinks and network-visualizations in order to understand the development of emerging technologies. By analyzing the way these different projects use digital methods, it illustrates how seemingly similar attempts to use web-based visualizations in social scientific studies of emerging technologies exhibit important differences in terms of the logic with which they produce visualizations, the extent to which they aim for these visualizations to live up to the methodological criteria of representation and the way they choose their starting points.

The discussion after Paper Two uses its findings to position the concept of 'web-visions' in relation to approaches in the paper that it shares important similarities with. It uses the 'micro-differences' between these approaches to pinpoint small details that make them distinct from each other and to motivate the need to conceptualize distinctions between different approaches to the construction of web-based visualizations. One detail that makes the concept of 'web-visions' distinct from other such approaches is that it translates the concepts of 'calculative spaces' and 'attention structures' from studies of market devices to controversy-visualization. A second is that it proposes to construct visualizations on the basis of case-study logics rather than samples. The framework of 'web-vision analysis' is, in that sense, introduced as a

challenge to the ambitions of representation that underpin many of the reviewed studies. This discussion also marks the first attempt to illustrate how the framework of 'web-vision analysis' is intended as a prescriptive intervention in relation to the way web-based visualizations can be constructed and used as an empirical tool.

Chapter VI is entitled 'Web-Visions of Synthetic Biology' and it is the third chapter that contains an empirical paper in journal format. It represents the end of the 'funnel' because it continues the prescriptive ambitions that ended Chapter V. The central paper in the chapter is namely a concrete attempt to utilize the framework of 'web-vision analysis' to actively engage in the production of digital visualizations. This paper is called *'Of Spheres, Bubbles, and Visions'* and it uses the framework of 'web-vision analysis' to provide insights into the central selection mechanisms involved in the way Google performs a 'web-vision' of synthetic biology for the average British web-user. The paper uses a longitudinal, experimental design to trace the influence of different selection mechanisms over the time span of a year, and it uses this empirical data to question mono-causal ways of speaking about Google´s guidance of their user's attention. Rather than locating algorithms as the decisive selection mechanism, the paper illustrates how selection mechanisms such as national differences in semantics, the power of synonyms, the tightness of distinctive thematic clusters, and the existence of big events are influential in performing Google´s 'web-vision' of synthetic biology.

Paper Three thereby illustrates how 'web-visions' are the result of distributed chains of selection mechanisms that involve human as well as non-human actors, and it illustrates how elements of these chains can productively be seen as variables in an experimental set-up that can be manipulated in order to obtain insights into their influence. The paper is, in that sense, an example of 'web-vision analysis' in action. It showcases how the framework of 'web-vision analysis' offers a pragmatic approach to digital methods that emphasizes the need to experimentally isolate and disentangle

effects from different selection mechanisms, and it uses these effects as a basis for learning about the 'web-vision' that Google offers the British public. The paper exemplifies how web-based visualizations can legitimately be produced without aiming at representative visualizations, and it provides a concrete illustration of the types of insights 'web-vision analysis' can (and cannot) provide. Finally, it is argued that the guidelines suggested on the basis of the analysis in this paper have resonance outside the specific case of Google as well.

Chapter VII is entitled 'Implications & Future Research' and it is the last chapter of this dissertation. It is divided into two sections of which the first is called 'Theoretical and Practical Implications Following from 'Web-Vision Analysis'. This section provides a brief discussion of the arguments provided throughout this dissertation and it formulates three theoretical implications and one practical implication that follow from conceptualizing web-based visualizations as 'web-visions'. These implications are used as the basis for the second section, which is entitled 'Future Studies in the Light of Organizational Analysis'. It suggests how the proposed framework of 'web-vision analysis' carries with it both descriptive and prescriptive suggestions concerning the way to study the use of web-based visualizations in a specific organizational context. Using the theoretical framework of 'web-vision analysis' to emphasize the way selection chains and organizational practices are intertwined will be highlighted as the priority of future research.

The dissertation will end with some brief **Concluding Remarks** that highlights some of the main claims of the dissertation and indicates the sections in which they were most clearly made. The remarks furthermore have the function of explicating how the claims and arguments in the dissertation serve as answer to the two research questions formulated in this introduction.

Chapter I: Background and Methodology

This chapter consists of two sections that will provide some background information so as to make it easier to read and follow the logic of the argumentation in the remaining chapters of this dissertation. Section 1.1 will give a definition of what kind of empirical objects this dissertation refers to as 'web-based visualizations' and thereby provide a demarcation of what the concept of 'web-visions' is intended to articulate something about. Furthermore, this section will give some background on what has inspired the choice of taking such visualizations as the subject matter and motivate why they are interesting objects of study for a social scientific dissertation. Section 1.2 will give a broad introduction to the methodological guidelines that have guided the theoretical and empirical work that will be presented throughout this dissertation. It will highlight three tenets of pragmatist philosophy that have served as a major inspiration for the way this dissertation approaches the practice of doing social science. Moreover, these three tenets will be used to suggest a foundation on the basis of which the contributions of this dissertation can be evaluated.

1.1 Demarcating and Motivating the Subject Matter of the Dissertation

It should be clear from the introduction that the concepts of 'web-based visualizations' and 'web-visions' are distinct in the sense that the former is intended as a general description of the subject matter of this dissertation, whereas the latter is intended as part of a theoretical vocabulary that it constructs in order to carve such visualizations out as a specific analytical object with specific characteristics. This section outlines what kind of empirical objects are referred to as 'web-based visualizations' in order to set the scene for a more focused discussion of the contributions of the framework of 'web-vision analysis' that is developed throughout this dissertation. Since the notion of

'web-based visualizations' is neither widely used nor well defined, it is difficult to give a clear-cut definition and demarcation that will immediately resonate with the reader. However, this section will pinpoint some general characteristics that give a sufficiently clear sense of the kind of empirical objects the concept is used to refer to, and finally, it will set the scene for discussing why they are of interest for a social scientific dissertation.

1.1.1 What Does 'Web-based Visualizations' Refer to?

On a broad note, it can be said that the concept of 'web-based visualizations' denotes a set of empirical tools, which are based on a belief in the potential of repurposing the intelligence hidden in digital traces in order to focus attention on relevant social issues. On a general note, it can be said that web-based visualizations are depictions of social phenomena that meet the following criteria:

a) They are constructed by programming software agents to 'scrape' digital traces in order to harness the 'crowd intelligence' of the web.

b) They are visual in the sense that their spatial arrangments or their colours carry a meaning in relation to the social phenomena they depict.

c) They are promoted as devices that help their users to understand or manage the social environments in which they live.

Before going through some of the different visualizations that fall under the heading of 'web-based visualizations', it is necessary to give more detail on the three criteria, that will come to serve as demarcations of the subject matter of this dissertation.

If we start by looking at the first criterion, it is important to note that the activity of 'scraping' digital traces is taken to refer to the automated transformation of

unstructured web data into structured visual formats. Such a transformation involves the use of software programs to extract formatted data out of an unformed mass of online data. The process of scraping the web simply involves a chain of software programs that strip raw data from its useless elements and subsequently formats them into a well-ordered, useable dataset (Marres & Weltevrede 2012: 9). An example of scraping technology that has been extensively used within the field of digital methods is the Google Scraper[3], which is built to extract ordered information about the partisanship of websites from the unordered mess of semantic cues inherent in their written content. The scraper does this by using Google´s own data repository as a vehicle to conduct a frequency analysis of different words on specific websites, and it links this index to a software component that can visualize the relative prominence of specific words in a tag cloud. This latter part of the chain could, however, also have been performed by other software components such as WORDij[4], which is able to detect and visualize semantic networks in textual data scraped from the web rather than providing frequencies in a tag cloud. The point is that the different selective chains involved in the activity of scraping lead to different modes of ordering.

The activity of scraping is, in this dissertation, also taken to include the use of crawlers and 'bots', which are capable of automatically downloading websites to a local server and extracting their URLs (Thelwall 2009). Such crawlers work by indexing webpages, and they let their users query and visualize the downloaded index rather than the real time web. It is this kind of indexing that is the backbone of Google, which allows its users to search an archived version of the web (Brin & Page 1998). This version is, however, updated very often so that important pages are crawled and indexed more often than less important ones[5]. Even though this activity of downloading and indexing

[3] Available at http://tools.issuecrawler.net/beta/scrapegoogle
[4] Available at http://www.content-analysis.de/2010/09/24/wordij.html
[5] The latest major update that Google have made in relation to the freshness of their results is popularly called the ´caffine update´. It was implemented in 2009 and it enables Google to keep up

is, technically speaking, different from the activity of scraping, it will be discussed under the same heading in this dissertation. The same is true for the activity of hooking software programs up to a commercial API[6] in order to get data feeds. This is, for instance, what the UN does when they construct the crisis monitor that was mentioned as an example of a web-based visualization in the introduction. The concept of scraping is, accordingly, used in the broad sense of the word in this dissertation. The central criterion for a visualization to be seen as an outcome of the activity of scraping is that it needs to be built by transforming unstructured web data into structured visual formats through a chain of software programs.

A second important point to clarify in relation to the first criterion is what the concepts of 'the web' and 'crowd intelligence' are used as references to. When this dissertation refers to the web, it is important to emphasize that it is referring to a subset of the Internet. The Internet is taken as a reference to the system of interconnected computers that form the basis of the web. The web is, more narrowly, taken as a reference to the system of interlinked hypertext documents that can be accessed by typing a URL into a web browser or by following links from webpages. The standards for structuring and interpreting these accessible documents are often promoted and issued by the W3C, and the most well-known standard is the HTML mark-up language that can be read by all web browsers. This distinction between the web and the Internet has the implication that certain forms of digital data can be found on the Internet while not being part of subject matter in focus in this dissertation. Examples of such data forms are mail correspondence in Microsoft Outlook and documents on the secured intranets of

with rapidly updated information sources such as Facebook and Twitter. See, for instance: http://www.webmasterworld.com/google/4402187.htm.

[6] API is short for ´Application Programming Interface´, which can be defined as a protocol that enables different software components to communicate with each other. Twitter´s API, for instance, enables external actors to 'hook up' their software to Twitter's data-repository in a way that is guided by the API.

companies and organizations. The data of such services would be interesting from the broader perspective of Big Data, but they are not part of the data forms that serve as the foundation for web-based visualizations.

The claim that web-based visualizations harness the 'crowd intelligence' of the web refers to the fact that proponents of web-based visualizations share a common assumption about the potential for using patterns in digital traces to focus attention on relevant social dynamics in the face of ever-increasing information. Rather than managing this flow of information through established techniques and methods, it is suggested that there is a need to develop software programs to make patterns in digital traces visible and take these patterns as a legitimate basis for prioritizing attention. The strategy is to take advantage of the intelligence of the crowd in much the same way as actors in liberalized markets believe in distributed price-setting mechanisms as an alternative to centralized pricing. This belief in 'the crowd' is ultimately inspired by the way Google challenged how search engines relied on editors to classify web pages on the basis of existing categories (such as 'sport' and 'music') in the mid-1990s. Google´s big innovation was to order the web by scraping hyperlinks and anchor-texts and then using these traces to order the relevance of information. This is still the main technique through which Google filters information on the web, and this approach to ordering is, to some extent, present in all web-based visualizations as they are defined in this dissertation.

The second and third criteria mentioned above are less ambiguous than the first, but they require a few clarifications as well. If we take a look at the second criterion, it is especially important to note that this dissertation uses the concept of 'visualizations' as a broad reference to any depiction that conveys information about a social phenomenon through spatial ordering or colour-coding. This broad definition includes everything from simple ordinal rankings of websites, where the spatial order carries

meaning about the phenomenon of information relevance, to complex info-graphics and network-visualizations, where colour schemes and graphics design are used to make distinctions between different elements in the phenomena they depict. The scope of visualization types that the concept of web-based visualizations refers to will be clearer with the introduction of concrete examples below and there is no need to go into any further discussion of the meaning of the word 'visualization' now. If we turn our attention to the third criterion above, it does nothing more than to state that web-based visualizations are introduced with a purpose in relation to the guiding of attention in a specific situation. Whether or not they succeed in their attempt is not part of the criterion, but this dissertation will only look at visualizations that are built on the basis of such an ambition.

From this theoretical demarcation of the subject matter of this dissertation, it is now time to provide some concrete examples of empirical phenomena that fall within the category of web-based visualizations. One of the simplest examples is the results page of Google´s search engine (the SERP), which is shown in Figure 1 below. Even though it is rarely talked about as a visualization, it falls within the demarcation given above. It is spatially organized in the sense that the vertical order of information conveys a meaning to its user. The top of the page shows the keyword queried for and just below is a highlighted box with commercial search results. Beneath this box is a vertical ranking of hyperlinks, where the most relevant websites are depicted closest to the keyword, and the lesser relevant results appear towards the bottom of the page. It is a depiction of a social phenomenon because its spatial organization indicates the social relevance of information sources, and it is presented as a technique that equips its users to manage the growing information environment in which they have to ground their knowledge of the world. The SERP is furthermore constructed by programming software agents to scrape digital traces from the web. Google´s most well-known algorithm—the PageRank—was initially built on the assumption that patterns in digital

traces could be interpreted as signifiers of people´s information preferences, and the displayed websites accordingly get their position in the vertical ranking on the basis of algorithmic recognition of patterns in digital traces such as hyperlinks and their anchor-texts (Brin & Page 1998; Vaidhyanathan 2011).

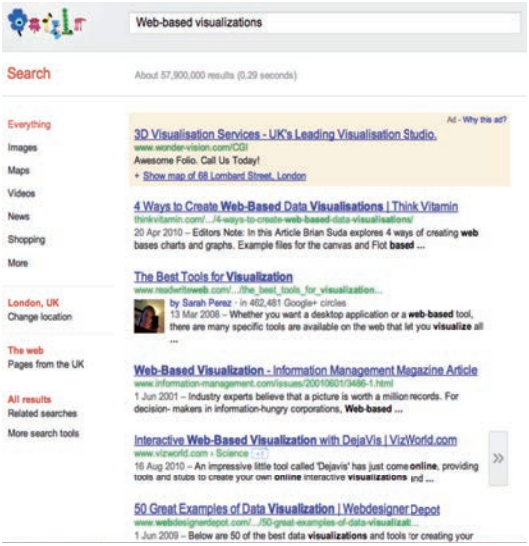

Figure 1: Google´s SERP reflecting a query for *web-based visualizations*

The fact that most readers of this dissertation will immediately recognize and understand the visual codes of Google´s SERP illustrates that the company has succeeded in standardizing and popularizing a specific technique to guide the attention of web users (Battelle 2006; Vaidhyanathan 2011). The SERP is, in that way, a telling example of the potential for web-based visualizations to influence social attention in a world of digital information. Rather than exploring the web on the basis of pre-defined categories, Google´s users just need to type a keyword of interest in a box and, thereafter, let their attention be guided by the collective intelligence hidden in the

digital traces through algorithms that are programmed to extract this intelligence in a useful way.

This strategy has made Google´s SERP a surprisingly successful alternative to the kind of web dictionaries that were the trusted technique with which to guide attention on the web when Google entered the market of search. Google´s success has subsequently led the company to develop other types of web-based visualizations as well. Figure 2, for instance, shows a 'Flu Trends Graph', which is used to alert both publics and institutions of public health governance of potential flu outbreaks in specific areas. The empirical foundation of this alert system is a scrape of the flu-related keywords that people are plotting into Google when searching for information. It is organized though an info-graphic that uses word-frequencies and geo-coordinates as the foundation for a colour code, where a red colour indicates an intensive threat of flu outbreaks. Figure 2 is an example of a visualization produced by Google Flu Trends and, here, it predicts the arrival of flu in Sweden.

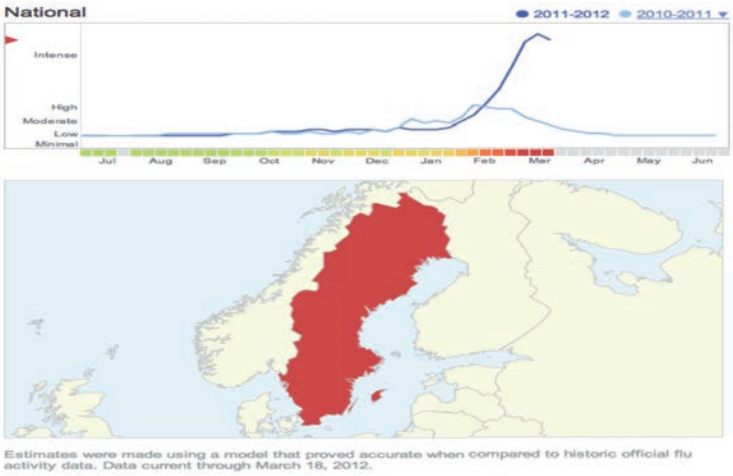

Figure 2: Screenshot of Google Flu Trends

Figure 1 and 2 are examples of the kind of web-based visualizations that are also beginning to transform analytical practices outside Google, and the introduction has already mentioned that this transformation is happening in quite different spheres of society. One is the social sciences, where research projects under headings such as 'Computational Social Science' (Lazer et al. 2009) and 'Controversy Mapping' (Venturini 2010) have promoted the idea of utilizing web-based visualizations as analytical devices with which to organize attention and thinking. The movement of computational social science, for instance, aims to emulate data-driven natural science, like physics, by compiling digital traces into depictions of individual and group behaviour. Figure 3 is an example of the kind of web-based visualizations that proponents of this approach envision to be a technique that can transform our understanding of the social world (Adamic & Glance 2005). The visualization is argued to reveal that bloggers communicate in so-called echo chambers that are characterized by a tendency for people to solely engage with other people who share their own basic beliefs (Sunstein 2006). It is the result of an algorithmic scraping of hyperlinks between blogs, an automated structural analysis of the patterns in these links, and a subsequent colouring on the basis of known differences between liberal and conservative bloggers. It is organized spatially through calculations of the networked position of the respective dots, and it promises to equip its users with an understanding of information flows in social media. In that sense, it is a good example of the emerging use of web-based visualizations within the academic social sciences.

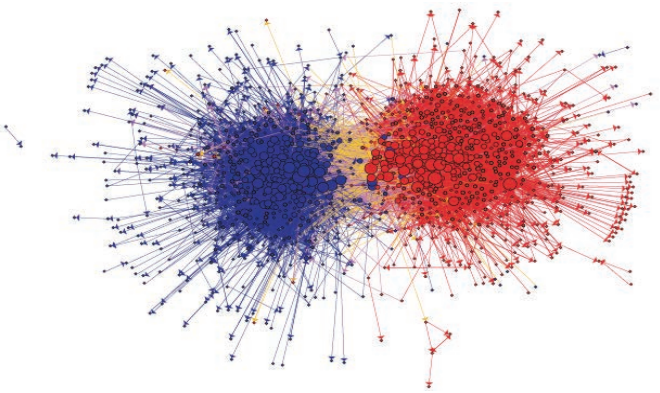

Figure 3: Visualization produced by Adamic & Glance (2009) of the American blogosphere. The red nodes indicate conservative blogs and the red links indicate connections between such blogs. The blue nodes indicate liberal blogs and the blue links indicate connections between such blogs. Orange links represent links from liberal to conservative blogs and purple links indicate links the other way.

When looking outside academia it has already been mentioned that the use of web-based visualizations is, to a large extent, driven by an increased focus on Big Data as a new foundation for data-driven approaches to governance and decision-making (McKinsey Global Institute 2011; World Economic Forum 2012). Digital traces are an important part of the so-called new Big Data sources, and the last five years have seen an emerging use of web-based visualizations in public as well as private organizations. One outcome of this development has been the establishment of specific branches working with this technique in major organizations such as the United Nations, General Electric, and The New York Times. The job of these branches is to turn the myriad of digital traces that are relevant to their organizations into useful depictions of the social environments in which they are acting. Figure 4 shows a visualization produced by UN´s methodological innovation lab, Global Pulse. It is built by scraping word patterns in streams of tweets in Indonesia and the USA. It is presented as a depiction that allows its users to detect early signals of crisis and enables them to understand how people in the two countries are coping with the effects of the financial

crisis. Accordingly, this is a depiction of a social phenomenon and it is spatially organized because the word size indicates how often words are used. The colours on the topic wheel to the right furthermore indicate the 'hotness' of specific topics. In that sense, it is a good example of the way organizations are beginning to use web-based visualizations as a strategic, analytical device that can generate insights into the way people associate with each other, and the way they assign meaning and value to things and events in the world.

Figure 4: Screenshot of a 'crisis-monitor' built by the UN Global Pulse that shows the semantic networks in Twitter data around the category of ´food´.

The combination of the theoretical demarcation, as well as the four concrete examples of web-based visualizations that fall within it, have hopefully given a sense of the kind of empirical objects the concept of web-based visualizations is intended to refer to throughout this dissertation. The visualizations produced by Google, computational social scientists, and the UN illustrate how the common trend of repurposing digital traces to organize social attention materializes in quite different visualizations, and it also illustrates how it is gaining influence in different contexts. The next section will take its point of departure in this demarcation of the subject matter and provide some general arguments as to why web-based visualizations are an interesting object of

study for a social scientific dissertation. It will do this by giving a few details about the process that led to the choice of taking such visualizations as the object of study and by giving a brief introduction to some concepts from Bruno Latour and Annamaria Carusi, which initially served as important inspiration in this process.

1.1.2 Why Are 'Web-based Visualizations' an Interesting Object of Study?

The decision to take web-based visualizations as the subject matter of this dissertation initially sprang out of my MA thesis that analyzed the infrastructures of two web portals, which were launched with the aim of generating, filtering, and synthesizing information in order to improve policy discussions and make democratic processes more responsive to evidence and citizen inputs (Madsen 2013). These portals were launched by the UK and the EU and they were to a large extent driven by an ambition to generate a 'semantic web' that orders information on the basis of formal logic and consistent classifications of web content. The way such schemas of logic and classification were incorporated into the infrastructures of the portals turned out to influence the kind of policy discussions they could facilitate and make visible to their users. This made the portals a good example of how we often come to think and see through technologies, but the fact that few people left data on them indicated that the really influential technologies were to be found elsewhere.

The examples given of web-based visualizations above have hopefully made it plausible that they have the potential to become more influential than the types of web portals that were the subject matter in my MA thesis. The big difference is that their logic is to repurpose the traces already left by people on the web rather than to ask people to leave data on a specific portal in response to a specific question. This move makes them more interesting to study than portals that are well defined but nonetheless rarely used. They are interesting to study because they pose new questions about the

way organizations, social scientists, and citizens use the web to generate knowledge about the social world. They create the possibility for new modes of organization by providing capacities for searching, aggregating, and cross-referencing datasets in new ways and they have the potential to reconfigure the production of knowledge in various spheres of society.

The research-interest in web-based visualizations was accordingly ignited by earlier studies of partly failed web portals. But this empirical motivation is not the only background for the choice of taking web-based visualizations as the subject matter of this dissertation. It was also spurred by a general theoretical interest in writings that emphasize how technologies have previously influenced the way people have thought about the world and acted within it. The relation between technology and cognition has, of course, been a topic in a broad range of academic literature, but two of the most important sources of inspiration in the initial process of framing the focus of this dissertation has been Bruno Latour´s writings on 'inscription devices' and Annamaria Carusi´s suggestion to think about technologies as 'engines' of thought. None of these concepts have been coined to make sense of digital methods per se, and they will not play an explicit role in the remaining chapters of this dissertation. However, the fact that they served as initial inspirations for the formulation of the project makes it relevant to give them a brief introduction. This will serve to set the general theoretical tone that this dissertation is going to follow, and it will provide a general indication of the relevance of approaching thought and attention as material-semiotic practices that are under the influence of technologies like web-based visualizations.

Latour defines an inscription device as "[…] any set-up, no matter what its size, nature and cost, that provides a visual display of any sort in a scientific text" (Latour, 1987: 68). He uses this definition to make a claim that has been influential in framing this dissertation: Inscription devices, and the visual displays they make, are the key subject

matter of study when one wants to understand the practice of modern science. His reason for supporting this claim is that the core output of science is to produce representations of the world, and he argues that such representations are ultimately conditioned upon the technologies that allow the scientist to scale the world down into simple inscriptions. Scientific practice is, in fact, the practice of making cascades of inscriptions that allow scientists to 'see' the world without looking directly at it. Galileo, for instance, only got to see the law of falling bodies when he had the opportunity to attend to diagrams and calculations rather than to the messy world they served as representations of. The point Latour makes is that such diagrams and calculations are inevitably shaped by the available inscription-devices. Scientific thinking is therefore a material and semiotic practice that relies upon the craftsmanship of imaging rather than a logical practice. This makes it more promising to understand its characteristics by looking at the chain of devices that enables inscription and imaging, rather than explaining its characteristics from assumptions about the existence of a specific 'scientific mind' that works on the basis of 'scientific logics'.

The suggestion to explain the scientific revolution as a revolution of sight rather than a revolution of logic is something inspired the early phases in the work on this dissertation. Latour makes this suggestion plausible through a discussion of the way different technologies have throughout time redefined "[…] both what it is to see, and what there is to see" (Latour 1990: 20). One important innovation that Latour focuses upon is perspective drawing because it enabled a previously unseen optical consistency in the presentation of absent things. This consistency made it possible to create representations of the world that could be circulated without being altered. Latour calls such visualizations 'immutable mobiles' and it was these technologies that made it possible for scientists and decision makers to turn their gaze away from the spectacle of the world and move it towards representations instead. One such representation is the map, which came to influence the way, for instance, politicians at Versailles

approached their colonies because they were easy to circulate among interested parties. Maps allowed for the comparison of objects of different scale on paper and allowed for superimposing different images and information. In short, they allowed for enhancing the way the French saw their colonies and the possibility of distributing this conception.

Latour discusses such immutable mobiles as technologies of power because they are devices that can convince people about the way the world looks. His writings assume the existence of an antagonistic situation where the aim of the involved actors is to enrol as many other actors (human and non-human) as possible into a network that can stabilize specific ways of looking at the world (Latour 1991). Latour´s point is that instruments can dominate both thought and sight, and that powerful inscription-chains influence how people see the world as well as how they act within it. The way an accepted map demarcates the world may, for instance, swing the balance of power in situations of colonization; and the granularity of microscope-visualizations may swing the power in scientific battles. Maps and microscope images are, however, just two examples of immutable mobiles that have the potential to influence the balance of power. Latour has argued that the same is true with other inscription-devices such as indexes, bibliographies, papers with references, tables, photographs, bureaucratic filing systems, and money (Latour 1990: 13). What this dissertation takes away from Latour´s discussions is that one should not grant to the mind what should be granted to the hands, the eyes, and the signs. Its choice of subject matter is fundamentally inspired by the suggestion to put inscription-devices into focus when studying what we normally perceive as social or cognitive practices.

This suggestion is also reflected in the work of Annamaria Carusi (2009), whose arguments about the way technologies have shaped philosophical thinking throughout history was another central inspiration for developing the specific research interest of this dissertation. Her work adds to the work of Latour in two ways. The first is that she

illustrates that the link between technology and thinking is not only applicable to empirical practices such as the mapping of a land or the description of microbiological organisms. She makes the important point that technologies also influence modes of thinking in philosophy, which is an academic discipline that is rarely concerned with empirical problems. The second way that her work adds to that of Latour's is in how it distinguishes between the following two manners in which technologies can influence the practice of thinking.

The first way is that technologies can come to function as 'epistemology engines', which means that they provide a frame of thinking that makes some questions more obvious to pose than others. For instance, in the history of philosophy, the theatre has been an important representational technology. With its physical set-up of a stage and a backstage, it prompted some of the questions about the interplay between representation and reality that troubled philosophers such as Plato in ancient Greece. Subsequent examples of technologies that have functioned as epistemology engines within the discipline of philosophy are the 'camara obscura', which raised questions about the extent to which there existed an ideal observer to ensure correspondence between images and reality, or the existence of 'computer models' whose flat ontologies that have prompted new ways of posing questions in the philosophy of mind as well as moral philosophy. On a general note, it can be said that the concept of epistemology engines is useful for drawing attention towards the way technologies can influence how problems are formulated and thereby also stimulate specific modes of thinking.

The second way that technologies can influence the practice of doing philosophy according to Carusi is when they are used as actual tools with which to think. When they are used in this way, Carusi calls them 'philosophy engines', because they become central elements in the way philosophical thinking is conducted. One example of a

historical shift in philosophy engines was when philosophy changed from being conducted through oral dialogues to being a written practice. The technology of paper facilitated a particular form of thinking and reasoning that culminated in Descartes´ lonely meditations, because the practice of thinking with the pen simply made the conception of an isolated (but logical and deductive) brain feasible. The point to draw from Carusi´s argument is that, had Descartes lived at a time when philosophy was practiced through oral dialogue, he would have reasoned in a different manner. A more contemporary example of the influence of philosophy engines given by Carusi is the increasing reliance on software processors with which to read and write a large number of philosophical texts. In contrast to hard copy, reading such texts are not presented as unbroken wholes, and the boundaries between them become blurry once software tools allow for the singling out of specific elements that contain certain references and for mixing these snippets into a new text. The text simply becomes a different semantic object where algorithmic data mining has influence on the phenomenology of reading and thinking.

The thoughts of Latour and Carusi that have been introduced here should, of course, not be seen as exhaustive of the broad range of literature that has suggested approaching thinking as a material-semiotic practice. A review of this literature would be much too general for the topic of this dissertation. The actual review that demarcates the literature that this dissertation is intended to contribute to will be presented in Chapter II, and it will be more narrowly focused on writings on digital methods. However, the arguments of Latour and Carusi have hopefully served to supplement the definition of web-based visualizations with an illustration of the relevance of taking it as the subject matter of a social scientific dissertation. The short introduction to these writers was meant to outline the theoretical inspirations that guided the dissertation work in its initial phases and to set the theoretical tone for way this dissertation will approach these visualizations. The dissertation will not return

explicitly to the concepts introduced by Latour and Carusi, but it follows Latour´s suggestion not to grant to the mind what should be granted to the hands, the eyes, and the signs; and it reflects Carusi´s warning against seeing knowledge as something that floats free of the technologies that structure the questions posed about the world and the technologies used to answer them. The proper literature review that will guide the discussion of web-based visualizations and digital methods throughout the dissertation will be presented in in Chapter II. Before reaching that review the next section will, however, give an introduction to the general methodological prescriptions that have guided the analytical work in this dissertation.

1.2 Clarifying the Methodological Inspirations from Pragmatism

The overall research questions of this dissertation were posed in the introduction where it was also mentioned that they will be answered through a frame as well as three papers that provide separate analyses of web-based visualizations within different contexts. The first paper concerns visualizations that are constructed by organizations in order to scan the environment in which they are to act; the second paper concerns visualizations that are constructed by social scientists in an attempt to understand the fate of emerging technologies; and the third paper presents visualizations that are constructed by the author as part of an experimental set-up, which allows for isolating the effects of specific selection mechanisms that influence the way Google performs the issue of synthetic biology for its users. Besides this variety in the context of the web-based visualizations they study, these three papers also draw upon a varied set of methods to conduct their analyses. The first paper is primarily based on interviews, the second paper is primarily based on document analyses, and the third paper represents an actual engagement with the kind of data mining tools that are the backbone of producing web-based visualizations. This means that the papers will contain different

research questions, be based on different strategies of data selection, and use different methods in their analysis of their specific data sources. The specific choices on these parameters will here be termed choices of 'method', and each paper will give a detailed description of the way it handles them.

It is important to distinguish these choices from the more general 'methodological' questions that are the topic of this sub-section. Whereas questions of method concern, for instance, case selection and coding choices, it can be said that questions about methodology concern fundamental beliefs about the philosophy of science that guides the choices of method throughout this dissertation. Put in another way: The papers may be distinct in terms of methods, but they are all guided by the same methodological sensitivity. This section will provide an introduction to this methodological sensitivity and it will illustrate how it is rooted in the writings of Charles Sander Peirce, William James, and John Dewey, who were all central to the formulation of early American pragmatism[7]. This section will not provide a proper introduction to all aspects of their writings but rather focus attention on three tenets of the movement that has inspired the methodological sensitivity of this dissertation. These tenets will be outlined below with references to their original formulations by Pierce, James and Dewey as well as with examples of the way they have subsequently guided pragmatic research projects within the social sciences. The text will furthermore discuss the influence of these tenets on the overall research questions of this dissertation and the specific choices of method in the three papers. This will be done in order to establish a methodological foundation from which the contributions of this dissertation should be evaluated.

[7] By grouping these writers together I am taking a deliberate choice to bypass the many differences that exist between their versions of pragmatism. I focus on their similarities and I use them to outline a general pragmatic mode of thinking that has inspired this dissertation.

1.2.1 Tenet 1: Create Analytical Objects that Generate Problematic Situations

The most important way in which this dissertation has taken inspiration from the tradition of pragmatism is that it has made the construction of an analytical object its central ambition. The empirical papers and the frame around them serve as inputs to establish 'web-visions' as a relevant analytical object within the field of digital methods. The way this dissertation attempts to write such an object into being takes important inspiration from the way pragmatists have thought about the role of objects in the process of social inquiry since Pierce (1878) proclaimed his 'pragmatic maxim' in 1878. The basic claim of this maxim was that the meaning of any object must be determined by the conception that we have of its effects and that scientific thinking should refrain from making a priori metaphysical distinctions between material and analytical objects. This maxim opens for the possibility to treat analytical concepts and distinctions as objects that have effects on the way people think about the world, and this view on the "objective" character of theoretical vocabularies was a central claim in the early pragmatist movement. It was, for instance, the foundation for James´ (1904) argument to treat religious concepts as real entities with real effects on thinking and action as well as the foundation for Dewey´s (1938) suggestion to approach theoretical concepts and distinctions as heuristic objects through which people experience the world and act upon it. When this dissertation states that the concept of 'web-visions' is introduced as an analytical object, it should be understood in this sense of the word. It is introduced as a new way of understanding web-based visualizations that carries with it guidelines for their practical construction as well. It is a conceptualization with potential effects.

This take on analytical objects is tightly coupled to another assumption that was central to the early pragmatists. This assumption is that such objects are always the outcome of practices of inquiry that follow a specific pattern where empirical and theoretical

influences interact. This idea has most forcefully been formulated by Dewey (1938), who defined the practice of inquiry as the activity of transforming indeterminate and unsettled situations into situations where the basic constituents and the relation between them are known (Dewey 1938:104-105). Dewey's argument is that the practices of inquiry that end up producing analytical objects are initiated as pragmatic engagements with situations that prompt questions about their constituents. They are 'vague' empirical situations with tensions around their description, and Dewey argued that it is this tension and vagueness that drives thought and inquiry. Whereas this is clearly a general methodological statement he claimed that the precise details of this tension and vagueness are unique to the specific unsettled situation. Each situation brings with it its own conditions for action and sense making and Dewey used this insight to argue that analytical vocabularies and methods of inquiry are hard to translate from one situation to another.

If we return the focus to the present dissertation, it is clear that these methodological assumptions fit the way the concept of 'web-visions' has so far been spoken of. It is introduced as an analytical object and the ambition of doing this is a response to a specific situation. This situation includes the failure of existing web portals to establish themselves as useful organizers of knowledge and the rise of digital methods and web-based visualizations as alternative empirical tools that are increasingly used to generate knowledge about the social world. This situation fits Dewey´s points about unsettledness, vagueness, and tension because web-based visualizations are still a flexible technology around which there has not yet been established a coherent vocabulary. Chapter II will review the best attempts at theorizing about the themes it raises in relation to knowledge-generation and it will illustrate that there are tensions associated with describing its main constituents. Theorists and practitioners have fundamentally different ideas about what a web-based visualization is and how to construct it. It is furthermore hard to settle this tension by transferring analytical

vocabularies that have previously been used to describe other empirical tools. In line with Dewey´s methodological prescriptions, there is a need to generate a more thorough understanding about what the situation consists of, and this need is also what motivates the research questions in the introduction.

This brings us to another important element in Dewey´s thoughts about the logic of inquiry. So far it has been argued that he saw practices of inquiry as springing from unsettled situations in order to transform these situations into something more determinate. However, we have only touched upon the characteristics of the unsettled situation and not yet focused on the characteristics of the transformation. Dewey argues that the first step in the process towards more determinate situations is to define the specific problems that the unsettled situation is posing (Dewey 1938: 107). Firstly, this is done by searching out the constituents of the situation, and settling what Dewey calls "the facts of the case". The way these facts are settled will then constitute the terms of the problem that the situation poses. Dewey exemplifies this by imagining a situation in which a fire alarm goes off. Specific facts of this situation would be that there is a fire at a certain location, that there are a number of exits from which people can escape this location, that there is a certain number of fire extinguishers at the firemen's disposal and so on. This example is very simple, but it serves to illustrate the importance of settling the facts of a given situation, constituting the terms of the problem it can be said to pose, and defining the boundaries of the possible solutions to this problem. Doing this is the central element in the practice of inquiry according to Dewey.

Returning to the present dissertation, it is clear that such a 'problematization' was already initiated in section 1.1, where the definition of web-based visualizations is obviously an attempt to settle the situation under discussion and constitute the problems it can be said to pose. This problematization will be continued in the sections

of this dissertation that provide answers to the first research question in the introduction. The identification of actors, challenges, and trade-offs in the construction of web-based visualizations is, at the same time, to draw up the constituents and "settle the facts" about a situation, where these empirical tools are spreading beyond the field of Internet search. The answers to the first research question will accordingly serve to disaggregate the phenomenon of web-based visualizations into its constituents in a way that will bring out problematic aspects of the situation in which they are currently constructed and discussed. Such problematic aspects can be practical problems in the actual construction of such visualizations as well as theoretical problems in relation to the way they have been previously conceptualized. The 'problematization' connected to the first research question is, accordingly, intended to stimulate an analytical sensitivity towards the multiple actors that go into producing web-based visualizations and to pinpoint the conditions of possibility for their production.

This strategy of 'problematization' through disaggregation is not only in line with Dewey's early claims about the patterns of social inquiry. It is also inspired by the way Emirbayer & Mische (1998) have recently illustrated the fruitfulness of this strategy by disaggregating the concept of agency into its analytical constituents. They use this disaggregation for two purposes. First, as a foundation from which to problematize the theoretical tendency to see agency as either a product of social structures or a result of individual free will; and second, to suggest the need for a theoretical vocabulary that sees agency as comprised of constituents that leave specific degrees of manoeuvrability on the basis of the way they are combined. By disaggregating the situation of action into its constituents, they build a foundation from which they can account for the variability and change in actors' capacities for intervention in the contexts within which they act. The point is that this disaggregation guides empirical research of agency in new ways compared to existing vocabularies (Emirbeyer & Mische 1998).

The detailed argument that Emirbeyer and Mische provide about agency is, however, not of interest here. The reason for mentioning their study is that its way of engaging with discussions about agency exemplifies Dewey´s points about the patterns of inquiry. It takes an unsettled situation, problematizes it by disaggregating it into its constituents, and uses this 'problematization' as a point from which to suggest a new way to think about it. This movement towards a 'resolution' is the third central aspect of the way Dewey spoke about the logic of inquiry. He emphasized that the practice of inquiry is not just to examine the conditions of a situation and disaggregate it into its constituents. It is rather to examine these conditions and constituents with reference to the potential of actualizing certain responses to the situation. Problematization and disaggregation must, in other words, be followed by resolutions that consist of the formulation of an idea or an analytical object that is coherent with the settled facts and suggests new ways of thinking about them (Dewey 1938). This is why Dewey took pragmatist inquiry to be a progressive mode of inquiry. It determines both a problem and provides resolutions to them (Dewey 1938: 108).

Returning to this dissertation, it is clear from the discussion so far that the introduction of 'web-visions' as a new analytical object is intended as a first step towards a resolution of the problematization ignited by the answers to the first research question. On a general note, it can be said that it is intended to produce empirical distinctions that are not yet present in the field of digital methods but nonetheless fits the empirical findings in the papers of this dissertation. One example of such a general distinction is that this dissertation suggests talking about 'web-visions' as a distinct empirical tool within the Big Data movement. This is done in a way that enables a discussion of the actors involved in the construction of these visions that is more focused than the general discussions of Big Data that collapse a range of different tools into one concept. However, this dissertation will also suggest more fine-grained sub-distinctions between the different constituents of 'web-visions'. This can, for instance, be

distinctions between elements in the socio-technical assemblages that influence the final shape of the visualization; distinctions between specific trade-offs that arise from the combination of these elements; and distinctions between different types of 'web-visions' with different dynamics. The details of the resolution suggested with the introduction of 'web-visions' will be developed throughout this dissertation. For now, it is enough to emphasize that it follows Dewey´s logic of inquiry. The next sub-section will argue that the extent to which 'web-visions' are considered to be productive and relevant analytical objects to study should also be discussed with roots in the criteria that the early pragmatists suggested using when evaluating theoretical interventions.

1.2.2 Tenet 2: Evaluate Analytical Objects as Heuristic and Coherent Interventions

The first thing to emphasize about the way the early pragmatists thought about theory and how to evaluate its merits is that they did not work on the basis of a clear distinction between the descriptive and the prescriptive. Following from Dewey's thoughts above, it is clear that he did not conceive of the process of settling the facts of a situation as unrelated to the process of providing a resolution that ties these facts into a coherent whole. Dewey's own work on the role of electrical communication at the end of the 19th century is a case in point. It shifts between statements about the way new communicative technologies, such as the telegraph, could be described as a giant nervous-system and prescriptive statements about the way it needed to be treated as such a system in order for the expanding American nation to function as a coherent whole, where the externalities of people's action became visible to themselves (Dewey, 1927). Because Dewey saw theories as ignited by pragmatic engagements with the world, he was also prone to evaluate them as heuristic tools that could be expected to provide possibilities for new forms of engagement and that were able to direct thoughts and inquiries in new productive ways. If one follows Dewey´s line of thought, one

should look at theories as 'objects' that are abstracted from practice and then used as a basis from which to engage with the same practices again.

The move of giving theories the status of tools could be misinterpreted as an acceptance of a pure theoretical instrumentalism where 'anything goes' as long as it generates good practical effects. This interpretation of pragmatism has often been made with reference to James´ statement about truth as something that has a 'cash value' in the sense that it is an instrument that can be more or less suited to generate effects in the world (James 1907a: 98). James´ argument is that propositions are not true and false, but that truth and falsity is something we ascribe to them if they do—or do not—enable us to engage with the world in productive ways. Or as James formulated it: "[…] the true is the name of whatever proves itself to be good" (James 1907a: 109). This anti-metaphysical epistemology represents a clear break with rationalistic attempts at solving theoretical problems whose solutions have no practical effects. Both early and more contemporary pragmatism has exemplified how the pragmatic stance on truth can be used to bypass fruitless metaphysical quarrels. James, for instance, provided many examples of what he believed to be fruitless metaphysical debates, and his work was an attempt to strip truth claims of their metaphysics and lay bare their lack of effects or their normativity. Peter Strawson (2008) has, more recently, continued this line of pragmatic reasoning by arguing against the possibility of discussing stances on free will and determinism on strictly logical grounds. Since this is a debate that cannot be settled on logical grounds, he argues that any attempts at doing so will be futile. The debate can, however, be settled though pragmatic means in the sense that the standpoint of determinism can plausibly be argued to have the worst consequences for the way we think about responsibility.

These examples illustrate that pragmatism does indeed involve a certain instrumentalism, but it is important to emphasize that this does not warrant the

interpretation that ‘anything goes’. The claim that theories must make a practical difference does not entail that everything that does make a difference should be considered true. Usefulness and practical effects on thinking and action are just *necessary* conditions for theories to be evaluated positively. They are not *sufficient* conditions for such an evaluation and this becomes evident when one inquires into the evaluation criteria that both James and other pragmatists proposed as supplements to that of truth’s ‘cash-value’. The most important such criterion is that of ‘coherence’ between the proposed analytical objects, the experiences we have of the world, the conditions of the problems the world provides us with, and the existing beliefs we hold about the world.

The introduction of the criterion of coherence shows that usefulness is not enough for a theoretical object to be evaluated positively. It must also stand in a coherent relationship to the existing system of accepted analytical objects. James even claimed that the production of true theories was a result of marrying previous parts of experience with newer parts and he emphasized that one needs to remain loyal to older truths in the production of new ones (James 1907: 102-103). Dewey also made the point that the final test of the worth of an analytical object should include its pragmatic functionality as well as its coherence with already held beliefs about the problem that ignited it (Dewey 1938: 111-112). A central element in Dewey´s approach to inquiry is, accordingly, that people doing inquiry must take account of the past and they must start their engagement with the world on the basis of knowledge of already held beliefs about it. The criterion of coherence accordingly illustrates why the early pragmatists were not pure instrumentalists, but it also indicates that they did not evaluate theoretical work on the basis of an otherwise widely used criterion, which is that theories should be slimmed down to a few concepts and their causal relation to each other.

The framework of 'web-vision analysis' is not introduced as a causal theory. It is rather introduced as an intervention that attempts to ignite new imaginations and new ways of thinking. It should, accordingly, be evaluated on the extent to which it succeeds in describing web-based visualizations in a way that does more than reproduce the language of the field and the extent to which these descriptions stimulate new discussions in relation to the construction of web-based visualizations. Furthermore, it should be evaluated with reference to the extent to which it succeeds in suggesting a way to deploy the digital media for research without succumbing to its own logics. The introduction of the concept of a 'web-vision' can, for instance, be said to run the risk of reproducing the visual bias of the medium, and it therefore needs to be evaluated with reference to whether it engages critically with this potential bias. Finally, it should be judged on the extent to which it can serve as an analytical object that brings out interesting tensions in existing vocabularies while at the same time maintaining consistency with accepted empirical findings in the field of digital methods. In short, it needs to be evaluated as something that intervenes in an unsettled situation and that has a descriptive as well as a prescriptive component that makes sense in the field of digital methods as it currently exists.

1.2.3 Tenet 3: Engage with the World Through Experimentation

The first tenet of pragmatism concerned the way analytical objects and practices of inquiry are to be understood, and the second tenet concerned the way they should be evaluated. The third tenet that ends this section on methodology concerns the way they are to be constructed and carried out. The general discussion about the patterns of inquiry were taken up in relation to the first tenet above, but it did not touch upon the special role that the early pragmatists gave to experimentation and the way this dissertation has taken inspiration from the experimental approach that the pragmatists advocated. This will be done here, and it is necessary to emphasize that the experimental mode of inquiry had two different meanings in early pragmatism. The

first meaning concerns the selection of data and the suggestion to maintain an iterative sensitivity to this part of the process of inquiry. The second meaning concerns the treatment of data and the suggestion to manipulate the world in order to produce interesting effects through which objects in the world can be understood and conceptualized. Both of these meanings of experimentation have served as methodological inspiration for the analyses in this dissertation.

The suggestion to maintain an experimental mode of inquiry in relation to the collection of data was especially central to Dewey, who emphasized the need to select data with reference to the problematic situation one inquires into. However, Dewey argued that the specific character of a problem may shift in the process of settling the facts about the situation that poses it. This led him to state that the activity of data collection is akin to the activity of collecting materials for building a house before having a plan for building it: One must collect in anticipation of what will come in useful after the plan has been made (Dewey 1938: 232-3). Dewey does not refer to this as a mode of experimentation, but his metaphor suggests an experimental and iterative approach to data collection. It is a way to acknowledge that the situations that are interesting to research are comprised of a wealth of empirical material, and that what ends up being selected as facts of a given situation is the outcome of a process where the end is not pre-given but rather achieved by trying out different settlements through the collection of different data forms (Dewey 1938: 497).

The fact that this dissertation covers a broad range of study objects and methods reflects that its process of data collection has been somewhat experimental and eclectic. It has been a priority to maintain a constant sensitivity to interesting examples of web-based visualizations rather than to follow a research design where the empirical objects of study, the methods, and the theories were decided beforehand. The rationale for having such an emergent and inductive research design is that web-based

visualizations is a phenomenon that has been constantly evolving and increasingly written about in the three years I have spent doing my studies. Whereas few wrote about Big Data in 2010, it is now mentioned as a research priority in journals, conferences, and even in departmental strategies. Rather than starting with clearly defined samples and concepts, I have tried to remain open to this development by constantly changing the way I saw the object of study and the questions that this dissertation was supposed to ask. Another way that the data collection has integrated experimental reasoning is that the case studies in the papers have been chosen on the basis of experimental logics. An example is the way the first paper is built on a 'most different' research design. The cases studied are chosen because they are constructed in response to a diverse set of problems, and this makes them a good resource for identifying general problems and trade-offs in the construction of such visualizations. This way of selecting cases on the basis of known parameters is very different than selecting cases on the basis of a sampling logic, and the visualizations studied in the other papers have been selected on the basis of similar logics.

The second way the pragmatists suggested that practices of inquiry could be experimental is more akin to what is traditionally understood by the concept. They simply argued for the potential of creating analytical objects through experimental set-ups, where the effects of the relevant objects are controlled through manipulation (Menand 1997). This suggestion has its roots in Pierce´s pragmatic maxim that called for the creation of knowledge of objects through a focus on their effects. Such effects are, however, not readily visible, and Pierce was one of the first to argue for the potential of using controlled experiments in psychology and education; he even proposed it as a way to solve philosophical questions (Hacking 1990). His pragmatic maxim simply led him to see mental reflection as an outcome of an experimental engagement with the world, and his positive attitude towards the experimental research design was taken up by other pragmatists as well. James, for instance, claimed that

inquiry was about learning what sensations to expect from the world and how to prepare reactions to it. Moreover, he argued that the experimental method was a powerful way of doing that (James 1907). The founding logic of the so-called Chicago School of sociology was similar in its conception of the city as one big laboratory. The members simply took advantage of the fact that the city burned down in 1871, and they used this destruction as an opportunity to study city planning and urban development through experimentation with new ways of building and organizing a city (Carey 1989). This is a good example of the way early pragmatists engaged with the logic of experimentation, and an important outcome of this engagement was that the distinctions between knowing/doing and description/prescription were blurred (Manand 1997).

Just as this dissertation is inspired by the way in which the pragmatists suggested an experimental approach to data collection, so is it inspired by this way of thinking about the treatment of data as an experimental endeavour. It has already been noted above that the papers in this dissertation are built on the basis of case-study logics; however, the third paper stands out because it presents a research design that comes as close to an experimental set-up as possible when studying web-based visualizations. More specifically, it generates knowledge about the 'web-vision' that Google provides its users with in relation to the issue of synthetic biology by subjecting the search interface to different experimental treatments and locating their effects. The results of the paper will not be discussed here, but it is important to note that it exemplifies how this dissertation has taken methodological inspiration from the way the pragmatists suggested controlled effects as a productive mode of inquiry. It has simply engaged in the creating and manipulation of 'web-visions' in order to learn about them. The discussion in section 6.2 of the third paper will contain reflections on the potentials and pitfalls of using the experimental method as a mode of inquiry to learn about digital methods and it will therefore not be commented upon further here.

This section has hopefully given a foundation from which to understand the general methodological sensitivities that have inspired the work in this dissertation and the way it aims at introducing a new analytical object into an already existing field. The choices of methods taken throughout the papers and the findings provided by these papers should accordingly be evaluated with reference to the three tenets of pragmatism outlined here. The subsequent chapters in this dissertation will only contain few explicit references back to these tenets, but it will hopefully be clear how they have guided the arguments they make. With these comments on the methodological foundations of the research done in this dissertation, it is now time to end Chapter I on 'Background & Methodology' and turn to a proper review of the main themes that have been discussed within the field of digital methods throughout the last decade.

Chapter II: Four Prominent Themes in Contemporary Research on Digital Methods

The previous chapter provided a demarcation of the concept of 'web-based visualizations' and a description of the intellectual process that led to the specific research interests in this subject matter. Furthermore, it outlined the central characteristics of the pragmatic attitude towards the practice of social inquiry that have provided the methodological foundation of the dissertation and guided the kind of theoretical contribution that it aims to make. At a general level, it was argued that the ambition of this dissertation is to carve out 'web-visions' as an analytical object that can inspire future analyses of web-based visualizations and make new (and potentially problematic) aspects of these devices visible. The ambition of constructing an analytical object that makes new aspects visible is, however, only meaningful if it is related to already existing vocabularies, and this chapter will clearly illustrate that the analytical object of 'web-visions' is not constructed in a theoretical vacuum. To the contrary, it is inspired by—and introduced to engage with—contemporary research that aims to understand the characteristics of digital traces and web-based visualizations and its potential as a resource for social inquiry.

This section will review contemporary research that this dissertation conceives of as belonging to the field of 'digital methods'. This is admittedly not a well-defined academic field, but it will here be taken to include the collection of academic works that a) have aimed to understand and conceptualize the way digital traces and web-based visualizations are influencing the way we generate knowledge about the social world; and b) share the general belief that such traces and tools have been accompanied by a shift in the way academics and organizations relate to the empirical (Adkins & Lury 2009). It is within this field of digital methods that the concept of

'web-visions' is intended as a new contribution, and the review below will highlight four themes that have been central to recent discussions within it. Each of the next four sections will introduce one theme and provide a review of the most influential ways of approaching it within contemporary writings on digital methods. By giving a detailed introduction to its central themes and the relevant existing vocabularies discussing them, this chapter intends to establish the 'state of play' within the field of digital methods and build a foundation from which to discuss the contribution that the framework of 'web-vision analysis' can make within it.

The first theme reviewed concerns the role of theory in the production of web-based visualizations. This theme has been the topic of much popular discussion about the potential of using web-based visualizations as a new tool of social inquiry and different approaches to it will be reviewed in section 2.1. It will be clear that this theme has particularly been promoted by theorists who argue that web-based visualizations provide a possibility to conduct a purely empiricist social science that pushes theoretical assumptions and inferences to a marginal position. But the section will also show how theorists with roots in Actor-Network Theory (ANT) have discussed the possibility of using the granularity of digital data to move away from the tendency in the social sciences to start with a priori theoretical distinctions. The second theme concerns the issue of representation and the extent to which web-based visualizations should be seen as representative of the social phenomena they depict. Section 2.2 will review the work of theorists that are all arguing for the need to rethink existing notions of representation because they sees these notions as ill suited to fit the characteristics of digital traces. The concepts they introduce as part of this rethinking are, however, distinct from each other and they each suggest different ways of approaching this theme. The third theme concerns the temporality of web-based visualizations. Section 2.3 reviews literatures that are touching upon the connection between the rise of digital data and the ambitions of doing real time social inquiry, but it also introduces other ways of thinking about the temporal dynamic of digital data. The fourth theme

concerns the distribution of actors involved in the production and analysis of data within digital methods, and section 2.4 reviews literature that has pondered the way this distribution can influence the role of professions that have traditionally claimed expertise in the practice of data literacy. Finally, section 2.5 provides a short outro that summarizes the main arguments of the four themes and hints at the way they will be used as a basis from which to discuss the characteristics of 'web-visions' throughout this dissertation.

Before initiating the review two things must, however, be explicated. The first is that the choice of talking about a field of digital methods that can be divided into four distinct themes is a construction on the part of the author. Firstly, it is not all of the theorists that are presented as contributing to a specific theme that refer explicitly to each other, and few of them define themselves as working within a field called digital methods. Those that do consider themselves as working within this field would, furthermore, define it in a much narrower way than I have done above. Indeed, this narrow definition is part of the reason why others would be reluctant to associate themselves with the label. Some writers may interpret the concept of 'methods' as denoting an empiricism that bypasses important theoretical and epistemological questions, and this would be a reason for them to label themselves practitioners of 'digital sociology' or another broadly labeled field. This dissertation has chosen to speak about a field of digital methods in the broad definition above because it is broad enough to capture the empirical developments and theoretical questions that drive its research interest and narrow enough to exclude a range of research interests that would fall under broader headings such as 'digital sociology'.

Secondly, it should be noted that the choice of splitting the field up into four themes is also not taken from the theorists themselves. It is an outcome of the way the literature review has structured and grouped their work. The text below will illustrate that many

theorists are active in discussing more than one theme and that their thoughts on two different themes can rarely be separated from each other. The distinction between the four themes, however, allows for putting emphasis on important theoretical discussions in relation to the practice of constructing web-based visualizations and the role that these devices are increasingly playing in contemporary knowledge-creation. The review below is in that sense constructed to be a useful basis for introducing the concept of 'web-visions' in relation to these central themes. This basis will be used to clarify which works within the field of digital methods that have served as inspiration for the concept as well as which modes of thought and concepts within the field it is meant to problematize.

The details of the relation between the concept of 'web-visions' and already existing vocabularies within the field of digital methods will, however, only be briefly touched upon in this chapter. The discussion on this relation will be more thoroughly taken up in the text surrounding the empirical papers in Chapters IV-VI as well as in Chapter VII. The text in this chapter will, to the contrary, focus on reviewing the most prominent contemporary thoughts on the four themes within the field of digital methods.

2.1 The Rise of Empiricism and the End of Theory

The first theme concerns the role of theory in digital methods, and this theme has most visibly been discussed by works that highlight the possibility of using digital data and visualization techniques to generate knowledge about the social world without invoking theoretical assumptions. These works argue that the emergence of such data and techniques have enabled a 'rise of empiricism'. They built this argument on the assumption that digital traces have certain merits compared to earlier forms of data. In

contrast to data obtained from, for instance, surveys and focus groups, it is argued that digital traces are less mediated and more direct sources of empirical insight. One argument used to back this claim is that digital data streams are so big and continuous that they can be analysed by taking advantage of the patterns that naturally emerge out of them in real time. Rather than having a theory from which to interpret data, it is argued that the size of digital data allows people to derive meaning directly from the empirical world. Another argument used to back this empiricist claim is that digital traces are 'honest signals' of people's preferences and behaviours because they leave them as they go about their daily routine, rather than leaving them as a response to a prompt by a researcher with biased theoretical preconceptions of the world. The two subsections below will look at each of these arguments in turn.

2.1.1 A Science Without Theory and Inferences

The first argument mentioned above concerns the possibility of deriving meaning from patterns of data in an inductive fashion rather than subjecting data to deductive theoretical tests. This argument has surfaced in different forms in different writings on digital data, but it has had its most extreme formulation in an essay in Wired Magazine entitled 'The End of Theory' (Anderson 2008). In this piece, Chris Anderson argues that we live in a 'petabyte age' where the flow of data is so massive and granular that organizational metaphors such as the folder, the filing cabinet, and the library have difficulties grasping the way data is produced, the way it should be ordered, and the way it can be used as a foundation for creating knowledge about the world. The point Anderson wants to make with this comparison is that contemporary data flows are too big to be organized on the basis of pre-defined categories, which is a central element in all the three organizational metaphors that he mentions. The conclusion he draws from this comparison is that contemporary practices of social inquiry must model

themselves on companies like Google. The reason for this is that Google grew large by refusing to order information on the web on the basis of pre-defined categories such as 'sport' and 'movies'. The company found an efficient way to determine the relevance of information on the basis of empirically detectable patterns in digital traces instead. Anderson´s most important claim is, accordingly, that the social sciences also need to understand the world by looking at people's interactions instead of looking in books filled with theories:

> This is a world where massive amounts of data and applied mathematics replace every other tool that might be brought to bear. Out with every theory of human behavior, from linguistics to sociology. Forget axonomy, ontology, and psychology. Who knows why people do what they do? The point is they do it, and we can track and measure it with unprecedented fidelity. With enough data, the numbers speak for themselves (Anderson 2008).

The reasoning behind this quote is that the proliferation of digital data and data mining software has made classic hypothesis-driven science obsolete. Whereas the pre-digital data environment made it necessary to rely on models and hypotheses to separate correlations from outright causations, this is no longer the case according to Anderson. Data without models or hypotheses should no longer be considered 'noisy', because the flow of data is so big, granular, and continuous that it tells more compelling stories than any theory that has ever been crafted on the basis of a sample. Who knows why people do what they do? Anderson´s answer is nobody. This is why he argues that the only sensible move for producers of knowledge about the social world is to follow recent moves within physics, biology and computer science and take advantage of new sources of data that can generate insights without the aid of pre-existing theories:

There is now a better way. Petabytes allow us to say: "Correlation is enough." We can stop looking for models. We can analyze the data without hypotheses about what it might show. We can throw the numbers into the biggest computing clusters the world has ever seen and let statistical algorithms find patterns where science cannot (Anderson 2008).

The arguments in Anderson´s essay are clearly polemical, and the fact that they were published in Wired Magazine also makes it necessary to read them as inputs to a popular and somewhat polemical debate. But this does not mean that they have no resonance in more serious academic discussions about digital data and knowledge-creation as well. Anderson´s earlier arguments about 'the long tail' of the Internet have been hugely influential for the way academics, organizations, and the public have come to think about the potentials of the web and the general line of his arguments in 'The End of Theory' have similarly surfaced in high profile publications both before and after his essay sparked discussion about the role of digital traces in contemporary knowledge creation.

An influential example is a 2009 paper in Science entitled 'Computational Social Science' (Lazer et al. 2009). The paper is co-written by some of the most influential North American scholars within the field of data mining and network-analysis and even though it does not contain explicit references to Anderson´s essay, it mirrors some of its central arguments. The overall argument of the paper is that digital traces represent a new empirical foundation for the social sciences that can potentially transform the way we understand ourselves and the societies we are part of. The argumentation in the paper resembles Anderson´s argument that the social sciences must emulate fields like biology and physics in being more data-driven. The authors emphasize that existing ways of approaching the social world were developed without access to the terabytes of data that are now available for describing minute-by-minute interactions and locations of entire populations of individuals. Why, for instance,

conduct cumbersome surveys when social networking sites have almost complete datasets that allow for understanding people's tastes, moods, and health in a much more granular manner? The claim underlying the rethorical question raised in this very influential paper is similar to Anderson´s. Social scientists need to understand and emulate the way a company like Google has let their understanding of the world be guided by patterns that emerge from big empirical datasets rather than by theoretical assumptions.

This suggestion to diminish the role of theory has so far been introduced with reference to writers that have sometimes been criticized for promoting a naïve positivism or too extreme an empiricism. But the argument about the need to bypass useless theoretical distinctions has also been made by writers within ANT such as Bruno Latour who was in Chapter 1 introduced as a theorist that emphasizes the performative role of technologies and material devices in the production of knowledge. Latour, accordingly, writes from a different epistemological perspective than both Anderson and proponents of computational social science but he nonetheless makes similar suggestions about the relation between digital data and theory. More specifically he argues that the granularity of digital traces should be used to start investigation of the social world without assumptions about the existence of micro- and macro levels of analysis:

> The best proof that those two levels do not correspond to any real ontological domains is that they begin to disappear, to be literally distributed, every time one modifies or enhances the quality of access to the datasets, thereby allowing the observer to define any actor by its network and vice versa. This is exactly what the striking extension of digital tools is doing to the very notion of 'individuals' and 'wholes' (Latour et. al 2012: 5)

The point underlying this quote is that the reason why sociologists have spent their time dividing the social world up into theoretical distinctions between the micro and the macro is that they have not yet had data that was granular enough to conduct

analyses without such distinctions. When an analyst lacks granular data it is a necessary move to start from artificial analytical distinctions that entail treating entities as different from their structural context. But Latour and others argue that the choice to start with this a priori distinction will always end up producing a social theory that explains either how interaction between individuals creates the structures or how the structures shape the individuals. The point they want to make is that the granularity of digital data make it possible to navigate from elements to aggregates and back again without pretending to shift analytical levels (Latour et. al 2012).[8]

2.2.2 An Honest Data Source

The second argument underpinning the 'rise of empiricism' is that digital traces are a more direct, unmediated, and honest source than data emerging from, for instance, surveys and focus groups. This claim has been made in different ways in different types of studies but it is most often made with reference to the work of Alex Pentland, who was also one of the co-authors of the paper on computation science mentioned above. Pentland and others has famously coined the concept of 'honest signals'

[8] Latour and others illustrate this point by pointing to the increased availability of digital profiles from which they argue it is possible to follow the network that makes up an actor. An example is that a homepage at a university is a digital profile that can be an entry point for tracing the network that makes a specific professor the actor he or she is at a specific moment in time. The point is that the activity of tracing such a network can be done without changing levels of explanations and without treating the professor as an individual entity and his or her network as a structure. The CV of the professor would perhaps disclose that he or she has been affiliated with other universities. But these universities do not need to be conceived of as existing at a higher level because the specific associations the person has had to these universities can be traced as well. The same is true for the fact that the CV will disclose the theoretical inspirations for his or her research. But instead of thinking of such inspirations as part of abstract paradigms, it is possible to trace whom they cite, who cites them, and who defines themselves as working with the same theories. The argument is that it is possible to draw the network in a 'flat' manner.

(Pentland & Pentland 2008) as a reference to the range of non-verbal behavioural data that people leave as they go about their daily lives:

> Nonverbal communication can be considered as one of the physical, detectable, and measurable evidences of our inner life, the other being the content of our verbal messages. But unlike the latter, nonverbal communication is typically *honest* and reliable because it is mostly out of the reach of conscious control, thus it leaks information about our actual state and not what we want to show as such (Vinciarelli et al. 2008)

The claim here is that non-verbal data provide honest signals of people's inner life because they are based on real behaviour rather than reported behaviour (Pentland 2012; Vinciarelli et al. 2008). Honest signals are, in Pentland´s work, argued to have a sort of introspective capacity that distinguishes them from other types of data.

In relation to the topic of this dissertation, it is, however, important to emphasize that Pentland´s thoughts about honest signals were introduced to make sense of quite specific physical behavioural cues like postures and voice qualities. He explicitly states that he is not talking about digital traces like Facebook updates and search queries, which are the kind of data sources that are the topic of this dissertation (Pentland 2012). Pentland´s ideas about honest signals are, however, still relevant for the subject matter of this dissertation because they have been translated into discussions about the potential of using digital traces as proxies of the social world in a range of disciplines. One example is the way the data about people's search behaviour on Google´s interfaces is argued to be a reliable source of data within the field of consumer studies:

> Search not only precedes purchase decisions, but in many cases is a more "honest signal" […] of actual interests and preferences since there is no bargaining, gaming or strategic signaling involved, in contrast to many market-based transactions. As a result, these digital traces left by consumers can be compiled to reveal comprehensive patterns of the true underlying intentions and activities (Wu & Brynjolfsson 2009)

Search behavior is, here, presented as an activity that reflects the true intentions of consumers because there is no strategic manipulation involved. The search box on Google´s interface is seen as a neutral device for collecting people's inner thoughts and this is once again positioning Google´s approach to data collection as being especially valid. This claim has also surfaced within contemporary network analyses where, for instance, Mark Newman and Duncan Watts have argued that digital traces are a direct source of data that is more objective and less prone to researcher bias than the survey data usually used for social network analysis (Newman et al. 2007).

This argument about the honesty of digital traces has also been promoted by Bruno Latour, who has stated that such traces are a kind of social scientific data that open up our private worlds for scrutiny in a way that makes visible the "[…] precise forces that mould our subjectivities and the precise characters that furnish our imaginations" (Latour 2007). Latour makes this claim on the basis of an assumption about the possibility to quantify the most intimate aspects of the social world, which he takes to be all the little connections and associations that individuals make with each other:

> […] the more we get into the intimacy of the individual, the more discrete quantities we'll find; and if we move away from the individual towards the aggregate we might begin to *lose* quantities, more and more, along the way because we *lack the instruments* to collect enough of their quantitative evaluations […] the very heart of social phenomena is quantifiable because individual monads are constantly evaluating one another in simultaneous attempts to expand and to stabilize their worlds (Latour 2010: 148-149).

Latour´s argument is that the rise of digital methods and web-based visualizations has provided tools that make it possible to depict the 'inner quantifications' of individuals. Such quesntifications could, for instance, be judgements of taste (through likes) and inflexions in the way we speak (through semantic pattern recognition). Latour draws

on the sociology of Gabriel Tarde to argue that such quantifications lie at the heart of social phenomena because it is through calculations that people coordinate their actions. His argument is that what we usually take to be qualitative phenomena is actually where the greatest numbers of calculations are being made and the fact that digital methods comes with techniques to measure these inner calculations will make it a productive move within the social sciences:

> It is indeed striking that at this very moment, the fast expanding fields of "data visualisation" "computational social science," or "biological networks" are tracing, before our eyes, just the sort of data Tarde would have acclaimed (Latour 2010: 160-161)

Latour is here making an explicit reference to the kind of computational social science advocated by Lazer and others and his argumentation about the potential of digital methods to depict 'inner quantifications' bears important resemblances to the arguments about honest signals reviewed above. He speaks about such quantifications as the 'real quanta' of the social (Latour 2010: 152) and as the 'precise' forces that mould our subjectivities and furnish our imaginations. In his view they can be the foundation for the introduction of new forms of measurements in the social sciences. One example he gives is how digital traces enables the construction of new 'value-meters' that can quantify inter-subjective mechanisms of valuation (Latour & Lepiney 2009: 20). The main point is again that the social scientists should understand what Google and other have already grasped. Namely, that a focus on the (qualitative) calculations people constantly make allows for a new form of quantification (Latour 2010: 155). Latour uses Tarde´s sociology and the emergence of digital data to argue for a redefinition of what it means for a discipline to be quantitative for the need to accept that the heart of the social is now quantifiable.

Throughout this dissertation, it will be clear that the framework of 'web-vision analysis' is introduced as a vocabulary that suggests a different way of approaching the

theme of theory than the works introduced in this section. The concept of 'web-visions' will first of all problematize the idea that the proliferation of digital data enables a mode of data collection where categories are derived out of empirical patterns. Rather than seeing web-based visualizations as devices that enable a break with theory, it will suggest that they are 'visions' that distribute theoretical work across different actors. This argument will partly be grounded in some of the works introduced later on in this chapter, but it will be most thoroughly grounded in the writings of Cooley, Gibson, and Espeland, which will be introduced as the theoretical foundation for the concept of 'web-visions' in Chapter III. This argument will also be backed up by findings in the three papers in Chapters IV-VI. Furthermore, the concept of 'web-visions' will provide a way of looking at web-based visualizations that can be used as an alternative way of interpreting and evaluating them as tools of introspection. The argument for this alternative way of looking at web-based visualization will most importantly be grounded aspects of Gibson´s writings introduced in Chapter III and in empirical examples from the three papers in Chapters IV-VI.

2.2 Re-thinking Representation

A second theme that has been the subject of intense discussion within the field of digital methods is the extent to which web-based visualizations should be seen as representations of the phenomena they depict. This section will introduce concepts that ignite a new reflection on what representation can possibly mean when we talk about digital methods. More specifically, it will discuss the way the concepts of 'more-than-representational spaces', 'web-epistemology', 'online groundedness', and 'second-degree objectivity' have each attempted to capture the ways in which digital methods and web-based visualizations can (or cannot) be productively evaluated on epistemological criteria related to representation.

Celia Lury and Lisa Adkins (2011) have recently touched upon the theme of representation by arguing that new modes of digital measurement and visualization need to be thought of as existing in 'more-than representational spaces'. The main point they make is that contemporary experiments with digital measurements and visualizations should not presume the term of representativeness. Such experiments are, to the contrary, conducted in spaces where the 'what' and the 'how' are co-produced and where the pragmatic conceptualization of knowledge as a practice that shifts between the two seems the only viable solution. Lury and Adkins argue that the rise of digital data and the rise of epistemic spaces that are 'more-than-representational' are connected because digital data streams have led to a shift in the way symbols and indices are used in the generation of knowledge:

> […] the recent emphasis on the post-representational has challenged the assumption of the importance of the symbolic over the responsive and the rhetorical dimensions of representation […] the indexical and the symbolic are being combined in new ways in such spaces (Lury & Adkins 2011: 19).

Lury and Adkins emphasize this shift in the relation between symbols and indices because representational activities are often tied to the use of symbols. The reason for this is that symbols are exterior to the mind and therefore easy to share and spread as representational metaphors. They mark associations between entities in the world in a way that allows humans to ignore the indices that are situated in the individual mind. The point is that the power of symbols have made such indices play a minor role in processes of representation, but Lury and Adkins´ argument is that this is changing with the introduction of new modes of digital data:

> […] the ability of the indexical to enable (social) relations is being vastly extended through the development of diverse, iterative and automatic information-processing systems, supported by

memory systems with the capacity to support, extend and make intelligible indices outside the individual mind (Lury & Adkins 2011: 20).

A central point in these quotes is that automated information-systems make indices intelligible outside the individual mind. This empowerment of indices over symbols has an impact of whether or not knowledge production on the basis of digital traces can be said to be a representational activity. Lury and Adkins do not provide any examples of the 'rise of the indexical' that they proclaim, but an example could be the way HTML codes have made an index like the hyperlink intelligible as a useful empirical trace that Google can use to generate the PageRank results they use as the basis of their search results. The hyperlink is not a symbol in the sense of a shared representational metaphor but rather an index that is left by an individual mind in a specific situation.

Lury and Adkins´ argument is that the changing relation between symbols and indices makes it necessary for sociologists to rethink the extent to which, for instance, visualizations that order information can be said to represent the external world. It is often assumed that the order of information is given by the relation to fixed external measures, but a central point in Lury and Adkins´ paper is that in many contemporary modes of ordering this is not the case. An example could again be that the order of information on Google is brought together without any external measure of information relevance. The order and ranking of web pages in Google´s SERP is, rather, determined by the performative capacities of the PageRank score that rely on indices like the hyperlink. Lury and Adkins´ more general argument in relation to the representational characteristics of digital data is formulated as follows:

[…] such data does not comprise a set of abstractions that attempt to model, represent or index aspects of an external or more real reality. Instead and because such data concerns whole populations and is often continuously updated in real time, its properties render the demand that social data

(meaningfully) represent or (quantitatively) index 'reality' besides the point (Lury & Adkins 2011: 21).

In this quote, we see the argument against having representative ambitions when working with digital data forms being tied to the argument that digital data streams have the potential to concern 'whole populations'. This emphasis on the possibility of working with 'whole datasets', and the epistemological consequences about categorization and representation that are drawn from this possibility, was also an issue in the discussion about theory in the section above and it will be returned to throughout this dissertation.

2.2.1 Web-epistemology and Online Groundedness

Richard Rogers is another theorist who has argued that the existence of digital traces and visualization tools requires a fundamental rethinking of the relation between data and the world. In his writings on digital methods he has, most importantly, introduced the concepts of 'web-epistemology' (Rogers 2004) and 'online groundedness' (Rogers 2009) as foundations from which to argue that web-based visualizations need to be seen as epistemic objects with unique characteristics that are not captured by existing methodological vocabularies. The concept of 'web-epistemology' is used to push the idea that the web is a source of knowledge about the social world, which has a distinct culture and therefore also requires distinct modes of data collection and distinct discussions about epistemology. Rogers´ argument is that there is a need to establish distinct digital methods that take their point of departure in the unique culture of the medium rather than importing methodological techniques and evaluation criteria from outside the medium. His suggestion is to start digital research from an appreciation of the unique characteristics of what he calls 'natively digital objects' (Rogers 2009). These are objects that are born in the new digital medium rather than objects that have

migrated into it, and Rogers sees them as valuable sources for generating new forms of knowledge about the social world.

One example of a natively digital object is the hyperlink, and Rogers´ point is that if such an object is to function as a source of knowledge about the social world, there is a need to follow this object and the society it makes visible without evaluating it on the basis of external epistemic criteria such as representation. Rephrasing a classic ANT trope, Rogers argues that web epistemologists must "follow the medium" and find the benchmarks for good science within it rather than importing benchmarks from the outside. His suggestion is to use the Internet to display what is going on in society and to use the "logic of the web"—its objects and adjudication mechanisms—to understand social trends and social dynamics. He argues that this kind of research needs to be built and evaluated on a different foundation than traditional modes of social science, and when Rogers speaks of 'online groundedness' he is referring to a mode of research that follows the dynamics of natively digital objects on the web. The idea is to take online data seriously as a unique data source and to try to see society in this data (Rogers 2009).

The approach of 'web-epistemology' has been used as an epistemological basis for producing various types of web-based visualizations under the heading of Rogers´ Digital Methods Initiative[9]. A prominent example of such visualizations is the 'issue-network', which is produced through a software program called the 'Issue Crawler' (see Rogers & Marres 2000). The crawler builds an issue-network by following hyperlinks from websites involved in a specific issue, and it has a visualization component that constructs a network-graph on the basis of the connection between these websites. In order to draw an issue-network, the crawler needs to be programmed in a specific way, and the instruction manual for the crawler explicitly argues that

[9] Website at https://www.digitalmethods.net/Digitalmethods/WebHome

certain settings will return an issue-network, whereas other settings will return a social network. There is, accordingly, an implicit assumption about the existence of different types of networks that can be made visible by the software, and the issue-network is specifically defined as "[…] a heterogeneous set of entities (organizations, individuals, documents, slogans, imagery) that have configured into a hyperlink network around a common problematic area summed up in a key-word" (Marres & Rogers 2005: 928). The hyperlink is approached as a natively digital object that 'carries' issues, and the visualizations produced by the Issue Crawler are argued to disclose the 'politics of association' around a specific issue (Rogers 2009: 14).

The important thing to emphasize in relation to the issue of representation is that Rogers argues that the merit of this kind of disclosure should be judged according to criteria from within 'web-epistemology' rather than through the tendency to import criteria from the outside. Issue-networks, for instance, should not be criticized on the basis of whether or not they 'represent' the public. It is readily admitted that the depiction of the issue they disclose is radically different from the kind of depiction that one would obtain through, for instance, a survey or another tool that claims to be representative. The visualization of the issue-network is built from within the logic of the web, and this makes it necessary to evaluate it from within the logic of the medium as well. The interesting questions are whether the hyperlink provides a useful way of exploring how issues play a role in getting the public involved in politics and in understanding the fate of certain issues. These are questions that were central to, for instance, Dewey´s conception of the public, and especially Noortje Marres (2005) has emphasized the possibility of gaining new insights into these pragmatist questions by following the logic of the digital media that become ever more pervasive parts of our lives. The move away from representation is, here, tied to the unique characteristics of natively digital objects and the potentials in learning from the logic of the web rather

than to the possibility of generating 'whole datasets' as suggested by Lury and Adkins above.

2.2.2 Controversy Mapping and Second-Degree Objectivity

The last concept that will be introduced to exemplify how the proliferation of digital traces has been used as an occasion to rethink the theme of representation is the concept of 'second-degree objectivity'. This concept is closely connected to a project known as 'controversy mapping' that proposes a specific way of using digital methods to understand scientific controversies. The idea of controversy mapping is rooted in ANT, as it has been formulated by Bruno Latour (2005; 2007) whose thoughts on digital methods have already been briefly encountered above. The relation between digital methods, controversy mapping and representation has been discussed in detail by Tomasso Venturini (2010) in a paper entitled 'How to Represent Controversies with Digital Methods'. The word 'representation' is heavily used throughout the paper, but this does not mean that the project of controversy mapping rests on standard methodological vocabularies concerning representative social science. Venturini, to the contrary, argues that digital methods allows for transferring a unique methodological sensitivity of ANT into a new cartography of controversies. This sensitivity is the preference for unfolding the complexity of controversies by taking native languages seriously while at the same time constructing what he terms 'quake-proof representations' of these controversies. Venturini suggests evaluating such representations on the basis of the criterion of 'second-degree objectivity', which he introduces as follows:

> Unlike positivistic 'first-degree' objectivity, second-degree objectivity is not interested in identifying the *matters of facts* that arouse everyone´s agreement, but rather in revealing the full range of oppositions around *matters of concern* […] second-degree objectivity comes from attributing to each

actor a representation that fits its position and relevance in the dispute. Being proportional in social cartography means giving different visibility to different viewpoints according to 1) their representativeness, 2) their influence, 3) their interest (Venturini 2010: 4).

This quote illustrates that Venturini refers to quake-proof representations as fulfilling three criteria. The first is to ensure representativeness by letting the visibility of viewpoints in the visualization relate to the number of actors subscribing to them. The second is to take account of the influence of different actors in the controversy by determining the centre and the peripheries in a controversy as well as locating the actors that have the potential to shape the controversies. The third is to take account of the interests of the involved actors and draw controversy maps in a way that ensures multiplicity in the depiction of the controversy by making minority viewpoints visible. The important point is that second-degree objectivity is only ensured if all of these criteria are fulfilled, and it is explicitly argued that this may involve the construction of several different maps:

[…] no one ever asked cartographers to produce just *one* map. The key for drawing effective representations is drawing many of them: each one dedicated to a different aspect of the phenomenon. Even if each map fails in capturing the richness of the disputes, all together they may do the trick (Venturini 2010: 6).

This quote reflects an underlying ambition of Venturini´s approach to controversy mapping, which is that a good map will allow its reader to observe a controversy from all concerned viewpoints. This is also where the political ideology behind the representative ambitions in the mapping project shines through. The representations of controversies need to reassemble the social (Latour 2005) in such a way that it makes the multiplicity of matters of concern visible. This is part of a larger 'compositionist agenda' within parts of ANT (Latour 2010a) that suggests evaluating empirical tools on the basis of whether or not they provide inscriptions of the world that allow its users

to see the 'whole' of society and enable them to navigate in it. When a controversy map is said to represent whole controversies, it is to be understood as providing a useful representation that makes matters of concern around a specific issue visible. In addition, it has also been suggested that the potential for reversibility is an epistemic criterion on the basis of which the merits of controversy maps are to be judged (Latour et. al. 2012). A good controversy map that can be said to adequately represent a topic must enable its user to retrace the sequence of translations that has taken place from the original data to the aggregate map.

Both Latour and Venturini have argued that the binary and mathematical foundations of digital data offer a unique opportunity for constructing maps of 'whole' controversies that enable their users to trace their shape back to the original substances from which they were constructed. In short they argue that digital methods are well suited to ensure the kind of representation that is demanded by second-degree objectivity and this argument is echoed in other attempts at mapping controversies (see for instance Yaneva 2012). It is important to emphasize that this is a way of talking about representation that is distinct from positivistic approaches to social sciences and this is also where it becomes clear that Venturini and Latour has a different take on digital methods than, for instance, Anderson and Lazer with whom Latour shares some points about the role of theory.

This difference becomes clearer when one digs a little deeper into the way Latour, Venturini and others conceptualize the 'whole' that web-based visualizations of controversies are meant to represent. They once again do that by reinvigorating Tarde´s concept of a 'monad', which they argue that the existence of digital traces and visualization tools have made operational. Their argument is that when one produces a controversy map one is essentially 'drawing a monad' and they describe the characteristics of a monad as follows:

A monad [is] a type of navigation that composes an entity through other entities and, by doing so, particularizes all of them successively - 'all of them' being an open ended list the size and precision of which always depend on more inquiries and never from the sudden interruption of a superior level accessible through a sudden shift in methods (Latour et al. 2012: 7 & 8).

By stating that a monad is a social phenomenon that provides a mode of navigation and a specific point of view on all other entities in a dataset this quote makes a link back to the arguments that Latour made about the role of theory in digital methods. Drawing monads means following the actors without shifting levels of analysis and the only way to draw a monad that represents a 'whole' is to draw it on the basis of data that is granular enough to live up to this criterion. Translated to digital methods this means that the quality of the navigation a monad enables will be sensitive to the quality of the information and the visualization techniques available. Latour and his colleagues note that current digital datasets are far from complete but they argue that the more complete they are, the more it will be possible to start generating knowledge in a way that lives up to the demands of second-degree objectivity (Latour et al. 2012: 7). It is namely through well-drawn monads that it becomes possible for the user to see the 'whole society':

When we navigate on a screen, zooming in and out, changing the projection rules, aggregating and disaggregating according to different variables, what stands out is what remains constant[10] through the shifting viewpoints […]. This is our 'whole' (Latour et al. 2012: 14).

[10] This idea of detecting constants in the process of zooming in and out is taken from the perceptual theory of James Gibson, which will be treated much more thoroughly below.

This quote links the concept of monads to the theme of representation. The argument is that a representation of the whole of society is nothing more than forms of navigation through limited datasets, and this is why it is explicitly argued that "the whole is always smaller than its parts" (Latour et al. 2012). It is a composition that enables people to see a specific matter of concern but to see it well; what Latour has also referred to as an 'oligopticon' (Latour 2005). A controversy is a matter of concern that is neither bigger nor more abstract than the actors that drive it, and the way to map controversies through digital traces is therefore to draw monads upon monads until one reaches a visualization that depicts repetitions and stabilities. An important methodological point connected to this way of thinking is that it is not so important where the researcher starts (Latour et al. 2012: 14). Each starting point will create a specific monad but it is the subsequent overlapping of these monads which will create the interesting whole.

These comments on Tardian monads mark the end of this subsection. All of the reviewed perspectives on the issue of representation have inspired the way the theme will be approached below, but the rest of this dissertation will primarily contain discussions about the extent to which the concept of 'web-visions' implies a perspective on representation that is distinct from the concepts of 'web-epistemology', 'online groundedness', and 'second-degree objectivity'. It will be clear that the suggestion to think about web-based visualizations as 'web-visions' has been somewhat inspired by all of these concepts, but it will also be argued that it provides a somewhat different viewpoint on what a web-based visualization is and to what degree it is (or is not) a representation of the social dynamics it sets out to depict. It will be clear from Chapter III that the framework of 'web-vision analysis' suggests grounding the discussion of representation in the works of Cooley and Gibson, and this theoretical foundation gives the discussion a specific twist in relation to the way the theme of representation has been introduced by the theorists reviewed in this subsection. The

discussion of the relation between 'web-visions' and representation will be initiated in Chapter III and given empirical inputs throughout Chapters IV-VI.

2.3 Handling a New Temporality

This section will introduce a third theme that has recently been discussed within the field of digital methods. This theme concerns the temporal aspects of web-based visualizations or what could also be referred to as the 'pace' or 'dynamics' of digital methods. A methodological issue that has been extensively discussed in relation to this theme is whether the digital researcher has time to stop and look closely at the collected data or whether the continuous flow of digital data calls for a movement towards real time analysis of the data flows. This discussion brings with it a related methodological issue, which is that real time analyses are often dependent on temporal metadata that is provided by external actors. An example of such metadata could be the timestamps that Google assign to the data they index and a point of discussion is the extent to which such a reliance obscures the distinction between the collection and analysis of data when it is conducted in real time. The point is that the metadata that is repurposed in the collection of data, is not neutral. Google´s timestamps, for instance, obscure the notion of chronological time of data by renewing the timestamp of web-pages on the basis of their most recent update rather than their original date of production (Wouters et al. 2004). They have an analytical conception of time built in.

Questions about the temporality of web-based visualizations are handled in different ways by different researchers and an important point of difference is whether they build visualizations to give retrospective insights or to generate real time sensitivities. If we take a look back at the controversy-maps discussed in the last two sections, it is, for instance, implicitly assumed that a good map of a controversy takes time to draw. It is emphasized that a good map is produced by putting layers upon layers of relevant

information until the map represents a 'whole' that is simple enough to navigate without importing unproductive distinctions between levels of analysis. If maps are produced on the basis of such a Tardian ambition it is impossible to develop them at the same pace as the data flow they are constructed from. This means that controversy maps are retrospective, and one temporal feature that is often found on the interface they provide is that the user can 'rewind' the controversy to explore which actors and viewpoints were active in discussing it in a specific month. In that sense, the digital data is made available for navigation in a chronological manner because the user of the map can move back and forth on a time-line that mirrors the chronology of the calendar (for an impressive example see Yaneva 2012).

Another way of approaching the temporality of web-based visualizations is to see them as tools that make it possible to take advantage of the continuous flow of fresh data on the web and produce research with previously unseen temporal characteristics. More specifically it is argued that real time visualizations can use the life cycles of online data to give structure to analytical objects (Marres & Weltevrede 2012). Web-based visualizations have the potential to be in real time but in order to be characterized as such, they must be built with an ambition to take advantage of the provision of fresh data flows on the Internet and provide its readers with content as soon as it is published on the web. Real time visualizations are often based upon the technique of scraping, which has been defined and outlined as a central aspect of web-based visualizations in Chapter I. It was argued that the activity of scraping involves the construction of a chain of software tools that can translate an informational mess on the web into a well-ordered, useable dataset that is stripped of useless information (Marres & Weltevrede 2012: 9).

In relation to real time research, scraping is used to prepare fresh online data for analysis by repurposing the formats it already has. This could, for instance, involve a

choice to repurpose Google´s timestamps or Twitter´s hash tags, which are both examples of temporal metadata that can be used to structure data flows without spending time looking at the actual content. When scraping is used to produce real time visualizations, it is evident that the chain that provides the data extraction must work instantly. This is why real time scraping is bound to rely on the use of automated tools such as API´s, which are programmed to push specific data streams from a specific source in real time. Twitter, for instance, has an API that constantly pushes tweets and metadata to subscribers (under conditions set by the company). This reliance on technologies that push and order data, accordingly, make real time visualizations quite different from the kind of controversy maps discussed above. In order to get real time data, there is a need to accept a certain 'black boxing' of the data collection and a certain ignorance of the details of the content.

The focus on real time methods has recently been subjected to critical scrutiny by Emma Uprichard (2012), who has argued that researchers who prioritize fast-paced temporal metadata over historical accounts of the world risk introducing a problematic 'presentism' into social inquiry. She argues that the success of services such as Google Flu Trends (see figure 2 in Chapter I) has spurred many social scientists to mirror the basic assumptions about social inquiry that drive such real time web-tools. The consequence is that social inquiry is becoming increasingly focused on the real time web and the way it can be used to provide the latest, most recent, and most timely snap-shots of the 'now'. Uprichard argues that this increased focus on the 'now' risks making real time digital methods ahistorical and blind towards society as such. She argues that the choice of focusing on real time data implies a choice of favouring the immediate 'knife-edge present' and diminishing the role of the kind of historically grounded generalizations that Uprichard argues to be necessary for making sense of specific trends.

Uprichard roots her argument in a pragmatic conception of time as something that is ultimately structured by practices. She draws on the work of George Herbert Mead to argue that time is not something external on which events can be placed. It is rather to be seen as a phenomenon that is structured by events and something that unfolds in interrelations between people and the world. It is this conception of time that Uprichard translates into a discussion of the way real time digital methods comes to structure a specific temporality of social inquiry as well. She argues that the pace of real time data accelerates a recursive dynamic. In the case of real time tweets, it is, for instance, argued that those observing twitter streams, those acting upon them, and those tweeting may structure time in a more accelerated way than in previous methods.

2.3.1 A Distinction between 'Liveness' & 'Liveliness'

When Uprichard critizises real time digital methods, she is speaking of it as a more or less unified tradition. However, this way of talking about real time methods and the web-based visualizations that emerge from them is problematized by Marres and Weltevrede, who propose distinguishing between two forms of real time research. One form is dedicated to monitoring 'live' content and the other is concerned with the 'liveliness' of issues. Both of these forms use scrapers to harness timestamps and other forms of temporal metadata, and they are both focused on taking advantage of the dynamic character of web data. But Marres and Weltevrede argue that 'liveness' and 'liveliness' denote radically different ambitions of real time digital research. By 'live' methods they refer to the kind of 'presentism' discussed by Uprichard as they characterize them as being driven by an interest in identifying 'current', 'instant', and 'fresh' data streams. 'Live methods' are accordingly defined as a form of social inquiry that emphasizes the need for empirical methods to be able to attend to the fleeting aspects of social life.

The point that Marres & Weltevrede want to make is that this focus on 'liveness' is just one form of real time research, and they propose an alternative form of real time research that looks for the 'liveliness' of data instead. They define the characteristics of this alternative form of real time research as follows:

> The key issue is not what topics, sources and actors have the most *currency* at a given moment ('now'). Instead, the crucial question for those researching social dynamics is which entities are the most *happening,* which terms, sources, actors are the most active, which fluctuate most interestingly over a certain period (Marres & Weltevrede 2012: 28).

The point that Marres and Weltevrede want to make is that a research interest in topics, sources, and actors that has 'currency in the now' is different from a research interest in topics, sources, and actors that are 'happening and fluctuating'. The former is the characteristic of 'live' methods, whereas the latter is characteristic of methods interested in the 'liveliness' of data. Marres and Weltevrede exemplify the difference between the two modes of real time research by pointing to the difference between scraping the platform of Twitter for the currency and frequency of the terms 'crisis' and using the scraped data to identify the social variation in semantic meaning around the term. The point is that a term like 'crisis' may have a high 'currency' and be mentioned often on the web while at the same time be 'un-happening' in the sense that the social forms of variation around the concept stay the same.

Marres and Weltevrede furthermore argue that this difference between 'live' data and 'lively' data is rooted in the software tools used for the analysis. For instance, they argue that frequency analysis software and visualizations of word-clouds are well suited for 'live' research, whereas co-word analysis tools and visualizations of semantic networks are conducive to research focused on 'liveliness'.[11] Both of these

[11] A frequency analysis is characterized by counting the frequency of words in a given text and it often involves visualising the results in a word-cloud that sizes different words according to the frequency with which they are mentioned. A co-word analysis is different in the sense that it counts

types of analysis can be characterized as real time research but co-word analyses are argued to give a particular spin to this form of research. Rather than focusing on the words that are current and hot right now it traces variation of key-word relations over time. It foregrounds variation of content over time and this is why Marres & Weltevrede argue that focuses on the live*liness* of data instead of focusing on the extend to which it is 'live' (Marres and Weltevrede 2012). They furthermore argue that this way of conducting real time research brings more social aspects into the analysis than the 'live' methods that are focused on the currency of data.

These comments on the distinction between 'liveness' and 'liveliness' mark the end of this subsection on the theme of temporality. The rest of this dissertation will contain discussions about the extent to which the framework of 'web-vision analysis' implies a take on temporality that is similar or different to the approaches of 'live' and 'lively' research. It will be clear that the suggestion to think about web-based visualizations as 'web-visions' has many similarities to the approach advocated by Marres and Weltevrede because it suggests focusing on changing compositions of data streams rather than focusing on the detection of real time data. The relation between these two approaches will especially be discussed in sections 4.2.2 and 6.2.2 and both of them will emphasize that the concept 'web-visions' exhibit slight differences from the concept of 'lively visualizations' despite the many similarities. These differences will mainly be grounded in Gibson´s argument that any detection of variance must be preceded by an attempt to derive invariants from the stream of data. The details of this argument will be given in Chapter III below.

---

relations between words. If two words, for instance, occur with less than three words between them they can be said to have a 'tie' and the results of a co-word analysis is often visualized in network graphs where each node is a word and each tie indicates the existence of such a relation.

2.4 Digital Methods as a Distributed Practice

The fourth theme that will be discussed in this chapter concerns the distribution of actors involved in the production of web-based visualizations. The approaches reviewed in this section all acknowledge the existence of an empiricist movement within digital methods where data is produced by a distributed set of people; however, they interpret it in quite a different way than the works reviewed in section 2.1 above. Contrary to, for instance, Anderson they all make the argument that the rise of digital traces has led to a reconfiguration of the relation between actors involved in the production of social scientific knowledge that cannot be interpreted as an epistemic goldmine that allows for unmediated insights into the social world. But the approaches reviewed also exhibit small differences in relation to whether they interpret this reconfiguration as a displacement of research capacities from academia towards commercial sociology that brings with it a 'crisis of empirical sociology' or as a redistribution of the division of labor that enables a 'revenge of methods'. An outline of these two ways of approaching the distributed character of digital methods will end the literature review of the four themes of digital methods provided in this chapter.

2.4.1 Displacement and The Crisis of Empirical Sociology

The argument for linking the rise of digital data to a displacement of research capacities from academia towards commercial sociology has most forcefully been made in Mike Savage and Roger Burrows´ papers on 'the crisis of empirical sociology' that were published in 2007 and 2009. These papers focus on the role that transactional data[12] have come to play in the profession of sociology, and they argue that we live in a

[12] It should be noted that the concept of 'transactional data' has a much broader scope than the concept of 'digital traces', which is used to demarcate the topic of interest in this dissertation. Much of the data that Savage and Burrows talk about therefore falls out of the scope of this dissertation.

data landscape where professional sociologists are losing their status as experts of empirical social analysis. After 50 years where the sample survey and the in-depth interview have been central devices to the practice of empirical social analysis, Savage and Burrows argue that these methods—and thereby the status of professional sociologists that ignited them—are losing ground:

> [In] the early 21st century social data is now so routinely gathered and disseminated, and in such myriad ways, that the role of sociologists in generating data is now unclear. Fifty years ago, academic social scientists might be seen as occupying the apex of the – generally limited – social science research 'apparatus'. Now they occupy an increasingly marginal position in the huge research infrastructure […] (Savage & Burrows 2007).

The main reason for this marginalization is that a distributed set of private companies are producing massive amounts of interesting data about people's behavior and life worlds as a by-product of their primary products. Telecommunication companies use phone-call logs to study communication networks; the geo-demographics industry rely on a myriad of transactional data to produce detailed socio-spatial maps; and companies like Facebook can continuously scrape the digital traces that their users leave on their platforms and use them as measures of their tastes and preferences (Savage & Burrows 2009). This kind of data is similar to the data that Latour referred to as the 'real quantas' that lie at the heart of the social and the fact that these types of data are produced and owned by private companies makes Savage and Burrows talk about a rise of 'commercial sociology'.

Transactional data can broadly de defined as the outcome of a transaction and it accordingly includes data such as credit card logs and e-mail correspondences that were previously argued to fall outside the scope of this dissertation. The arguments that Savage and Burrows make nonetheless apply to the smaller scope of digital data that is of interest to this dissertation as well.

They agree with the theorists reviewed in section 2.1 that the digital data produced within commercial sociology is both bigger and more granular than the data obtained from sample surveys and in-depth interviews, and they also agree that its size makes its owners able to bypass the principles of inference and work directly with 'real' and 'complete' data (Savage & Burrows 2007). Furthermore, it is an important asset for actors within commercial sociology that they can produce data without much consideration about the issues that ethical councils pose about privacy when data is collected within academia. Savage and Burrow's argument is, in short, that we live in a world of 'knowing capitalism' (Thrift 2005), where commercial forces drive the study of the social world. The digitization of social life simply involves a displacement of research capacities from social scientists to leaders of the information industries.

This diagnosis is not far from the one given by Anderson in section 2.1; however, Savage and Burrows are not interpreting this development as a much-needed possibility for the rise of a direct and unmediated empiricism. They do not agree that it represents a golden opportunity to get rid of sociological theorizing, but they agree that the profession of sociology needs to change with the empirical data sources. Their interest lies in the fact that interesting new methods for creating knowledge about the social world emerge from corporate analysts rather than from professional sociologists inside sociology departments. The reason why this fact is interesting to Savage and Burrows is that they see empirical methods and devices as inherently political and historical. A shift in methods and modes of description therefore also entails a shift in the norms and power of knowledge-generation. This is why they find it necessary to critically engage with the existing repertoires of empirical sociology:

> Running through this article is our interest in an alternative vision, where sociology seeks to define itself through a concern with research methods (interpreted very broadly), not simply as particular techniques, but as themselves an intrinsic feature of contemporary capitalist organization. (Savage & Burrows 2007: 896-897).

This quote argues that research methods have become intrinsic to capitalist organization and that sociology needs to define itself by taking stand towards this development. The more specific point underlying this quote is that sociologists need to inquire into the way specific methods for doing social research is intimately connected to the legitimacy of specific professions, their skills, and the institutions they are connected to. If research methods are an intrinsic feature of contemporary capitalist organization and if the needed research skills are being displaced from sociology to the industry it is important to make the unique contributions of sociologists visible. In fact, this is particularly important at a time where empiricists such as Anderson argue that we should forget about sociology and other theoretical disciplines.

This theme of displacement and the loss of professional legitimacy in practices of knowledge creation has also been discussed throughout the last decade within the field of Internet research. Danah boyd and Kate Crawford have, for instance, argued that it is important to ensure that the rise of 'Big Data' does not entail a loss of the professional authority of skilled social scientists. They emphasize the danger of displacing data analysis from scientists to crowds and amateurs who are not as equipped to ask critical questions about big data sources: Who gets access? How is data deployed? To what ends and with which implicit definitions of social life? (boyd & Crawford 2011). The importance that boyd and Crawford attach to these questions makes them dismissive of Anderson´s argument about the end of theory. They emphasize the need for professional social scientists to engage with such mythologies of objectivism and empiricism and to ask informed methodological questions about data cleaning, data error, data reliability, data provenance, data samples, data access, and other methodological issues that may not be as thoroughly treated if research power is displaced away from the academy.

Other writers within Internet research have focused on the way digital methods have displaced authority away from other types of professions that have for a long time been central to the production and organization of knowledge. A central theme in this debate has been how the skills of information-filtering that have for a long time been associated with professions like librarians and journalists has throughout the last decade been challenged by automated measures of relevance such as those provided by the algorithms of Google. As put by Alex Halavais: ”We once asked people for information now we ask machines” (Halavais 2008: 2). The point behind this quote is to emphasize how search engines and other actors that ignited the movement towards digital methods are suddenly the nexus of the way people filter information and guide their attention. They have taken over the jobs of librarians and journalists who previously dictated the dominant modes of ordering information (Halavais 2008: 57-58 & 150).

This point is echoed by Siva Vaidhyanathan (2011) who has argued that we are on the brink of ‘Googleizing’ our society. The power of Google´s algorithms and their impressive physical infrastructures of research labs, server farms and data networks makes the company an imperialist in relation to the contemporary information infrastructure that is very hard to compete with for professional experts that previously carried out the roles that Google does now (Vaidhyanathan 2011: 108). Vaidhyanathan illustrates the power of Google´s automated system of information processing through an example of the way Google´s time-stamps is relied upon by security investors and new agencies to order the temporality of information and how this reliance has previously led to the spread of dated information in a way that would probably have been stopped by a skilled professional. This emphasis on the way capacities of information filtering have been displaced from professionals to machines is also central to the writings of Eli Pariser (2011) who has recently suggested that people are increasingly living in ‘filter-bubbles’ where personalized algorithms guide their

attention to information that is tailored to their taste on the basis of the history of their digital traces. The theme of 'displacement' of the capacities for knowledge creation from one profession to another is accordingly resurfing in various writings on digital methods.

2.4.2 Redistribution and the Revenge of Methods

A slightly different way of approaching the theme of distribution is visible in the work of Noortje Marres who has recently argued that we should discuss such methods as involving a 'redistribution' of the division of labour between actors involved in social research rather than an outright 'displacement' of power from traditional professions to corporate cultures (Marres 2012b). The reason she gives to back this interpretation is that social research methods has always been a distributed phenomenon and that the idea of a self-sufficient academy from which the power over research can be displaced is a myth. Before the rise of digital data it was also the case that social scientific research was a shared accomplishment between a diverse set of actors including researchers, research subjects, funders, providers of research materials, infrastructure builders and interested amateurs (Marres 2012b). Marres, for instance, explains how a prominent research method like the focus group have always relied upon contributions from a distributed set of actors such as research subjects, recruitment agencies, moderators and how it has also been shaped by the physical circumstances in which it was carried (see also Lezaun, 2007).

It is from this general statement about the distribution of social research methods that it is possible to understand the kind of redistribution of labour that Marres suggests digital methods to involve. An important point in her argument is that it is not just the production of data that is redistributed. It is the whole chain of research skills—from

the data collection to analysis and visualization—that is distributed across online platforms, web users, meta-data providers, algorithms and professional analysts (Marres 2012b; Madsen, 2012). The point she makes is that the collection, analysis and presentation of data can hardly be distinguished in digital methods because the platforms on which digital traces are left often come with a set of tools that facilitates the analysis and presentation of the data generated. If one relies on Twitter's API for the collection of data one is at the same time provided with a specific selection of meta-data with which to analyse it. Other hubs of digital data, such as Google and Yahoo, even provide proper analytical tools that enable their users to get a visual overview of the kind of data they contain (examples are Google Analytics and Yahoo Web Analytics). The point to draw from Marres argument is that the redistribution of social research in the face of digital data is not just a redistribution to other human actors such as commercial agencies and users. It is also a distribution towards technological infrastructures, the measures that are implicit in them and the people that feed them with data.

Marres argument about distribution as the normal condition for the development of both digital and non-digital research methods is the basis from which she argues against the theoretical ambition of pinpointing a clearly identifiable location to which the power over methods is displaced. In her view it is simply misleading to talk about social research as being shaped by single domains such as the university, the private laboratories of IT firms or the crowd. Her focus on distribution furthermore carries with it an implicit critique of approaches to digital methods that have too narrow a focus on the role played by technology and algorithms. An example of this is the way a concept such as the 'filter bubble' is focused on the extent to which the power of information-filtering has been displaced from librarians and journalists to personalized algorithms such as Google´s. The implicit counter-argument in Marres writings is that the function of a search engine in modern knowledge society cannot be understood by

looking at the way the algorithm functions and who codes it. It is rather a distributed socio-technical network of actors that shape its mode of ordering and it is the redistributions within this network that it is important to put analytical focus on.

Marres, finally, ties this descriptive argument about redistribution to a normative program when she argues that an analytical focus on the redistribution makes it possible to make progressive methodological interventions through the remediation of already existing methodological critiques. Her diagnosis is that digital methods can be seen as a remediation of classic sociological methods that redistributes the practical work of performing them. Google´s search interface is, for instance, built by transferring classic citation analysis to a new medium with the result that the work of forging ties is distributed towards the web users that link to each other. A central normative claim in Marres´ writing is that this insight makes it possible to intervene in this translation by actively remediating existing methodological critiques into the digital environment as well. She terms this strategy a 'revenge of methods' and some of the previous sections in this chapter have already provided examples of the way she imagines that such a revenge can be carried out. The idea of visualizing issue-networks through the Issue Crawler in section 2.2 was, for instance, ignited by an ambition to intervene in the way Google´s search engine re-mediated the method of citation-analysis. The Issue Crawler was deliberately programmed to work on the basis of a co-link analysis that gives less weight to authority dynamics than Google. The development of the Issue Crawler was in that sense an intentional attempt to re-mediate an existing critique of citation analysis into the digital environment (Rogers & Marres 2000). The same is true for the suggestion in section 2.3 to introduce co-word analysis and semantic network visualizations as alternatives to the kind of frequency analyses and tag clouds that dominate the landscape of textual analysis (Marres & Weltevrede 2012).

Marres´ argument is in that sense twofold. First, she argues that digital methods entails a redistribution of labour that enables private companies to refashion existing methods in a new context; secondly, she argues that insights into this redistribution are at the same time opening for a possibility to refashion existing critiques of the re-mediated methods. In the examples with the Issue Crawler and the co-word analysis the explicit aim was to construct a software application that allows for reinserting a difference between the popular and the relevant that has been lost in software applications based on citation- and frequency-analyses. An important assumption beneath this normative strategy is also that the construction of software should be informed by the context in which it is to intervene (Marres 2012b). Specific modes of seeing the world are distributed to software choices, but this does not mean that software-design is the driver of methods. Marres´ focus is on the broader socio-technical network and her argument is that it is only through an active engagement with this distributed network that it is possible to ensure a 'revenge of methods' that does not buy into stances such as the pure empiricism in section 2.1 and the focus in live content described in section 2.3.

2.5 Outro

This chapter have demarcated a field of digital methods to which this dissertation aims to make a contribution and it has reviewed literature on four themes—the role of theory, the ambitions of representation, the challenges of a new temporality and the distribution of research methods—that is central to the way web-based visualizations have been discussed within this field. It has used these themes to introduce contemporary thoughts on the characteristics of digital methods and the way web-based visualizations cabn function as empirical devices. This dissertation will from now on frequently return to the concepts of 'theory-free empiricism', 'honest signals', 'second-degree objectivity', 'more-than-representational spaces', 'web-epistemology',

'live methods', 'lively methods', 'displacement' and 'redistribution' when it discusses the concept of 'web-visions' and motivates its introduction to the field of digital methods. The chapter has thereby built a foundation that the rest of the dissertation will use as a reference when discussing the concept of 'web-visions' and its role within the field of digital methods.

One last thing to note about the literature review conducted in this chapter is that it illustrates how the development of digital methods raises questions that go beyond the digital. The concepts listed above are clearly reinvigorations of classic debates in sociology and the philosophy of science. They illustrate that the feeling of being in the midst of "information explosions" ignited by new technologies is not something that is unique to the present age (Blair 2003). The theme of theory, for instance, reinvigorates dilemmas between inductive and deductive research that has been heavily discussed within ANT (Latour 2005) and other strands of social scientific reserach. The theme of representation reinvigorates discussions about performativity that has recently been central to the work of, among others, Nigel Thrift (2005). The theme of temporality reinvigorates discussions that has for a long time been central to pragmatist social science (Emirbeyer & Mische 1998) and the theme of the distribution of research methods was also argued to be a theme that has been taken up in relation to non-digital methods such as the focus group (Lezaun 2007). The rise of digital methods is therefore not to be seen as an extraordinary revolution as some popular writers suggest. It is rather to be seen as a movement that poses classic questions in sociology and the philosophy of science while at the same time calling for new answers.

The concepts listed above are all attempts at giving new answers to classic problems and it will throughout the rest of the dissertation be clear that the concept of 'web-visions' have closer affinities with some of the concepts introduced than others. In relation to the theme of theory it has already been argued that it will draw on the works

of Gibson to problematize the idea that web-based visualizations are devices that enable a break with theory and it will instead suggest that they distribute theoretical work across different actors. This theme will especially be touched upon in the discussions of the empirical papers in Chapter IV and V. In relation to the theme of representation it will be most closely connected to Rogers´ suggestion to judge the epistemology of web-based visualizations with reference to the logic of the medium through which they are produced. But it will draw on the works of Cooley and Gibson to problematize aspects of his web-epistemology as well. This problematization will be given thorough attention in the discussion of the empirical paper in Chapter V. In relation to the theme of temporality it will throughout the dissertation be clear that the concept of 'web-visions' draws upon Marres´ concepts of liveliness, but it will enroll Gibson´s thoughts about invariant structures to suggest a slightly different approach to the temporality of visualizations. The details of this difference will mainly be touched upon in the discussion of the empirical paper in Chapter VI. The concept of ' web-visions' will finally be aligned with Marres´ thoughts about the redistribution of digital methods while at the same time providing a new theoretical foundation for conceptualizing and handling this redistribution. The theme of redistribution will be touched upon in the discussions of the empirical papers in Chapters IV, V and VI. Before turning to these chapters and the empirical papers they contain it is, however, necessary to turn to Chapter III for an introduction to the works of Cooley, Gibson and Espeland that will provide the theoretical roots of the concept of 'web-visions'.

Chapter III: Establishing a Theoretical Foundation for the Concept of 'Web-Visions'

The review of literature on digital methods in Chapter II was written with the intention to outline the central themes that are discussed in the most influential works within the field that this dissertation aims to contribute to. Throughout this dissertation, it will be clear that the concept of 'web-visions' is more affiliated with some of these works than others. It particularly echoes some of the analytical points that are conveyed by concepts like 'web-epistemology', 'liveliness', and 'redistribution'. This, however, does not mean that it is identical to these concepts and the foundation for talking about 'web-visions' as a distinct take on digital methods will be laid down in this chapter. It will ground the concept in the writings of three theorists that have not yet played a central role in the discussion on digital methods, but nonetheless provide a useful resource for thinking about the four themes in a slightly different way than the theorists reviewed in Chapter II. The introduction of the theoretical foundation for the concept of 'web-visions' provided below should accordingly be read as a theoretical contribution to the field of digital methods that offer a new mode of thinking about web-based visualizations.

The three theorists who pave the theoretical ground for carving out 'web-visions' as a distinct analytical object are Charles Horton Cooley, James. J. Gibson, and Wendy Espeland. None of these writers work within the field of digital methods as defined above. Cooley wrote about information technology and experience in the aftermath of the electrical revolution in the late 19th century. Gibson wrote about technological affordances and perceptual systems in the middle of the 20th century, and Espeland is currently writing on commensuration and quantification in relation to, for instance, university rankings. This chapter will not provide an introduction to the full body of

work produced by these theorists. It will rather focus on those aspects of their work that will be used as a foundation from which to think about web-based visualizations as 'web-visions'. The sections below are, accordingly, intended to highlight the distinctive theoretical roots of the concept of 'web-visions' and indicate how these roots are a useful foundation from which to ask different questions about web-based visualizations than the concepts introduced in Chapter II.

The theoretical grounding provided in this schapter is divided into five sections. Section 3.1 will present a brief background on Cooley, Gibson, and Espeland. It will provide some context on the choice of using their work as the foundation from which to talk about 'web-visions' and argue for their relevance in this regard. Section 3.2 will draw on concepts from Cooley and Gibson in order to propose an ontology of 'web-visions' that suggests understanding web-based visualizations as systems of experience that are located in-between situated practices, technological infrastrurctures and human intentions. Section 3.3 will use selected parts of Gibson´s writings to propose an epistemology of 'web-visions'. This epistemology will suggest seeing web-based visualizations as dynamic devices that generate useful perceptions of social dynamics without pretending to be representative of anything outside the data flows from which they are generated. Section 3.4 will use the writings of Cooley and Espeland to emphasize the normative aspects of 'web-visions'. It will be argued that web-based visualizations enable social navigation through the creation of situations in which things and events can be (quantitatively) evaluated and given meaning. It will also be suggested that such a demarcation of situations are necessary for social organization in the face of massive digital data flows. Finally, section 3.5 will provide a brief summary of the main points in this chapter and provide a short introduction to the way the suggestions about the ontological, epistemological, and normative characteristics of

'web-visions' will be used to inform the discussions of the three empirical papers in Chapters IV-VI.[13]

3.1 Three Sources of Theoretical Inspiration

This section will outline the motivation for using Cooley, Gibson, and Espeland as the main theoretical foundation for constructing 'web-visions' as an analytical object that is distinct from the ones reviewed in Chapter II. On a general note, it can be said that this choice is the outcome of an experimental and iterative process that is in line with the third methodological tenet outlined in Chapter I. The research process did not start with an interest in any of these writers, and the choice of giving them a central role in this dissertation is a result of a constant movement back and forth between conducting the empirical analyses presented in the three papers below and reading a broad range of literature on the theme of digital methods. Throughout this movement, it became increasingly clear that Cooley, Gibson, and Espeland provided useful theoretical resources for two reasons. First, they enabled ways of thinking about web-based visualizations that suited the analytical results emerging from the empirical studies; and secondly, they provided a foundation from which to think about web-based visualizations in a different way than the concepts presented in Chapter II. The works of the three writers made it possible to live up to the methodological prescriptions outlined in section 1.2 because it allowed for crafting analytical objects and distinctions that bring new aspects of web-based visualizations in focus. This section will present a brief introduction to each of the three writers before the subsequent

[13] It should be noted that the choice of dividing arguments about the ontology, epistemology and normativity of 'web-visions' into three distinct sections is somewhat artificial. It will throughout this chapter be clear that these three aspects of a 'web-vision' will be seen as tightly interrelated. Ontological points will carry with them epistemological criteria for the evaluation of knowledge and such evaluations will have normative implications in relation to what we see and assign value to. But the distinction is a useful heuristic for outlining how the thoughts of Cooley, Gibson and Espeland are used a a foundation for constructing the concept of 'web-visions'.

sections give a more detailed introduction to the parts of their work that are considered to be of particular interest.

3.1.1 Cooley: Experience and Communication Technology in the Late 19th Century

Charles Horton Cooley (1864-1929) is popularly considered to be part of The Chicago School of Communication, which flourished at the turn of the 20th century. This was a time when new technologies of transportation and communication raised important questions about fundamental aspects of American life. The establishment of the first railroad to cross the American continent, for instance, challenged local models of democracy and fostered a need to establish new models of public communication that fitted an expanding nation (Carey 1989). The rise of electric technologies like the telegraph contributed to this development by enabling modes of communication that were quicker than any form of human transportation. Electricity was popularly conceived of as a technology that had the potential to 'wire' the expanding American public together, and new modes of social organization—such as centralized price setting and standard time—were deeply influenced by the development of electricity (Carey 1989). Besides this restructuring of markets and time, the turn of the 20th century was also a period when technologies like typewriters, Dictaphones, and telephones posed questions about the way public administration was done, and how the growing American bureaucracy was to be managed at the office-level (Stephens & Lubar 1986). Electrical technologies were simply thought of as new tools with which to experience and organize the social world. Issues about information and data management were therefore as pressing during Cooley´s time as they are today.

The Chicago School is an interesting source of inspiration for the research conducted in this dissertation because it represents the most ambitious sociological attempt to

understand and conceptualize these socio-technical developments. Its members provided innovative analyses of the relation between technological innovations and the reconfiguration of market economies, knowledge production, and democratic citizenship. The concept of 'web-visions' is inspired by the general sensitivities of the Chicago School, but Cooley´s work on the relation between electric communication technology and the way people and organizations experienced the world in which they lived have been a particularly useful theoretical resource. It is productive to pay attention to Cooley´s thoughts on this relation because the situation in which he wrote has many characteristics in common with the contemporary situation. Just as electricity was, at the time of Cooley, seen as a progressive new technology that could potentially give people a better grasp of their world, so are digital traces today. Throughout this paper, Cooley´s writings will be used as a comparative heuristic to think about the ruptures that 'web-visions' make in contemporary organizations of experience. [14]

This use needs a motivation and on a general note, it can be said that reading texts from a time when 'old technologies were new' serves to make continuities and differences in the interplay between technology, knowledge, and society visible in a way that is harder to do on the basis of contemporary texts (Marvin 1988). By looking for elements in old texts that still resonate after a hundred years of technological development, one can identify elements of this interplay that seem permanent rather than tied to the specific technology in question. Looking for elements that do not

[14] It should be noted that some of the arguments and ideas that this chapter will attribute to Cooley could also have been attributed to other pragmatists at his time. For instance, Dewey´s work contains important thoughts on communication and society and the role that situations and events play in our experience of the world. Lippman´s work contains interesting ideas about the selection mechanisms that influence the publics knowledge of the externalities of their actions. Mead's work suggests looking closer into the selective organism in order to understand social organization and James´s work has several arguments about the uselessness of dualistic ontologies. These are just a few examples that illustrate why Cooley´s work cannot be seen as especially unique. But his work is here used to introduce many of these thoughts because he combined them in his work on the environment of experience, the selective communicative system and situations of valuation in a way that makes him especially an especially suitable inspiration for working with 'web-visions'.

resonate, however, helps to pinpoint interplays that are context bound. It can therefore be argued that a historical perspective on information technologies allows for avoiding two common pitfalls (du Gay & Madsen 2013). One is the tendency to deem the technologies of the present as being so new and revolutionary that the past is seen as an irrelevance. The other is the tendency to see interactions between technology, society, and knowledge production as following the same patterns no matter the technology and context.

Another reason for drawing on Cooley´s work is that it makes a contribution to works within the field of digital methods that have already suggested the potentials of returning to early 20th century American pragmatism in order to understand the interplay between digital technologies, visualizations, and the production of knowledge (Marres 2012). The writings of John Dewey and Walter Lippmann have, for example, been used as a foundation for arguing that web-based visualizations can be understood as 'issue-networks' (Marres 2005), and the sociology of Gabriel Tarde has been drawn upon to define them as depictions of 'monads' (Latour 2010; Latour et al. 2012) and as new 'value-meters' (Latour & Lépinay 2009). This rediscovery of early American sociology has, however, not integrated the work of Cooley into its theoretical vocabulary. Reading Cooley with the topic of digital methods in mind can, in that way, contribute to broadening an already existing theoretical movement that this dissertation is seeking to engage with. Cooley´s work will particularly be drawn upon to introduce thoughts about the ontology and normativity of 'web-visions' in sections 3.2 and 3.4 respectively.

3.1.2 Gibson: The Ecological Approach to Visual Perception

James J. Gibson (1904-1979) may seem a somewhat odd figure to take inspiration from in relation to the research interest of this dissertation since he never wrote on media and their role in the organization of social experience. Gibson´s field of study was perceptual psychology, and his early work was carried out in the 1920s, when pragmatist philosophy was a popular source of inspiration in American psychology (Reed 1988). Especially the empiricism of William James came to influence his take on psychology, and he started out studying the topic of perception on the basis of some of the tenets of James´ thinking (Chemero 2003). The most important assumptions he took from James were his belief in the connection between experience and reality; his belief in the role of associations between objects as something that is central to experience; his belief in the experimental method as a source of knowledge; and his disdain for theories that conceived of experience on the basis of a dualism between mental images and the external world. Gibson opposed both mechanistic and mentalist conceptions of perception and he emphasized the central role that purpose and activity play in perception.

Another academic tradition that came to guide Gibson´s work was the gestalt psychology of the 1920s. Especially the work of Kurt Koffka, who was Gibson´s colleague from 1928 to 1941, had an important influence on his early thinking (Reed 1988). The gestalt psychologists echoed the pragmatist's suggestion to think about the human mind and behaviour as a whole that was more complex than the sum of its parts. A central argument within this approach to psychology was that humans always perceive objects in relation to a standardized and already specified framework. This framework—and the way we relate to it—was seen by the gestalt psychologists to be equally important to analyse as the perceived object if one were to understand the process of perception (Braund 2008). The important point that Gibson took from the gestalt psychologists was that changing content is always understood on the basis of predefined forms that serve as the stable element against which flux can be perceived.

Gibson took his point of departure in this idea, but he developed it to fit his own theory and we will see how he came to conceive of the fixed points of perception as something that emerges out of the environment of perception rather than a priori forms imposed on it.

Despite not having media and information-technologies as his specific point of attention, we will see how several aspects of Gibson´s theoretical and conceptual work have served as important inspirations in the attempt to carve out 'web-visions' as a distinct analytical object. At a most general level it is an interesting theoretical foundation because it grounds the concept of 'visions' in a theory of perception. Besides that it can be said that Gibson´s writings has relevance because his so-called ecological approach to perception implicitly continued and extended some of the important themes and interests in Cooley and the Chicago School. Gibson was, for instance, focused on developing a theory of experience that is based on a dynamic ontology, and he contributed to this line of thought with a conceptualization of the perceiving person as an active, dynamic, and situated agent that engages with his surroundings. This conceptualization is an antidote to that of speaking of persons as isolated agents that 'process inputs of information', and the relevance of this idea will be further elaborated in sections 3.2 and 3.3 below.

The concepts of 'affordances'[15], 'invariants', 'ecological objects', and 'perceptual systems' will be introduced as relevant for thinking about the ontology and epistemology of 'web-visions' in sections 3.2 and 3.3 respectively. Another element of Gibson´s writings that will be in focus in these sections is his insistence upon starting

[15] It should briefly be noted that many writers on technology have interpreted Gibson´s work in a very functionalist way. The concept of 'affordances' has especially been given a functionalist interpretation in the field of design studies (see, for instance, Norman 2002). This is not the reading of Gibson that will be provided in this section. It will instead interpret Gibson as a post-pragmatist and highlight how his ontology is less functionalist than often assumed.

theories of perception without a priori distinctions such as the mind and the body. This ontological stance will be used to question the extent to which 'web-visions' can be seen as representations of the things they visualize. Gibson´s thoughts will be presented on the basis of his last book, 'The Ecological Approach to Visual Perception', which was his final attempt to summarize the work of his entire career into a new foundation for the study of visual perception.

3.1.3 Espeland: Commensuration and Valuation

During the last decade, Wendy Espeland has done important work within valuation studies, which is a field concerned with the way orders of worth are produced and maintained (see Stark 2011). She has published influential papers on the concept of 'commensuration', which she defines as the practice of transforming the qualitative world into quantitative measures. One of the important insights of her work is that such transformations are not easily achieved. They are rather the result of hard work of a distributed set of people and technologies that in combination establish new analytical objects, develop metrics on which they can be assigned a value, and develop vocabularies that enable these new metrics to be accepted as legitimate. Espeland has illustrated this distributed character of the process of commensuration through studies of attempts to establish commonly accepted measures of the value of nature in Arizona (Espeland 1998), the quality of law schools (Espeland & Saunder 2007), and the price of emissions (Levin & Espeland 2002). Through these studies, Espeland has successfully shown that the outcome of processes of commensuration—such as prices and rankings—can have both intended and unintended effects in relation to the way people create representations, the way they ascribe status to things, the authorities they rely upon in evaluating entities, and the way opportunity is distributed between actors.

Espeland, accordingly, insists that commensuration is a normative act, and this is why she argues for the importance of inquiring into the actors involved in processes of commensuration. Her work has been a relevant source of inspiration for the concept of 'web-visions' for two reasons. The first is that the concept of 'commensuration' echoes some of Cooley´s thoughts on the role that mechanisms of segmentation play in the organization of experience while at the same time providing more analytical leverage in relation to the way it can be studied. More specifically, Espeland´s work allows for disaggregating processes of segmentation and valuation into distinct analytical subparts that can be analysed as interrelated. The second reason for the relevance of her work is that 'web-visions' are outcomes of processes of commensuration because algorithms require digital traces to be quantified in order to organize them and make them manageable. The connection between Cooley and Espeland and the way Espeland´s work has been inspirational in the process of thinking about the normativity of 'web-visions' will be outlined in detail in section 3.4.[16]

These comments about the work of Espeland marks the end of the initial introduction to the three writers that will be used as a foundation from which to argue for the relevance of thinking about web-based visualizations as 'web-visions'. The concept is a suggestion to think about such visualizations, as devices through which people experience and perceive the social world and the rest of the chapter will provide a detailed review of the aspects of Cooley, Gibson´s and Espeland´s works that can be used to suggest an ontology of 'web-visions', and epistemology of 'web-visions' and to discuss the normative aspects of 'web-visions'. When the chapter speaks about, for

[16] It should be noted that the topic of calculation has been covered by other writers within the field of economic sociology such as Michel Callon, Fabian Muniesa and Donald Mackenzie. These writers will be retuened to throughout the dissertation, but the reason why Espeland´s work is used as the main theoretical foundation for constructing the concept of 'web-visions' is that she is clearer in explaining how the work of turning a qualitative world into quantitative measures have different phases with different dynamics.

instance, the ontology of 'web-visions' it is accordingly referring to the ontology that one must ascribe to web-based visualizations if they are through of as 'web-visions'. The arguments made in the rest of this chapter is therefore the foundation to talk about a framework of 'web-vision analysis' that can ignite new ways of thinking about web-based visualizations as well as new guidelines for their construction.

3.2 The Ontology of 'Web-Visions': Systems of Experience in-between Practices, Technologies, and Human Intentions.

This section will propose a way of thinking about the ontology of 'web-visions', which is inspired by Cooley and Gibson´s work on experience and perception. Even though they did not refer to the exact same thing with the concepts of experience and perception, their arguments will nonetheless be used in combination to talk about the ontology of 'vision', which is taken as a broad reference to the way a person 'sees' the world he or she is acting within. It will be illustrated that both Cooley and Gibson conceived of vision as something that is neither the result of mental processes in the subject nor the causal result of stimulus from the external world. Their ontological standpoint was rather that it cannot be understood through dualisms between the material and the mental and both of them subscribed to a holistic ontology when they wrote about this issue. The first subsection below will provide a detailed review of what Cooley meant when he referred to 'systems of communication' and 'environments of experience' as intertwined, and the second subsection will provide a review of what Gibson meant when he argued that the capacity to see is the result of a 'system of perception' that has specific 'affordances' in the way it interacts with the world. Besides giving an overview of the way Cooley and Gibson thought about the ontology of vision, this section will also foreshadow some of the results of the empirical analyses in the three papers below in order to clarify why Cooley and

Gibson´s concepts are a relevant foundation from which to construct the concept of 'web-visions' and think about its ontological status.

3.2.1 Systems of Selection and Environments of Experience

It has already been argued that Cooley was interested in the connection between communication technology, experience, and social organization. In order to understand the relevance of this interest in relation to establishing an ontology of 'web-visions', it is first of all necessary to understand that Cooley defined communication in such broad terms that it would also have included digital traces if they had existed in his time. In his book 'Social Organization', he defined communication as follows:

> By communication is here meant the mechanism through which human relations exist and develop - all the symbols of the mind, together with the means of conveying them through space and preserving them in time. It includes the expression of the face, attitude and gesture, the tones of the voice, words, writing, printing, railways, telegraphs, telephones, and whatever else may be the latest achievement in the conquest of space and time. All these taken together, in the intricacy of their actual combination, make up the organic whole corresponding to the organic whole of human thought (Cooley 1909: 61).

This quote clarifies two important things. The first is that Cooley conceived of communication as a socio-technical arrangement that is made up of symbols that span from linguistic entities such as words to material objects such as railways. The second is that he took the whole of this socio-technical arrangement to correspond to 'human thought', which he accordingly conceived of as a phenomenon that is larger than individual consciousness. A central ontological claim in his writings is that human thought should not be seen as an individual mental act that is mediated by communication technologies. Communication technologies and their materiality are, to the contrary, an essential part of the ontology of human thought. Cooley´s argument is simply that people experience the social world through the types of environments that

the existing system of communication provides them with. This connection is emphasized in the following extract from a paper entitled 'The Process of Social Change':

> A man´s social environment embraces all persons with whom he has intelligence or sympathy, all influences that reach him […] the social influences act through a mechanism; and the character of their action depends upon the character of the mechanism. The existing system of communication determines the reach of the environment (Cooley 1897: 73-74).

This quote indicates that the social environment that a person experiences has the temporal and spatial characteristics that the system of communication allows for. Two of the examples that Cooley gave to clarify this idea was that the existence of durable paper allowed his own environment to include Greek philosophers that were long dead, and that the existence of the transatlantic telegraph cable allowed his environment to be sensitive to contemporary developments in selected parts of Europe. Such technologies simply enlarged what can be referred to as a person's 'environment of experience', and it is important to emphasize that Cooley took such environments to be selected environments. In fact, he argued that the existence of any ordered experience is conditioned upon the existence of a system of communication that ultimately determines and selects in "[…] the ways through which thought and feeling can pass from man to man" (Cooley 1897: 22).

Because Cooley saw such selective systems—and the environments of experience they enabled—as corresponding to human thought, he was naturally very interested in determining their ontological characteristics. But in his attempts to give more detail to this ontology, it seems that one specific question was troubling him: Where does the power of selection lie when environments of experience are created? To Cooley this was an important question because the nexus of selection is also the nexus of human thinking. However, it is profoundly unclear to what extent he saw the location of

selection as residing in communication technology or human intentionality or perhaps even in the distributed environment. When he wrote about the shift from oral modes of communication to technologies of writing, he seemed to give ontological primacy to the individual:

> [Writing] permits one to form his own environment by retaining what suits him from a variety of materials, and by opening communication with congenial minds in remote times and places. In doing so each individual, of course, becomes a center for the distribution of what he receives, and extends the environment of many others (Cooley 1897: 75).

This quote seems to locate the act of selection in an intentional human being that 'forms his own environment' and thereby becomes the 'centre of distribution' of information. It suggests an individualistic ontology that is, however, at odds with Cooley´s general emphasis on the artificiality of taking the individual mind as a distinct entity. This tension is somewhat resolved in other passages where Cooley talks about the act of selection as somewhat guided by unintentional choices:

> The process that generates value is mental but not ordinarily conscious; it works by suggestion, influence and the competition and survival of ideas […] values imply an act of selection, which may also be unconscious as well as conscious (Cooley 1912: 7).

This quote suggests that the production of 'environments of experience' (that makes it possible to ascribe value to things and events in the world) is a process that involves repetitions and associations between ideas, and Cooley explicitly argues that this form of association is "[…] mostly subconscious in its production" (Cooley 1909: 21). This emphasis on the subconscious elements of association and selection opens for an ontology of human cognition that balances the choice of the individual with the influence of the system of communication. As he formulates it himself:

> The selective principle […] is ever human in nature – but human nature conditioned in its choices by the state of communication, which determines what influences are accessible, as well as by the constraining momentum of its own past (Cooley 1897: 81).

If 'the state of communication' is central to selection, it follows from Cooley´s earlier definition of communication that the important associations are shaped by the material technologies of communication. This stand is even clearer when he argues that the history of communication technologies is the foundation of all history (Cooley 1897: 21). This statement almost implies a technological determinist position that is at odds with the ontological position he suggested in the quotes concerning the freely choosing individual above. His ontology of experience and cognition suddenly seems materialist.

Cooley´s ontological quarrels could easily be written off as a vague aspect of his theory of experience, but throughout this dissertation, it will be clear that this vagueness is a productive point from which to think about the ontology of 'web-visions'. The fact that Cooley had difficulties locating the nexus of selection that creates environments of experience has been used as an analytical eye-opener to highlight a similar difficulty in pinpointing the acts of selection that shape 'web-visions'. A particularly interesting element in Cooley´s work is that the problem of locating the acts of selection led him to slide away from starting his analyses of experience from a priori assumptions about the location of selection. Cooley´s move was to focus analytical attention on the situations that create environments of experience for their users. A productive interpretation of Cooley´s quarrels is therefore that we need to start from situations rather than preconceived ideas about selection when we analyse web-based visualizations as 'web-visions'.

Therefore, the concept of 'web-visions' suggests being agnostic about the specific forms of selection mechanisms being looked for. Throughout the analyses, it will be clear that this ontological stance makes the concept stand in contrast to approaches outlined in Chapter II. Chapter V will, for instance, discuss how it is in conflict with Anderson´s suggestion to see the shape of web-based visualizations as a result of the real and unmediated behavior of people. Chapter VI will furthermore discuss the way it is different from the concept of a 'filter bubble', which explicitly draws analytical attention to algorithms and technological filters by starting from the assumption that these are the selection mechanisms that guide the attention and experience of the users. 'Web-visions' are to the contrary taken as empirical sites where distributed selection mechanisms can be rendered explicit. In Paper Three, it will, for instance, be shown that Google´s 'web-visions' are produced by a chain of selection mechanisms that, for example, includes the semantics of the person searching for information, the history of web-infrastructures and HTML codes, and the interfaces and situations within which people leave their traces. The framework of 'web-vision analysis', accordingly, draws on Cooley in order to maintain sensitivity towards the distributed and constantly renegotiated chain of mechanisms that go into producing web-based visualizations.

3.2.2 Affordances and the Perceptual System

Gibson´s theory of perception follows Cooley´s lead about the distributed ontology of experience, but it provides a set of more detailed concepts that will prove relevant in the attempt to suggest an ontology of 'web-visions'. One example is the concept of 'affordances', which is a useful starting point for understanding Gibson´s ontology of perception. He claims that the environemmt of perception has 'affordances' and the first thing to notice about this concept is that Gibson used it in both functional and relational manner. Its functional aspect is visible in passages where he used it to refer to characteristics of entities in the environment that surrounds the perceiver. Its relational aspect is visible when he used it to refer to the connection between these

entities and the characteristics of the perceiver, who he thought of as being part of this environment. That Gibson used the concept with such a dual reference is clear in the following definition:

> The *affordances* of the *environment* are what it *offers* the animal, what it *provides* or *furnishes*, either for good or for ill. The verb to *afford* is found in the dictionary but the noun *affordance* is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of both the animal and the environment (Gibson 1986: 127).

Gibson used the concept of the 'environment' in a way that is not dissimilar to the way Cooley used it. Gibson presented it as a reference to all material and immaterial entities that provide a perceiving agent the potential for action. A simple example of material entities that can be found in the environment are surfaces, and the functional aspects of the concept of affordances serves to highlight that different types of surfaces offer the perceiver different possibilities for action. A horizontal, flat, extended, and rigid surface, such as a frozen lake, will afford support in a way that a vertical and slippery surface does not. Besides such material entities, Gibson conceptualized the environment as filled with 'objects' (such as pencils that afford trace-making), 'persons' (such as colleagues that afford specific forms of social interaction), and 'mediums' (such as air that affords smooth locomotion) (Gibson 1986: 130-136). It was when Gibson used the concept of 'affordances' to refer to the environment as providing specific possibilities for perception and action that it took on a functional character.

Gibson was, however, not a material or technological determinist. The functional aspect of 'affordances' was only half the meaning that he assigned to the concept. The

latter part of the quote above explicitly emphasizes that the concept was used to refer to both the environment and the perceiving agent. This dual reference indicates that even though entities in the environment shape the possibilities for perception and action, it is necessary to understand these possibilities in relation to the perceiving agent. To keep with the example of surfaces, Gibson´s argument was, simply stated, that "[…] different layouts afford different behaviors for different animals" (Gibson 1986: 128). It is, for instance, obvious that a newly frozen lake may afford support for a mouse but not for an elephant. In relation to non-material elements in the environment, it is similarly the case that they have different affordances for different animals. A medium like air affords different possibilities for the locomotion of a bird than that of a human, and the appearance of a specific human being in the environment may afford different forms of interaction for different persons depending on the way they perceive this person and their previous interactions with him or her.

This relational aspect of the concept of 'affordances' carries with it a central ontological point, which is going to play an important role in relation to the ontology of 'web-visions'. The point is that 'affordances' is a noun rather than a verb because it has a distinct ontological status. It is neither a reference to a quality of a physical object nor a reference to some subjective idea about the value and qualities of that object. Ontologically speaking, Gibson preferred to call it an 'ecological object' that exists in-between the subject and the object in a way that makes the distinction between them wholly uninteresting:

> […] an affordance is neither an objective property nor a subjective property; or it is both if you like. An affordance cuts across the dichotomy of subjective-objective and helps us understand its inadequacy. It is equally a fact of the environment and a fact of behavior (Gibson 1986: 129).

We are now beginning to see the contours of an ontology where an affordance is considered to be an object (hence it is a noun) that is located in-between the physical

and the mental world. A further point that is relevant in relation to the suggestion to talk about web-based visualizations as 'web-visions' is that this ontological in-betweenness is also true for the information that the perceiving agent needs so as to specify the utilities of the environment and act upon it:

> [T]he information to specify the utilities of the environment is accompanied by information to specify the observer himself […] to perceive the world is to co-perceive oneself. This is wholly inconsistent with dualism in any form […] the awareness of the world and ones complementary relations to the world are not separable (Gibson 1986: 141).

Gibson argues that in order to grasp and take advantage of the information that enables the perceiving agent to experience specific qualities in the environment, it is necessary that she actively co-perceive herself and her relation to the world (Gibson 1986: 240). To keep with the simple examples above, one can say that in order to perceive the affordances of a newly frozen lake, one must have a good sense of one's own weight. Similarly, in order to correctly perceive the affordances of another person, one must have a good idea of one's relation to that person. This emphasis on the necessity of having a theoretical vocabulary that 'cuts across' the subjective and the objective made Gibson talk about the ontology of perception as dynamic. He saw it as an active system rather than a result of passive sense-organs that channel impressions from the external world to the mind (Gibson 1986: 244-246):

> The visual system is distinguished from the visual sense, from the modality of visual experience and from the channel of visual inputs. It is a hierarchy of organs and functions, the retina and its neurons, the eye with its muscles and adjustments, the dual eyes that move in the head, the head that turns on the shoulders, and the body that moves around the habitat. The nerves, tracts, and centers of the brain that are necessary for vision are not thought of as the "seat" of vision (Gibson 1986: 309).

At this point we can begin to relate Gibson´s ontological arguments to the work of Cooley and indicate their relevance to the ontology of 'web-visions'. It was already argued above that Cooley provided a foundation from which to talk about 'web-visions' as distributed systems of selection rather than determined by, for example, algorithms. The way Gibson refuses to talk about the brain as a seat of vision in the quote above is closely related to these arguments. The point to be driven form these arguments is that an algorithm will occupy a similar position in the framework of 'web-vision analysis' as the brain does in his theory. It is without doubt a necessary component, but it is not to be seen as the 'seat of vision'. Gibson´s concept of affordances and concept of the perceptual system will throughout this dissertation be referred to as the foundation from which to argue that it is also not possible to talk about the world of digital data and its affordances as something that is external to the perceiving agent and the tools that she has to interact with the world.

The framwork of 'web-vision analysis' involves looking at the world as being full of digital traces that afford specific ways of seeing the world, but, at the same time, emphasizes that these affordances need to be seen in relation to the capacities of the perceiving agent. A digital trace like the tweet can be said to afford real time experiences, but this potential is only relevant for specific perceiving agents with specific characteristics and specific problems. Speaking about web-based visualizations as 'web-visions' entails speaking about them as systems of experience that have an ontological status similar to the one Gibson ascribed to perceptions. The empirical analysis in Paper One will, for instance, illustrate this point with an example of the way the crisis monitor made by the United Nations (see figure 4 in Chapter I) is a result of balancing and aligning such different elements. The insights from this paper fit the idea of thinking about such a monitor as a 'web-vision' that is an active construction with an ontological status in-between practices, technologies, and human

intentions. It is therefore also a device that can take many different directions depending on the way the elements of the distributed system are aligned.

Broadly speaking, it can be said that Gibson used the concept of the perceptual system to emphasize that the perceptual capabilities of an organism do not lie in discrete anatomical parts of the body but rather in systems with nested functions (Gibson 1986: 205). Different organs are capable of picking up specific forms of information from an environment with specific affordances (Gibson 1986: 53). It is only when organs, their capabilities, and the affordances of their environment are aligned and properly interconnected that an elaborate and precise perceptual system is possible. This focus on the necessity of alignment and interconnection will, as argued above, be in focus in the empirical analyses of web-based visualizations in Chapters IV-VI.

3.3 The Epistemology of 'Web-Visions': Pragmatic and Dynamic Detections of Invariance

Whereas the last section indicated how Cooley and Gibson´s work can provide a useful foundation for thinking about the ontology of 'web-visions', this section will focus on the way Gibson´s work has inspired thoughts about their epistemological status. Here, epistemology is taken to refer to the procedures through which knowledge about the social world is created and evaluated. Talking about the epistemology of a 'web-vision' is therefore equivalent to talking about the procedures through which web-based visualizations can be used to generate knowledge about the social world and the way they can be evaluated as sources of knowledge. Gibson´s work on perception is a relevant foundation from which to construct an epistemology of 'web-visions' because his ontological thoughts carry with them epistemological claims about the criterion through which perceptual systems can be evaluated as sources of knowledge. This

section will outline the details of these claims and indicate why they are well suited for making sense of the way knowledge about the social world is produced within the field of digital methods as well.

Gibson´s thoughts about the epistemological aspects of the perceptual system are tightly connected to his above-mentioned critique of theories that approach perception as a property of the brain that receives stimulus from the external world through sense organs. He argued that theorists who work on the basis of such a dualistic ontology inevitably end up evaluating the content of perception through criteria of correspondence. The epistemological questions they ask end up concerning the extent to which a specific mental image is representative of the stimulus that created it. However, we have just seen that Gibson approached perception in a much more dynamic way than such theories. Whereas these theories suggest speaking of 'points of observation' as isolated instances where the sense organs transmit external stimulus to the brain, Gibson spoke about 'observational paths' through which the perceiving agent must move in order to perceive the world (Gibson 1986: 243). An important point here is that perception involves movement. Being on the move is, to Gibson, the only possible way to discriminate information in an environment where information is inexhaustible and constantly flowing. For a perceptual system to function in such an environment, Gibson argued that it necessarily needs to be an active whole that organizes, fuses, and selects information through, for instance, "[…] the activities of looking, listening, touching, tasting, or sniffing" (Gibson 1986: 244).

A very important aspect of Gibson´s theory is, accordingly, that it implies a connection between ontological claims about perception and epistemic criteria for the production and evaluation of visual knowledge. Echoing a tenet of classic pragmatism it contains descriptive and prescriptive elements that are hard to separate from each other. Perception is described as a distributed and active system that becomes more and more

elaborate with practice. The epistemic prescriptions regarding the evaluation of visual knowledge must therefore be coherent with this ontological status rather than being derived from static and dualistic ontologies. This move is interesting for the concept of 'web-visions' for two reasons. The first is that Gibson characterizes the environment of perception as consisting of inexhaustible and continuous data flows. This characterization has important similarities with the way the digital data environment is described within most works on digital methods. The second is that it motivates seeing 'web-visions' as ambulatory systems that search, explore, scan, and constantly adjust themselves to align the distributed elements they are made up of. It will be clear throughout the dissertation how these thoughts can serve as a foundation for thinking about web-based visualizations through different metaphors than, for instance, that of a map.

It is therefore necessary to inquire a little more into what Gibson more precisely meant when he talked about an elaborate and precise perceptual system. He argued that elaborate visual knowledge should not be seen as an approximation of a correspondence with something external. But what could then be the criteria on which to judge its merit? Gibson´s answer was to define a well-functioning perceptual system as one that enables sensitivity towards changes and 'invariant structures' in the environment:

> We can say that the perceiver separates the change from the non-change, notices what stays the same and what does not, or sees the continuing identity of things along with the events in which they participate. The question, of course, is how he does so. What is the information for persistence and change? The answer must be of this sort: The perceiver extracts invariants of structure from the flux of stimulation while still noticing the flux (Gibson 1986: 247).

Gibson´s point is that invariant structures is the kind of information that comes to structure the way the perceiving agent experiences both the environment and herself.

Gibson kept emphasizing that such structures should not be conceptualized as external inputs to a perceiving person. They are rather to be seen as created by an active perceptual system that picks up invariants in information flows and become increasingly sensitive with practice. This is why Gibson argued that the legitimacy of perceptual knowledge cannot be evaluated on the basis of a correspondence theory of truth. The important epistemic question is not whether the mental image represents the external world. It is whether the perceptual system is able to pick up useful invariants through active engagement with the environment.

So what did Gibson mean when he talked about 'invariant structures'? On a general note, it can be said that he wrote about such structures as fixed points with reference to which the chaos of the environment can be organized. His argument was that the creation of such points is a necessary condition for perceiving change and thereby for engaging and acting in the world. He conceptualized the perceiving agent as a constant sampling point that is always on the lookout for invariant structures (Gibson 1986: 311). In order to make this conceptualization of the perceiving agent more detailed, he outlined four types of invariant structures that he saw as fundamental for the development of an elaborate and useful perceptual system.

The first type is 'invariants under changing illumination', and Gibson exemplifies this type of invariant structure by the movement of the sun (Gibson 1986: 88-91). For instance, if the sun hides behind a cloud or moves across the sky, it will change the way the environment is illuminated. This change can enable a perceiving agent to detect specific invariant structures in the environment that remain constant despite the change in illumination. A shadow on a stone may vanish while the contours of the stone remain. Gibson argues that the perceptual system is ultimately built upon the detection of such fixing points, and their merit cannot be evaluated on the extent to which they correspond to anything in the world.

The second and third types of invariant structures are defined as 'invariants under changing points of observation' and 'invariants under activities of sampling'. The first involves locomotion in the perceiver such as running (Gibson 1986: 72-76), whereas the second involves activity in the body such as the activity of looking around (Gibson 1986: chapter 7 and 12). By moving between points of observations on an observational path or by engaging in activities of sampling by moving the head, it becomes possible for the perceiver to detect invariant structures in the environment that are not dependent on changes in illumination. Gibson´s point is once again that it is the detection of invariants through dynamic action that enables both perception of the environment and self-perception on the part of the perceiver. In order to take perceptual advantage of these invariants, the perceiving agent needs to know herself and her movements in the world as well. Perceptual knowledge exists in-between the perceiving agent and the material world.

The last type is defined as 'invariants under local disturbances', and it is with the introduction of this type of invariance that Gibson echoes Cooley´s thoughts about the role of situations and events in his theory of experience. Gibson defines events as 'local disturbances' that have a structuring role on the perceptual system (Gibson 1986: 93-110). Just as changing illumination, changing points of observation, and activities of sampling are processes that can enable the perceiving agent to structure her vision, so are different forms of events. Gibson argues that they are a particularly good source for perceiving the kind of persistence and change that he argued is a central element of perception. Simple examples of events that have this effect are water that freezes, plants that green, and iron that rusts. Such events involve a change in the layout and colour of surfaces that leaves the perceiving agent with sensitivities towards specific invariant structures. The fact that the freezing of water is a reversible process, for

instance, allows for discriminating between persistent and non-persistent elements in this medium (Gibson 1986: 209).

Gibson´s conclusion is that perception occurs when a perceiver succeeds in discriminating invariant patterns in a changing visual environment and subsequently using them as a basis for understanding this change. The capability to 'see' and act is tightly coupled to such discriminatory skills in Gibson´s theory. These skills are bound to be situational in the sense that they change from organism to organism and from event to event. An important point to take away from Gibson´s theory of perception is, therefore, that different perceptual systems are tuned into picking up different types of information from environments that afford very different kinds of 'information pick-up'. It is the interplay between the affordances of the environment, the perceiver, and the situation that determines the elaborateness of the perceptual system. It is therefore only with reference to this interplay that it makes sense to evaluate the insights derived from this perceptual system.

This review of Gibson´s thoughts on the epistemology of perception may seem far removed from the topic of this dissertation, but the findings in the empirical analyses in Chapters IV-VI will illustrate why these thoughts have served as an inspiration for thinking about the epistemology of 'web-visions'. Gibson´s suggestion to look at the detection of useful invariants rather than approximation of correspondence as a criterion for judging the elaborateness of perceptual systems will, for instance, be used to reflect on the way web-based visualizations can be said to produce knowledge about the world. In a data environment where it is difficult to control samples and where the provenance of data sources is often non-transparent, there is a need to think about the epistemic merit of such visualizations in other terms than correspondence and representation. One alternative is to build visualizations on the basis of invariants. For instance, Paper One will illustrate how the United Nation´s attempt at detecting crisis

signals through the practice of scraping tweets is built upon the detection of anomalies inside the streams of tweets. There is no external benchmark to judge the result of the visualizations up against. To the contrary, the epistemic choice is to take the normal fluctuations in the word patterns from the data streams as an invariant structure against which change in crisis sentiment can be detected. This difference between invariant detection and correspondence will be discussed more thoroughly in the discussion after this paper in Chapter IV.

Another aspect of Gibson´s epistemological thinking that will be used to make sense of the empirical analyses throughout this dissertation is the argument that events are some of the central proxies through which we make sense of the world. This statement echoes some of Cooley´s arguments, but the way Gibson connects it to the concepts of invariants and local disturbances makes it an even more relevant foundation from which to make sense of the findings in the empirical papers. Paper Three will, for instance, illustrate how major American events within the field of synthetic biology shape the 'web-vision' of the British public. The distributed selective system that produces these visions simply has a specific sensitivity towards American linguistics. This underscores Gibson´s point that the perception of events is tied to the information we can successfully extract about them and that elaborate perceptions of the world involves co-perception of the self. British web-users would be better off if they had knowledge about the specific 'web-vision' they are seeing the world through. The details of this argument will be unfolded in Chapter VI, where it will also be used to illustrate why the concept of 'web-visions' differs from, for instance, that of the filter bubble. The next section will shift the focus from epistemology to the normative aspects of 'web-visions' and discuss the role they play in the way their users assign meaning and value to things and events in the world.

3.4 The Normative Aspect of 'Web-Visions': Segmentation and Valuation as Conditions for Social Organization

Whereas the sections above have aimed at providing a foundation from which to talk about the ontology and epistemology of 'web-visions', this section will draw on Cooley and Espeland to argue that there is a need talk about them as normative devices as well. This move towards something normative was already indicated with the link between ontological descriptions and epistemological evaluations above. This connection will be continued by outlining a theoretical foundation from which to talk about 'web-visions' as devices that set conditions for the way the social world can be organized and the way things and people within it can be assigned value. This theoretical foundation will be initiated with an outline of Cooley´s argument for a connection between acts of segmentation and conditions of valuation in the creation of environments of experience. Cooley used the concept of 'variegation' to refer to the necessity for segmenting the empirical world into bits of information when one wants to make sense of—and evaluate—things and events in it. This is not dissimilar to the way Gibson talked about the necessity for generating invariants; but whereas his thoughts were used to build an epistemology of 'web-visions', this section will use Cooley´s work to reflect on their normative aspects. The last part of this section will relate Cooley´s arguments to Espeland´s concept of 'commensuration'. This will be done in order to highlight the way quantification of qualitative events will necessarily be an important component of constructing 'web-visions' and thereby also shape the kind of evaluative practices that emerge from them. It will be argued that the combination of Cooley and Espeland´s vocabularies provide a useful foundation for talking about the normative aspects of 'web-visions', and this section will end with a few illustrations of the way their concepts will be used in the discussion on the empirical analyses in Chapters IV-VI.

3.4.1 Variegation as the Condition for a Free Mind

Cooley was part of the pragmatist movement described in Chapter II, and his work was inherently normative in the sense that it aimed at highlighting the conditions under which social organization and shared attention was possible in electrified America. This aim was a continuation of his early writings that focused on the role that 'primary groups' such as the Family and the Church played in shaping the way people experienced society. However, his later writings focus on the way such primary groups were, in his time, supplemented (or even challenged) by technologies that transmitted new symbols of the mind through electric wires (Cooley 1909). We have already seen that Cooley saw such technologies as necessary components of social experience, and he perceived the changes in modes of selection as having important implications for social life:

> The changes that have taken place since the beginning of the nineteenth century are such as to constitute a new epoch in communication, and in the whole system of society (Cooley 1909: 80)

It is clear from this statement that Cooley was interested in the normative effects that electricity had on experience and one of his arguments was that the new epoch in communication had consequences for the way people in intellectual functions, in business and in public professions saw the world. He argued that these people came to live in a situation where systems of communication were expanding and quickening, while their attention remained scarce. Cooley saw this development as a challenge to the way businessmen and professionals had usually constructed their environments of experience through encounters with local groups. His argument was in that sense an early diagnosis of the kind of 'attention-economy' that is also claimed to be the outcome of the rise of digital data. Cooley´s formulation of this diagnosis is as follows:

[I]t is beyond doubt that the constant and varied stimulus of a confused time makes sustained attention difficult […] in general there is more opportunity, more responsibility, more complexity, a greater burden upon intelligence, will and character. The individual not only can but must deal with a flood of urgent suggestions, or be swamped by them (Cooley 1909: 100-101).

This quote shows that Cooley was clearly aware of the problematic sides of electrified communication technologies, but this did not keep him from having a progressive attitude towards new technologies and he was constantly emphasizing their liberating potentials. Cooley saw technologies such as the telegraph as giving access to an expanded system of communication that allowed for new empirical sensitivities. He saw them as devices that could positively shape the way people and organizations formed thoughts, opinions, and identities. Whereas the coherence of society had previously depended on primary groups such as the Church, he saw it as increasingly dependent on new systems of communication that were ignited by the electrical revolution:

Communication must be full and quick in order to give that promptness in the give-and-take of suggestions upon which moral unity depends. Gesture and speech ensure this in the face-to-face group; but only the recent marvelous improvements in communicative machinery makes a free mind on a great scale even possible (Cooley 1909: 54).

Despite never losing faith in the importance of primary groups, it was in electrical communication technologies that Cooley saw the possibility of new forms of social organization (Cooley 1909: 32-33). He simply made a connection between the rise of new systems of communication and the possibility of a 'free mind' that is able to evaluate things and events in the world. This connection between technology, selection, and valuation is most clearly expressed in a paper entitled 'Valuation as a Social Process', where he defines valuation as follows:

In a large view of the matter valuation is nothing less than the selective process in the mental life of man […] The manner in which a certain object develops value for a man in a particular situation is a matter of commonest experience: at every instant we are passing from one situation to another and the objects about us are taking on new values accordingly (Cooley 1912: 1).

Valuation—or the act of assigning a value to things and events—is here presented as a relational process that depends on the characteristics of the situation in which valuation occurs. This resonates with Gibson´s discussion on the importance of events above. But whereas Gibson was interested in events as disturbances and epistemic sources of invariance, it is clear that Cooley made stronger normative links between events and valuations. Since selective processes in the system of communication shape the way people experience things and events in the world, it is implicitly argued that this system play an important normative role:

[By] fixing certain thoughts at the expense of others [the] system of communication is a tool, a progressive invention, whose improvements react upon mankind and alter the life of every individual and institution (Cooley 1909: 64).

This is where Cooley´s appraisal of segmentation comes into the picture. His argument is that the system of communication fixes certain thoughts at the expense of others and thereby enables individuals and institutions to grasp the growing numbers of communicative symbols without the "strain and confusion" that accompanies their production. Following Latour, one can say that this system makes the whole smaller than its constitutive parts, and Cooley used the term 'variegation' to denote this process of segmenting the social world into graspable chunks of information. He saw this process as the cornerstone of social organization:

[…] social organization is nothing less than this variegation of life, taken in its widest sense possible [and] any fairly distinct and durable detail of this structure may be called a social type; this being a

convenient term to use when we wish to break up the whole into parts, for analysis or description (Cooley 1909: 22).

When Cooley talks about the 'variegation of life', he refers to the segmentation of the social environment into distinctions that allow individuals and institutions to compare and evaluate objects within it. Cooley took the concept of 'variegation' from biology, where it is, for example, used to refer to the existence of different color zones in leaves. The reason why he used this metaphor is that such color zones are symbols that carry information about the leaf or the tree on which it hangs. The important point, however, is that they can also be used to evaluate the condition of these trees and leaves. A spot of white tissue on an otherwise green leaf can, for instance, be an indication of a lack of chlorophyll. Forms of variegation simply provided distinctions that could serve as a useful basis for understanding, evaluating and managing an otherwise complex environment. Cooley´s ambition was to translate the concept of 'variegation' into the study of social organization, and he argued that a certain 'variegation of life' is a necessary condition for the kind of analysis, description, and evaluation that makes flexible modes of social organization possible.

The normative aspects of Cooley´s writings are especially clear when he argues that the practice of breaking the social world into analytical types that can be demarcated from each other is a necessary condition for obtaining a 'free mind', in the same way as the process that creates visible distinctions in nature is a condition for the freedom to act in this environment. Good selection mechanisms are essential elements in obtaining social progress, and Cooley explicitly argued that the difference between levels of social and cognitive development between people and institutions lies "[…] neither in human nature nor in capacity, but in organization […]" (Cooley 1909: 29). To Cooley, it is the extent to which the system of communication makes organized experience

possible that determines the level of development in human beings, organizations, and societies:

> […] it is the ability to grasp the course or state of value […] that distinguishes the capable man from the incapable in any field. It may be said in general that the power to grasp process, to see the drama of values, is the height of the practical (Cooley 1912: 10).

To see the drama of values is the height of the practical, says Cooley. The practical is, accordingly, to engage with selection mechanisms that produce situations and experiences that enable the individual in search of his role in 'the larger mind', as well as the state and other formal organizations and institutions, to make useful evaluations of their surroundings.

Cooley´s argumentation resembles that of Gibson, but his focus is on normative aspects of social organization, whereas Gibson´s is more epistemic. On a general note, it can be said that Cooley sees selection, demarcation, and framing as positive enablers of experience, and this stance on the normativity of systems of communication will be returned to in the discussions of 'web-visions' throughout this dissertation. 'Web-visions' can productively be seen as producing situations of valuation because they create segregations where objects can be compared and where valuation can occur. If we keep within Cooley´s vocabulary, we could say that the selection mechanisms behind Google´s SERP create a situation (the vertical order described in the introduction) within which an 'object' (a web-page) can obtain indications of significance (a measure of relevance in relation to a keyword). But this situation is only established because the communicative system enables digital traces like the hyperlink to be used as distinct social signifiers that can be assigned a value. This form of valuation has slowly come to influence the attention structures of many people in the Western hemisphere, and one could even argue that it has helped them cope with what Cooley would call the 'strain' on their attention. They are manipulated to be

manageable and Chapter VI will discuss the 'web-visions' of Google with reference to Cooley´s thoughts on segmentation and variegation.

Another element in Cooley´s thinking that will influence the discussions on 'web-visions' in Chapters IV-VI has already been touched upon in the section on pragmatism in Chapter II. This element is the implicit interplay between description and prescription. When Cooley, for instance, writes about the possibility of expanding and quickening environments of experience, it is not a neutral description. It is simply his suggestion as to how American democracy could sustain the enlargement that resulted from the growth of transportation infrastructures. Situations of experience are never neutral, and they bear traces of the thoughts and values put into their creation. As already argued in section 1.2, this connection between knowledge and usefulness will be central to the framework of 'web-vision analysis' as well. However, it will leave the unchallenged optimism that characterized the progressive movement of which Cooley was a part. This will be more thoroughly discussed in the reflections on the empirical analyses in Chapters IV-VI. Before getting to these discussions, the next subsection will introduce Espeland´s concept of 'commensuration' and illustrate how it provides further analytical resources for transferring Cooley´s thoughts on variegation to the study of 'web-visions'.

3.4.2 Commensuration as a Condition for Functioning Algorithms

This section will show how Espeland´s definition of 'commensuration' implicitly continues Cooley´s ideas about variegation in a way that adds to the theoretical foundation on the basis of which the normative aspects of 'web-visions' will be discussed throughout this dissertation. One important addition is that Espeland´s work allows for highlighting that the segmentation of the social world into quantified segments is a necessary condition for algorithms to organize it into visualizations. Another important addition is that her work provides useful distinctions between three

different dimensions of this segmentation process that are interrelated and involve a distributed set of actors. A third important addition is that her work has a much more explicit focus on the effects that such segmentation has on the behaviour of individuals and institutions. Her concept of commensuration captures these three points better than Cooley´s concept of variegation, and it is therefore a useful analytical addition in relation to the ambition of building a theoretical foundation from which to understand the normative aspects of 'web-visions'. The concept of commensuration will be introduced through Levin and Espeland´s study of the institutional work that went into creating a market for air pollution throughout the 1990s. In this study they define commensuration as follows:

> Commensuration is a process for comparing and integrating different objects and practices. It constructs relations among disparate things by uniting them based on their shared relation to a third thing – a metric. (Levin & Espeland 2002: 124).

Commensuration is here defined as a process that turns qualitative differences in the world into quantitative metrics. The example Levin and Espeland give of such a process is the creation of a market for air pollution, and they show how the success of this market was dependent upon a settlement on a commonly accepted definition of emissions; an agreement on ways of transforming these units of analysis into comparable commodities; and the creation of techniques that allowed for attaching prices to these commodities and establishing a market-infrastructure through which they could be bought and sold. A central point in Levin and Espeland´s study is that this process of commensuration was not based on translating already existing units of analysis into a pricing scheme. To the contrary, it involved hard construction-work across a distributed set of people:

> In nature, air pollution does not appear as a fungible, tradable commodity. To see it as such requires human intervention […] It required the coordinated labor of thousands of people, the mobilization of

vast and disparate technical and cultural resources, and layers of commensurasive practices (Levin & Espeland 2002: 122).

This quote serves to emphasize that a necessary condition for seeing air pollution as an allocation problem was the coordination of distributed 'layers of commensurasive practices'. This general reference to 'layers' is the point from which Levin and Espeland introduce the three different dimensions of commensuration that will serve as an influence in the discussion of 'web-visions' as well.

The first dimension is called 'technical commensuration' and is used to refer to strategies for "[…] measuring or classifying specific characteristics and practices more accurately" (Levin & Espeland 2002: 126). The work done in this dimension lays the foundation for turning qualitative phenomena into quantitative metrics. It involves the creation of new classifications of the world through which new analytical objects become possible subjects for valuation. The work of technical commensuration that underpinned the construction of a market for air pollution was, for example, characterized by establishing a procedure for quantifying 'emission-units' that allowed economists to distinguish this empirical phenomenon from other entities in the world. The act of carving out emission-units as a discrete, quantifiable object was a necessary condition for establishing the monitoring systems that came to serve as the backbone of the air-pollution market.

The work done in the technical dimension of commensuration further includes the maintenance and calibration of the systems that emerge from these choices. The systems that were established to monitor the outlet of emission-units, for instance, needed constant updating when feedback indicated that classifications or measures were imprecise. An example of a process of technical commensuration that is related to the topic of this dissertation could be the way Google relies on specific analytical units

in order to make the world of information readable for algorithms. For example, the company relies heavily on distinctions between hyperlinks, source-texts, headlines, and other HTML-based objects as the building blocks on which they ground their search results. However, they are also continuously calibrating the way they segment information on the web, and we will see that this continuous segmentation and calibration is an essential characteristic of producing a 'web-vision'.

The second dimension of commensuration is called 'value commensuration'. It involves using the classifications and measures developed in the dimension of technical commensuration to assign values to entities in the world. Espeland implicitly echoes Cooley in arguing that such an act of valuation is relational in the sense that values are assigned to specific objects of analysis through a comparison with other objects (Espeland 1998: 317). The work of value commensuration in the example of air pollution consisted of the attachment of monetary prices to the units of an emission that were carved out as discrete units in the technical dimension. This valuation was done through the use of private markets and annual auctions, and this act of pricing things can be seen as an act of value commensuration precisely because it ensures that classifications and measurements are turned into a metric that assigns value to objects in the world. Returning to the example of Google, one could say that the decision to interpret a hyperlink as an indicator of information relevance and integrate this as a variable to be valued in the PageRank algorithm is an instance of value commensuration. Furthermore, it is also a relational mode of valuation because the ranking on the SERP—which is the outcome of value commensuration—is not an absolute scale. The worth of a website is part of a zero-sum game where one website's loss of value is another website's gain. The relevance of a website is valued in relation to others, and we will see that this type of relational valuation is also a central characteristic of 'web-visions' in the empirical analyses below.

The third dimension of commensuration is called 'cognitive commensuration' and "[it] involves reclassifying the world in terms of categories that align more closely with the new metrics" (Levin & Espeland 2002: 126). In the example with the market of air pollution, this dimension, for instance, included the work of getting the international community to change the logics with which they understood and thought about environmental issues and polluters. It involved defining air pollution as a problem of allocation in a way that changed the relations between emissions, the emitting firm, and the total number of emitters on the market. As a consequence of the new problem definition it, for instance, became a possibility for a heavily emitting firm to pay for legitimacy by buying allowances from less emitting firms. In the example of Google, this dimension involves the attempt by the company to convince web-users to change their concepts of information relevance from something that was determined by specific professions, such as journalists and librarians, to something that could be competently carried out by algorithms relying on crowd-intelligence. The choice of taking hyperlinks as votes for websites was, for example, framed by Google as a form of direct democracy in the process of selection. On a general note, it can be said that successful cognitive commensuration changes relations between the central actors in a field and this will also be true of successful 'web-visions'.

It is important to emphasize that the point of introducing these three dimensions of commensuration is not to suggest that they are isolated from each other. To the contrary, Levin and Espeland emphasize that "[…] in many examples of commensuration […] all three dimensions will be present to varying degrees" (Levin & Espeland 2002: 127). But the distinction between the different dimensions has analytical value because it suggests a need to focus on the interplay between them. A central empirical task that emerges from the concept of commensuration is, accordingly, to sort out the relative significance of the different dimensions in processes of commensuration. This is an important analytical task because

commensuration processes ultimately "[…] shape where attention is directed, how problems, solutions, and their causal connections get defined […]" (Levin & Espeland 2002: 122). It is therefore a task that will be returned to throughout this dissertation.

The review of these normative points in Cooley and Espeland´s theoretical vocabularies has outlined similarities between them as well as pointed out where Espeland´s concept of commensuration adds important elements to Cooley´s concept of variegation. Their vocabularies are similar in the sense that they both emphasize how choices of classification and measurement are essential elements in the attempt to make objects comparable and valuable. However, the concept of commensuration adds three details that make it easier to understand the processes that produce such segmentations. First, it is more useful in relation to emphasizing the centrality of quantification as a prerequisite for algorithms to organize the kind of digital traces that provide the foundation for most 'web-visions'. Second, it provides a distinction between three dimensions of commensuration. This distinction is useful for putting focus on their internal relations and the way the interplay between them succeeds or fails in making specific analytical units something shared and something that has an effect on social organization. Third, it provides a vocabulary that puts analytical attention on the way different outcomes of commensuration open for different modes of governance and organizational action. These aspects of commensuration will all be used as part of the foundation on which the normative aspects of 'web-visions' will be discussed throughout this dissertation. The topic of quantification and formalization will be returned to in all the empirical analyses, and the interplay between actions that can be said to belong to the technical and the value dimensions of commensuration will receive special focus in the discussion about the results of the empirical analysis in Paper One. The concept of cognitive commensuration will not be used much in the discussions on the empirical papers, but it will be returned to in Chapter VII, where it

will be used to outline possible future studies based on the framework of 'web-vision analysis'.

3.5 Outro

The four sections in this chapter have introduced concepts from Cooley, Gibson, and Espeland so as to provide a theoretical basis for carving out 'web-visions' as a distinct analytical object to study. The three writers are admittedly concerned with different questions at different historical epochs, but they share some fundamental assumptions that make it suitable to integrate their work into a coherent theoretical foundation from which to talk about web-based visualizations as 'visions'. All of them approach problems of social organization as related to the mechanisms/systems/metrics through which people and organizations experience the world, and they accept that reduction and selection are conditions for acting in a world of massive information flows. Selection mechanisms that fixate thought and attention are therefore not primarily seen as problematic power instruments but rather as prerequisites for communicating about the world and navigating in it.

The three writers, furthermore, accept the fact that the achievement of experience or perception of the world should be interpreted as a pragmatic, and to some extent, normative act. Different 'visions' will have different affordances and produce different modes of social organization and competent experience of the world is therefore seen as a pragmatic approximation that needs to be learned. All three writers emphasize the need for constant calibration and adjustment of the selection mechanisms we use to base experiences of the world upon. Finally, they agree that experience is a relational practice and that comparison is a central part in the way we perceive and make sense of the world. Information is not something in the external world that is processed by a

passive human agent or a passive organization. The analytical objects that carry information are actively produced through a distributed set of (material and non-material) actors. The theoretical grounding that has emerged from the introduction of Cooley, Gibson, and Espeland will serve the following two main purposes throughout the rest of this dissertation.

The first purpose is to use this theoretical ground as a basis against which the findings of the empirical analyses in the three papers below can be discussed. The way this will be done has already been briefly indicated in the snippets of text that foreshadowed some of these findings above. But the more detailed discussions of the relation between the theoretical inspiration from Cooley, Gibson, and Espeland and the interpretation of the empirical results will be taken in the meta-text around each of the papers in Chapters IV-VI. As mentioned in the introduction, it is not necessarily the case that the papers themselves mention these theoretical influences. This is partly because some of the papers were written at distinct times in the three-year period of dissertation work where the relevance of Cooley, Gibson, and Espeland was not yet clear, and partly because the papers have been targeted at journals where references to their work would perhaps seem misplaced. The introduction given to Cooley, Gibson, and Espeland in this part of this dissertation and the meta-text around the papers are, accordingly, to be seen as an aspect of this dissertation, which is distinct from the papers and provides a reflection on them.

The second purpose is to use the combination of the theoretical grounding in this chapter and the findings of the empirical papers to carve out 'web-visions' as an analytical object that has relevance within the field of digital methods; and to establish 'web-vision analysis' as a prescriptive framework that can be used to guide the construction and evaluation of such visions. The ambition is to use these analytical interventions to suggest a way of thinking about web-based visualizations that can

supplement some of the concepts and vocabularies introduced in Chapter II. The discussion of the empirical papers in Chapters IV-VI will highlight tensions between the findings of the papers and the existing vocabularies and they will suggest that some of these tensions can be approached in a different way by thinking of web-based visualizations as 'web-visions'. In line with the pragmatist methodology outlined in Chapter I, the ambition is to describe problematic aspects of the current situation and suggest a resolution with theoretical as well as empirical roots.

It is, however, important to emphasize that this resolution is to be seen as an enrichment of some of the existing vocabularies rather than a replacement of them. If we compare the vocabularies introduced in Chapter II with the theoretical foundation outlined in this chapter, it is clear that there are some shared theoretical affinities. This is especially true of the vocabularies with which it shares roots in pragmatism. Two examples is the way Marres´ concept of issue-networks is grounded in a pragmatic tradition that shares similarities with that of Cooley and the way Latour´s concept of monads has brief references to Gibson´s idea of invariants. The relation between the existing vocabularies and the concept of 'web-visions' will be given a detailed discussion in the meta-text around the papers as well as in Chapter VII. For now it is sufficient to end this theoretical chapter by emphasizing that the concept of 'web-visions' and the framework of 'web-vision analysis' should be seen as an addition and refinement to already existing performative approaches to digital methods that can inspire distinct empirical questions in future studies of the phenomenon. With these closing comments, we can now turn to Chapters IV-VI, which each consist of an empirical paper and a meta-text discussing its relation to the theoretical concepts introduced in Chapter II and III.

Chapter IV: 'Web-Visions' & Organizational Intelligence

This chapter is centered around the first of three papers that will provide empirical arguments for the relevance of seeing web-based visualizations as 'web-visions' in the sense suggested above. Whereas Chapter III outlined the major theoretical foundations of the concept, it is the ambition of Chapters IV-VI to discuss the relevance of using this theoretical foundation to understand the way web-based visualizations are produced in practice. In the introduction it was mentioned that this dissertation will present three papers that have different empirical focal points, and that these papers should be seen as a 'funnel' that starts from empirical insights into general conditions for constructing web-based visualizations and ends with concrete attempts at producing 'web-visions' and extracting insights from them. This part is therefore concerned with the analysis of general conditions, and it looks at the production of 'web-visions' at an organizational level. The empirical paper at its centre is entitled 'Between Technical Conditions and Epistemic Assumptions - Making Web-based Visualizations a Device of Social Analytics'. This paper will be preceded by a short introduction in section 4.1, and it will be followed by a more comprehensive discussion of its relevance to the project of developing a framework of 'web-vision analysis' in section 4.2. This discussion will also include a reflection on the extent to which the concept of 'web-visions' and the theoretical vocabulary drawn from Cooley, Gibson, and Espeland provide a better foundation for interpreting the empirical results of Paper One than the concepts introduced in Chapter II.

4.1 Background on Paper One

It was noted in the introduction that the choice of writing a paper-based dissertation brings with it both possibilities and limitations. One of the limitations is that each paper in this dissertation has gone through a peer-review process in a specific journal. This has inevitably shaped the papers in a way that is not necessarily conducive to the general argument that this dissertation sets out to answer. Each paper needs to make its own coherent argument and this argument needs to be framed for the audience of a specific journal. This means that the framing of the paper has been influenced by reviewers and editors. Paper One has, for instance, been quite heavily reshaped on the basis of comments at the conference 'Big Data – Big Challenges' in Oxford in September 2012, and on the basis of the first peer-review process in the journal 'Policy & Internet'. The consequence has been that the theoretical aspects of the paper have been toned down, and the contribution of the paper is rather an empirical analysis that clarifies the central choices involved in producing web-based visualizations across different organizations. It illustrates how these choices are bound to be made in-between conditions of possibility set by the digital technologies used to scrape the web and existing epistemic assumptions about what a legitimate depiction of the social world is.

The paper makes this empirical argument on the basis of document analyses and interviews with initiators of visualization projects across contexts as different as military intelligence, brand monitoring, crisis management, and technology foresight. More specifically, it uses this empirical material to construct analytical continua that indicate central trade-offs in the process of constructing web-based visualizations across these organizational contexts. It is argued that the identified continua evoke an empirical sensitivity towards the interplay between technological conditions and epistemic assumptions, and the extent to which this sensitivity can guide future analyses of visualizations used for policymaking is briefly discussed. However, the

paper does *not* discuss how these empirical findings relate to the concept of 'web-visions'. It does not even mention this concept and neither does it mention any concepts from Cooley and Gibson.

This, however, does not mean that the empirical arguments made in the paper are irrelevant to the overall conceptual discussion introduced in Chapters II and III. Firstly, it is explicitly argued in the paper that the identified continua illustrate the necessity for thinking about web-based visualizations as outcomes of processes of technical commensuration that balance technological affordances and epistemic assumptions. This is already a hint back to the vocabularies of Espeland and Gibson. Secondly, it will be argued that the empirical findings illustrate that some of the concepts introduced in Chapter II are ill-suited for making sense of the trade-offs involved in such commensuration processes. The discussion of the paper in section 4.2 below will especially focus on the challenges that the findings of the paper pose to the vocabularies of Anderson, Latour, and Venturini. It will discuss the details of these challenges and the extent to which the framework of 'web-vision analysis' provides a better foundation from which to make sense of the findings. Before taking this discussion, however, it is necessary to turn to the paper itself.

Paper One:

Between Technical Conditions and Epistemic Assumptions

- Making Web-based Visualizations a Device of Social Analytics -

Anders Koed Madsen
Department of Organization, Copenhagen Business School
Mail: akm.ioa@cbs.dk

[Currently under review in 'Policy & Internet']

Abstract
Digital traces and the visualizations they give rise to are increasingly used as a source of data with which different kinds of organizations produce knowledge about the social environment in which they have to act. This paper presents an analysis of eight projects that are experimenting with the use of 'web-based visualizations' for such empirical engagement. Despite being carried out in response to different organizational problems, the paper shows that the mode of experimentation is conditioned by two characteristics of web-based visualizations that influence all the cases. The first concerns the need to distribute choices of data formatting to third-party actors, and the second concerns the need to balance machine intelligence and human intuition in processing this data. For each of these conditions, the paper identifies two opposite approaches that indicate a continuum of flexibility in the way these conditions are met across the cases. Furthermore, it shows how these approaches are legitimized by being grounded in different epistemic assumptions about proper ways to generate knowledge about the social world. On the basis of this conceptual work, the paper argues that the future use of web-based visualizations as an analytical device in, for instance, policy-intelligence, will reflect a balance between remediating and reconfiguring existing analytical methods.

Keywords

Visualizations, digital methods, commensuration, inscription devices, big data

1. INTRODUCTION

When Google began to use hyperlink-patterns as an empirical basis for determining the relevance of web pages at the end of the 1990's, the company did not just redefine the practice of search (Brin and Page 1998). Their rapid success made a compelling case for the argument that traces left in the digital world can be interpreted as indications of social dynamics and used as a basis from which to organize the growing amount of information that confronts citizens and organizations in contemporary society. Google's main innovation was to treat hyperlinks as an indication of information relevance that is strong enough to build a search technology upon, and the idea of repurposing the intelligence of digital traces in order to guide people's attention has, since then, spread beyond the field of search. Within academia it has, for instance, been articulated in the call for 'computational social science' (Lazer et al. 2009), and it has recently been influential in managerial efforts to manage the explosion of new data forms in the world of business consulting (McKinsey Global Institute 2011; Anderson 2008) as well as within the field of policy-intelligence and development work (World Economic Forum 2012). The fact that social analysts across different organizational sectors find themselves confronted by an unprecedented proliferation of data, information, and devices to handle them has simply inspired a shift in the way the empirical social world is approached (Savage & Burrows 2009; Adkins & Lury 2009; Lury & Adkins 2011; Gane 2011).

This trend to repurpose digital traces to organize social attention will here be referred to as 'digital methods', and the output of such methods often come in the form of visual metrics that synthesize digital traces into spatially organized depictions of a social dynamic of interest (see Madsen 2012). Such 'web-based visualizations' are here defined as (a) being built by scraping the web for digital traces and (b) presented as devices that enable their users to understand and manage the environments in which

they live. Facebook's 'friend wheel' (see Figure 1) is a simple but well-known example that falls within this definition. It is built by scraping friendship-ties on Facebook, and it synthesizes these structural indicators into a depiction that allows its user to focus attention on those friends that can serve as bridges between his or her friend groups. Other examples of web-based visualizations will be given below, and it is the choices made in their construction that is the object of analysis in this paper.

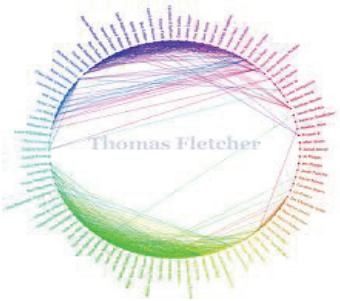

Figure 1: Facebook's friend wheel

The reason for writing a paper that is focused on the construction of web-based visualizations is that they can be seen as 'inscription-devices' that have the potential to reconfigure organizational attention, thinking, and decision-making (Latour 1990). Whereas social inquiry has previously been conducted using devices such as surveys and interviews, it seems that web-based visualizations are an increasingly used as a supplement or an outright substitute. Such visualization will here be seen as outcomes of a process of 'commensuration' where digital traces are formatted and made apt for presentation in a visual and quantified form (Levin & Espeland 2002). This commensuration-process is enabled through the use of specific information infrastructures that come with specific conditions of possibility in terms of the way data can be produced and processed. These infrastructures can be said to 'afford'

certain modes of empirical sensitivity at the expense of others (Hutchby 2001). However, the way they do so is neither determined by the underlying technologies nor completely flexible. As an emerging analytical device, they are still largely experimental. Even though their underlying technologies set some conditions for their use, they are never entering the world in a ready-made and widely accepted form (Marres 2012a). This is why this paper will analyze web-based visualizations as underdetermined tools that need to be experimentally stabilized, made sense of, and harmonized with existing practices and technologies (Marres 2012a; Marres 2012b; Plesner & Horst 2012). On the basis of this theoretical grounding, this paper sets out to answer the following questions:

To what extent is the production of web-based visualizations across different organizational contexts influenced by general conditions that shape their use as a device of social analytics?

If such general conditions exist, then what is the scope of variation in the way these conditions are handled and the way different approaches for handling them are legitimized?

These questions are quite general, and they are aimed at developing general analytical concepts that can evoke a theoretical sensitivity towards (a) the ways in which specific technological affordances may condition the way web-based visualizations can be used as an analytical device in organizations and (b) the experimental flexibility in handling these conditions across different organizational contexts. The paper is organized so that section 2 presents the theoretical framework that guides the research questions and the analysis. Section 3 explains the empirical methodology of the study. Section 4 identifies two common conditions that come with the affordances of the technologies needed to produce web-based visualizations, and it outlines the most different

approaches to handling these conditions across different visualization projects. Section 5 presents an analysis of the way these opposite approaches are legitimized and it identifies two opposite legitimization strategies that are grounded in different epistemic and ontological assumptions about how knowledge about the social world should be generated. Finally, section 6 discusses the analytical results and concludes that web-based visualizations are shaped by an interplay between specific technical conditions and epistemic assumptions. It is further argued that the concepts derived from the empirical analysis are a useful starting point for studying this interplay more thoroughly in, for instance, policy-intelligence units.

2. COMMENSURATION-PROCESSES & TECHNOLOGICAL AFFORDANCES

The introduction has argued for approaching web-based visualizations as inscriptions of the social world, and for seeing them as outcomes of commensuration-processes where specific digital technologies are relied upon to turn streams of digital traces into manageable visual depictions. The concept of 'inscriptions' is rooted in Actor-Network Theory (ANT), where it has been used to argue that the production of knowledge in modern science is heavily shaped by the technologies through which scientists inscribe the world into fixed representations. 'Inscription-devices' are broadly defined as "any set-up […] that provides a visual display of any sort in a scientific text" (Latour 1986: 68). Examples of such setups can be anything from the invention of perspective drawing to electronic microscopes and finally to statistical software tools. The main point is that in order to understand the way modern science is practiced, we need to understand the way such technologies 'draw the world together' into a simple and mobile representation (Latour 1990). Knowledge of the materiality of inscription-devices is argued to be important because such materialities have a huge impact on "[…] what it is to see, and what there is to see" (Latour 1990). The point made by

Latour and others is that this makes inscription-devices a good window through which to study the practice of science without having to start by assuming the existence of abstract social entities such as the 'culture of science'. The analytical move suggested by ANT is to study science as a semiotic practice in which technologies play a central role in the way the world is scaled down to signs and symbols.

The argument that knowledge production is intimately connected to inscription-devices is, however, also relevant when one shifts the focus from natural science to social analysis (see Uprichard, 2011; Carusi 2009). This is evident by looking at the role analytical devices such as surveys and focus groups have played in scaling down the social world into scatter plots and standardized report-formats during the last half century. Surveys—along with the standardized guidelines for making and interpreting them—have, for instance, been central in carving out 'the public' as a standardized object of analysis across a range of organizational sectors (Glynn et al. 2004). It is the process of establishing such standardized references to the empirical world that, here, will be denoted as a process of 'commensuration'. Commensuration processes involve the transformation of a qualitative phenomenon (such as a public) into a metric (such as survey statistics), and when they are successful they "[change] what we pay attention to and how we compare things […] (Levin & Espeland 2002: 127). An important dimension of this process has been defined as 'technical commensuration', which refers to the work involved in parsing qualitative relations in the world into discrete, quantifiable elements that can be measured and compared in relation to a common baseline (Levin & Espeland 2002). Technical commensuration involves the production, calibration, and validation of data, and the work done in this dimension is therefore a necessary (but not sufficient) condition for inscription-devices to alter the way people guide their attention.

Web-based visualizations are here approached as inscription-devices that are built through a process of technical commensuration. They are the outcome of a process whereby a diverse set of digital traces has been translated into a comprehensible depiction through acts of data formatting and quantification. Essential acts in the technical commensuration that underpin web-based visualizations include the creation of interfaces on which data can be left; the structuring of data into computer readable formats; and the programming of algorithms and visualization tools to harness and organize the data into visualizations. The work of technical commensuration is therefore heavily dependent on software tools that provide a scope of technical resources with which web-based visualizations can be built (Manovich 2008). These tools have specific features that can be said to 'afford' specific forms of empirical engagement with the social world (Hutchby 2001; Markus 2005; Lee 2010). The point is that software has 'affordances' that "[…] frames, while not determining, the possibility of agentic action in relation to an object" (Hutchby 2001: 444).

The concept of affordances allows for approaching the technological elements in the process of technical commensuration as both enabling and constraining in relation to the specific activities they are used to support. In the case of web-based visualizations they constrain certain empirical sensitivities while making others possible, and they provide specific conditions of possibility (Hutchby 2001) for engaging in the activity of digital methods. People using them for analytical purposes must therefore work within the conditions set by the software while at the same time try to connect the potentials of the software to the specific task that the visualizations are meant to solve. The choices that guide the work of technical commensuration are therefore caught in a balance between the need to comply with the conditions of possibility set by new inscription-devices and the need to establish their legitimacy in relation to the tasks they are appropriated to solve. Web-based visualizations are therefore approached as devices that are constrained by specific technological affordances of software systems

and information infrastructures while at the same time being flexible tools that have the potential to reconfigure the practice of empirical social analysis in many different ways. They should be seen as objects that exist in-between technical conditions and epistemic assumptions and the choices made by the project leaders in handling this in-betweenness will be the central focus of the empirical analysis.

3. METHOD & RESEARCH DESIGN

It has already been argued that the empirical ambitions of this study are threefold. The first is to identify central conditions of possibility that influence the work of technical commensuration in visualization projects across different organizational contexts. The second is to illustrate the scope of variation in the way these conditions are dealt with across the projects; and the third is to pinpoint central epistemic and ontological assumptions that underpin the legitimization of these distinct approaches. The empirical data sources used to meet these ambitions are twofold. One source is a set of interviews with eight project leaders that are experimenting with the construction of web-based visualizations for purposes that vary from the detection of cultural tensions around brands to the detection of innovation paths around emerging technologies. The other source is qualitative analyses of specific documents that these interviewees suggested as relevant readings in order to understand their work. Each project leader will be taken as a case of analysis that includes the two types of data mentioned.

The interviewees were chosen on the basis of a 'most different' case-study design that is well suited to meet the first ambition, which is to identify conditions of possibility that are reoccurring as influential across otherwise different projects (Flyvbjerg 2004). The specific selection of the interviewees was decided through a snowball sampling (Bryman 2004) that involved browsing presentations of web-based visualizations at relevant academic and business conferences as well as suggestions from the first

interviewees and other experts in the field. The search for cases was finished when the interviewees spanned diverse enough projects to fulfil the criteria for a 'most different' design. The interviews were carried out between October 2011 and April 2012 in New York City, Boston, and through Skype. They lasted between forty-five minutes to an hour, and the semi-structured interview guides were inspired by the theoretical framework outlined above as well as documents that the interviewees suggested to be relevant. The transcribed interviews and the documents were coded and analysed in NVivo and the specific data sources are listed in columns three and four in Table 1. The codes (e.g., D1) after the sources will be used to indicate when they are referenced in the analysis.

Name of project leader and organizational affiliation.	**The social dynamics that the visualizations are intended to help analyse.**	**Interview-data imported into NVivo.**	**Document-data imported into NVivo[17],**
Ana Andjelic Digital strategist and marketing consultant Droga 5.	Value creation and cultural tensions around brands.	Thirty-five minute interview (D1)	Two years of blogposts by Ana Andjelic on the blog 'I [love] marketing' (D2).
John Kelly Co-founder and chief scientist at Morningside Analytics.	Communities that share knowledge and focus attention on particular sources of information and opinion.	One hour interview (MA1)	Three academic papers: Pride of Place (MA2) Mapping Iran's Online Public (MA3) Mapping the Arabic Blogosphere (MA4)
Alan Porter Foresight analyst at Search Technology Inc.	Innovation paths around emerging technologies and trans-disciplinary reach of research fields.	Forty-five minute interview (STI1)	Three academic papers: Forecasting Innovation Pathways (STI2)

[17] The documents can be obtained by contacting the author, and their references are listed after the literature if they are not anonymized.

			A Forward Diversity Index (STI3) Assessing the Human and Social Dynamics Program (STI4)
Chris Pallaris Senior consultant at I-Intelligence.	Signals of changes that can support government policy and business strategy.	One hour interview (I1)	One academic paper: OSINT – Knowledge, Activity and Organization (I2) One keynote presentation: The Four Architectures of Competitive Intelligence (I3)
Vincent Lepinéy Sociologist at MIT's Mapping Controversies program.	The dynamics of socio-technical controversies.	One hour interview (MC1)	NONE
Guilhem Fouetillou CEO and co-founder at Linkfluence.	Product-related conversations taking place in social web communities.	One hour interview (L1)	NONE
[Anonymized] Founder and consultant at Information Service Bureau.	Information-flows that can aid the quality of military intelligence.	Forty-five minute interview (R1)	One keynote presentation [Anonymized] (R2)
Robert Kirkpatrick Director of the visualization branch 'Global Pulse' at the United Nations.	Early signals of crisis-related stress and other indications of developmental concern.	One hour interview (UN1)	Three project white papers: Twitter and Perceptions of Crisis-related Stress (UN2) Using Social Media and Conversations to Add Depth to Unemployment Statistics (UN3) Streams of Media Issues: Monitoring World Food Security

			(UN4) One statement from the UN Secretary-General (UN5)

Table 1: Overview of cases

The analysis of the data in Table 1 proceeded in three steps. The first step was to code the empirical material for conditions of possibility that influenced the work of technical commensuration across the cases. The 'most different' case-study design makes it legitimate to interpret such common conditions as influential constraints that need to be taken into account by any organization that engages in using web-based visualizations as an analytical device. The second step was to recode the data that addressed these conditions with the aim of identifying the scope of variation in the way these conditions were handled across the cases. This led to the development of analytical continua with an analytical ideal type in each end. These continua are to be read as analytical constructs that indicate a room for flexibility within the conditions set by the technological affordances. Therefore, the analytical ideal types at each end of the continuum do not represent the position of any of the individual project leaders. The third step was to recode the data representing these ideal types with the aim of identifying the assumptions through which they are legitimized and carve out the most different legitimatization-strategies across the cases.

4. CONDITIONS OF POSSIBILITY & IDEAL-TYPE APPROACHES TO HANDLING THEM

The first step of the analysis resulted in the identification of two conditions of possibility that influence the process of technical commensuration across the cases. One is the need to *distribute choices of data formatting* to third-party actors, and the other is the need to *balance the powers of machine intelligence and human intuition* when it comes to automating the analysis of the collected data. These conditions are connected to specific affordances of the digital technologies and software tools that are used to build web-based visualizations. In the presentation below, each condition will briefly be described without reference to the empirical data and thereafter grounded in the interviews and documents in the conceptualization of ideal-type approaches to handling them. This mode of presentation is chosen because the conditions of possibility were more visible in the explanations of the way they are handled than in explicit statements of these conditions themselves.

4.1. CONDITION 1: DISTRIBUTING DATA FORMATS

To format data is here taken as a reference to the practice of segmenting it on the basis of predefined specifications. In relation to the construction of web-based visualizations, such formats are of the upmost importance because they structure digital datasets in a way that enable computers to process them. Data formatting is therefore an essential element of the technical commensuration behind web-based visualizations, and the analysis of the empirical material illustrated that this aspect of commensuration is conditioned upon the need to distribute choices of data formats to third-party actors across the cases. Whereas data formats in a survey or a focus group can be more or less controlled by a single organization from the initial formulations of questions to the final analysis, this is rarely the case with web-based visualizations. They must be built on data that is preformatted by third-party actors because the production of interesting digital data occurs on a distributed set of platforms that are

beyond the control of the project leaders. These third-party actors furthermore make decisions about data formats on the basis of other interests than the project leaders that are repurposing them. This means that access to relevant digital data often comes at the cost of losing control and transparency in relation to the way it is formatted and produced. The empirical analysis identified two ideal-type approaches to meet this condition across the cases, and the continuum between them indicates a central trade-off in the work on technical commensuration that goes into the production of web-based visualizations.

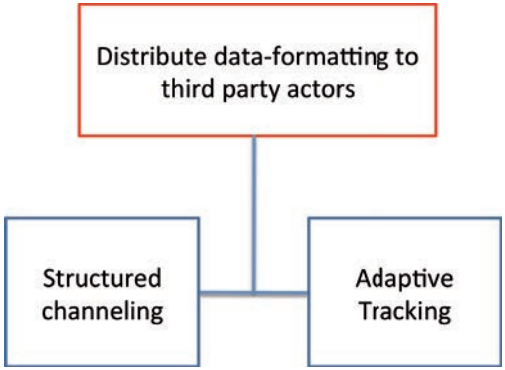

Figure 2: Illustration of the condition of data distribution (red box) and the continuum between two ideal-type approaches (blue boxes) to handle these conditions in the process of technical commensuration.

One ideal type is conceptualized as the approach of '*structured channelling*'. It represents a suggestion to handle the necessity of having third-party actors involved in the process of data formatting by confining the distribution of data formats to communication channels that are deemed valid and reliable in relation to handling information about the specific aspects of the world that the visualization is meant to make visible. The specific channels that are deemed relevant naturally vary from

visualization to visualization, but a general characteristic of the approach of 'structured channelling' is that it assumes the existence of specialized channels that have unique competencies in formatting data from specific groups that communicate about specific issues through specific genres.

An example of a visualization in the empirical material that follows many of the prescriptions from the ideal type of 'structured channelling' is given in Figure 3. It uses the data formats from the 'Web of Science' (WOS) as a basis for depicting the extent to which the U.S. National Science Foundation succeeds in funding research that crosses disciplinary and organizational boundaries. Its visual make-up is explicitly argued to "[…] depend on the WOS subject categories" (STI3). These categories present a way to segment information in scientific papers into data chunks, such as author affiliations, citation scores, publication dates, and journal types, that are easy to turn into structured metadata that can be processed by a computer (STI3; STI4). The choice of relying on WOS categories means that the process of data formatting is distributed to a channel that has an explicit and institutionalized expertise in segmenting scientific texts. A paper is classified as belonging to a specific category in WOS because a competent human with known competencies in the genre of scientific writing has placed it there. Proponents of 'structured channelling' emphasize that this does not ensure that the formats are perfect, but it is argued that they are sufficiently stable, well defined, and transparent. These characteristics of the data formats are what make the producers of the visualization accept the loss of control that is inevitably involved in distributing decisions about data formats to a third-party actor (STI3; STI4).

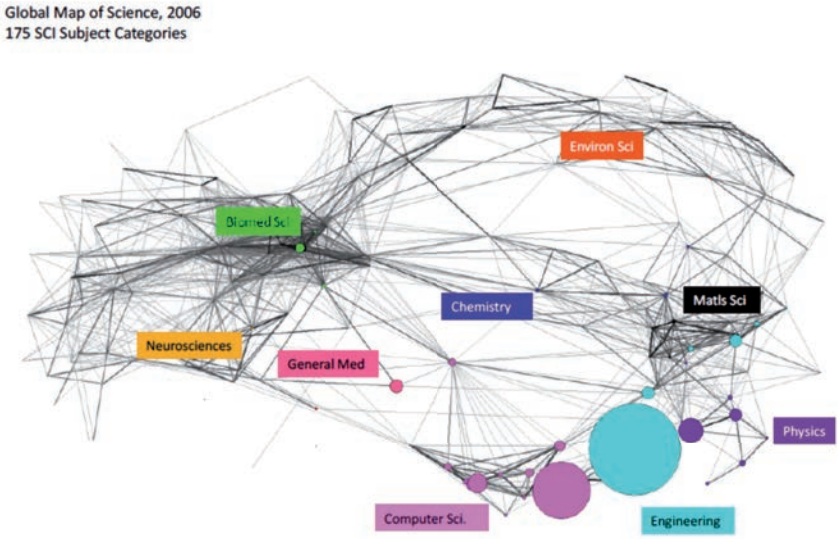

Figure 3: Visualization depicting the inter-disciplinary reach of scientific disciplines in order to evaluate whether the U.S. National Science Foundation is succeeding in funding research that crosses disciplinary boundaries.

The ideal type of 'structured channelling' is an approach that is also influential in the way other projects in the empirical material handle the condition of distributed data formatting. One project uses the data formats in Thompson Reuter's Derwent World Patent Index as a basis for visualizing innovation pathways around emerging technologies (STI2), and another uses the formatting of press releases in Dow Jones' business tool, Factiva as the basis for mapping the influence of different food security issues (UN4). All of these third-party actors provide stable, well defined and transparent formats and the reason why proponents of 'structured channelling' prioritize such sources is nicely summarized by one of the interviewees, who states that if one wants to know what, for example, the medical profession thinks about a specific issue, one must first look for "[…] whatever channel there is where medics discuss

these things" (R1). This quote indicates that medics are the best sources of information about the medical profession, and that the analyst should prioritize data formats that are legitimized by specialized channels where medics communicate. A common characteristic of the projects sliding towards the approach of 'structured channelling' is that they prioritize the possibility of grounding visualizations in structured data formats from channels with an institutionalized expertise and a clear and transparent process for segmenting data.

The analytical ideal type at the opposite end of the continuum in Figure 2 is conceptualized as the approach of '*adaptive tracking*'. It is a different response to the distribution of data formats than 'structured channelling' because it prioritizes taking advantage of the fact that "[…] internet communications technologies are eliminating the channel-segregation" (MA2). Facebook and Twitter are examples of such technologies because they are not designed for communication between people with predefined expertise who communicate in specialized genres. They are, to the contrary, interfaces that "[…] function more as a media platform than as a publisher with editorial control" (D2; MA4). Such platforms provide a more diverse set of web users with the opportunity to communicate and share information than WOS, Thompson Reuters or Factiva. This makes it possible to, for instance, understand the spread of research without having to rely on data formats built from within the disciplines of science such as the formats from WOS. On such platforms it is, for instance, not assumed that a research idea is communicated in the format of a paper made by an identifiable author, and its influence would also not have to be judged on the basis of institutionally validated formats such as a citation. The flexibility and openness of the data formats on platforms like Facebook and Twitter are argued—by proponents of 'adaptive tracking'—to make data flows fast and more adaptive to changes in the world (UN1).

An example of a visualization in the empirical material that follows many of the prescriptions from the ideal type of 'adaptive tracking' is given in Figure 4 because it trades the quality indicators of validity, reliability, and transparency for heterogeneous, fast, and large data flows. It is produced by the UN's Global Pulse, and the data format that is used to build the visualization is the 'tweet', which is highly adaptive to changes in the world. Its length of 140 characters makes it much 'lighter' than other text-based formats, and it is intentionally designed to be left on mobile devices (L1). The visualization in Figure 4 gets its data through Twitter's so-called Application Programme Interface (API) through which the platform releases sets of tweets to be used by outside analysts. By harnessing semantic patterns in these tweets, the visualization monitors the meaning attached to the topic of 'food' in Indonesia and the USA. To the left, we see the words most frequently used, in the middle we see the clusters of words used in combination with predefined key words, and to the right we see a topic wheel that shows groups of related posts and the popularity of the topics they belong to. The visualization is produced as a monitor that can help UN analysts to detect early signals of vulnerable populations and crisis-related stress in the regions covered (UN2). This use illustrates that a central aim of the approach of 'adaptive tracking' is to build visualizations on "[…] information that is a current enough reflection of reality to be used to respond in ways to alter the outcome" (UN1). To fulfil this aim, there is a need for prioritizing adaptive data formats in the work on technical commensuration.

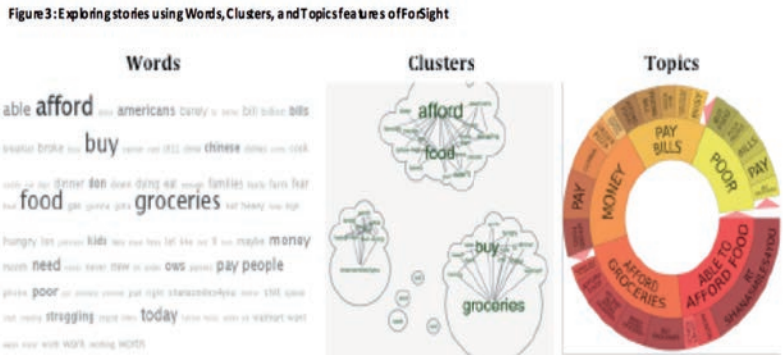

Figure 4: Visualization depicting meaning structures around the topic of food in order to detect negative emotions and early signals of crisis.

'Structured channelling' and 'adaptive tracking' represent opposite approaches for handling the fact that data formats often need to be distributed to third-party actors in the construction of web-based visualizations. As two ends of an analytical continuum, they pinpoint a central trade-off in the process of technical commensuration behind web-based visualizations. This trade-off concerns the need to balance an interest in transparent, structured, and trustworthy data formats with an interest in formats that are adaptive, heterogeneous, and able to scale with fast data flows. The choice of building visualizations on data formats from WOS ensures the first set of qualities, whereas the choice of hooking ones visualization up to data formats from an API of a private company like Twitter ensures the latter set of qualities. Project leaders committing themselves to data formats from sources like Twitter run the risk of relying on data formats that may be redesigned in the process of conducting an analysis and formats where the source of data is unclear. Such things are—all other things being equal—more established in channels like WOS, Thompson Reuter's, and Factiva. But the data formats from such channels often rely on specific professional indices that make it hard to locate trans-institutional and trans-discursive networks in an adaptive way.

4.2 CONDITION 2: BALANCING MACHINE INTELLIGENCE & HUMAN INTUITION

Meeting the condition of distributed data formatting, however, immediately gives rise to a second trade-off in the process of technical commensuration that also reoccurs across the cases. This trade-off is tied to the fact that the scope and pace of the datasets that underpin web-based visualizations makes it necessary to integrate automated data-processing tools in the process of turning the chosen data formats into comprehensible depictions. Choices about the proper level of trust in machine intelligence are therefore decisive for the way the attention of the user of the visualization ends up being guided. Such choices are, for instance, decisive in determining the way the visualization in Figure 3 is coloured. The colours reflect scientific practices such as 'biomedical sciences' and 'neurosciences' and the classification of these practices is the outcome of an automated analysis of relations between papers belonging to predefined categories in WOS (STI3; STI4). The colouring of the visualization is, in that sense, a hybrid between the initial expert categorization in WOS and an algorithm running an inductive factor analysis. This mode of colouring exemplifies the need to strike a balance between machine intelligence and human intuition in the process of forming the visualization, and the cases are once again exhibiting differences in the way they handle this condition. These differences are once again used as a foundation from which to build an analytical continuum with ideal-type approaches at each end.

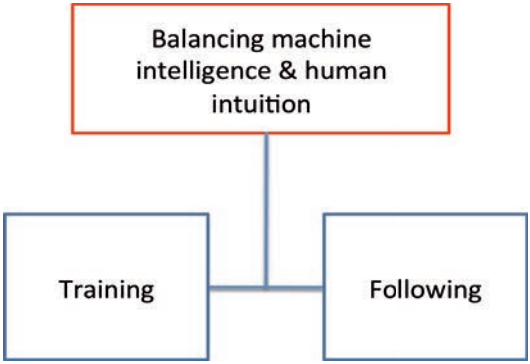

Figure 5: Illustration of the condition of automatization (red box) and the continuum between two ideal-type approaches (blue boxes) to handle this condition in the process of technical commensuration.

One ideal-type approach is conceptualized as '*following*'. Projects adhering to this approach emphasize the power of algorithms to recognize surprising patterns in data without being distracted by cultural preconceptions. Despite being 'blind' in their processing of data, the argument is that algorithms can guide analysts to innovative analytical concepts and categorizations. A visualization in the empirical material that is built on this approach is depicted in Figure 6 below. It depicts relations in the Arabic blogosphere and it is coloured on the basis of algorithmic pattern recognition of the link histories of blogs (MA3; MA4). This distinguishes it from most previous visualizations of the blogosphere that have been coloured on the basis of pre-established distinctions between, for example, liberal and conservative bloggers. The choice of bypassing such predefined categories as drivers of technical commensuration is motivated by the fact that intelligent algorithms can automatically "[…] locate these large political clusters as well as a number of other attentive clusters that […] prove to have their own thematic foci […]" (MA2). The clusters in Figure 6 are not rooted in popular theories about groupings in the Arabic blogospher and the idea of colouring the visualization by following algorithmic pattern detection is presented as a needed

alternative to "[…] colour[ing] the nodes on the basis of some pre-existing typology […]" (MA1). The ideal type of 'following' thereby represents an attempt to avoid the drawbacks involved in relying too heavily on a priori human intuition (L1). It is an inductive approach that promises the readers of visualizations to see "[…] something that [they] have previously missed" (D2).

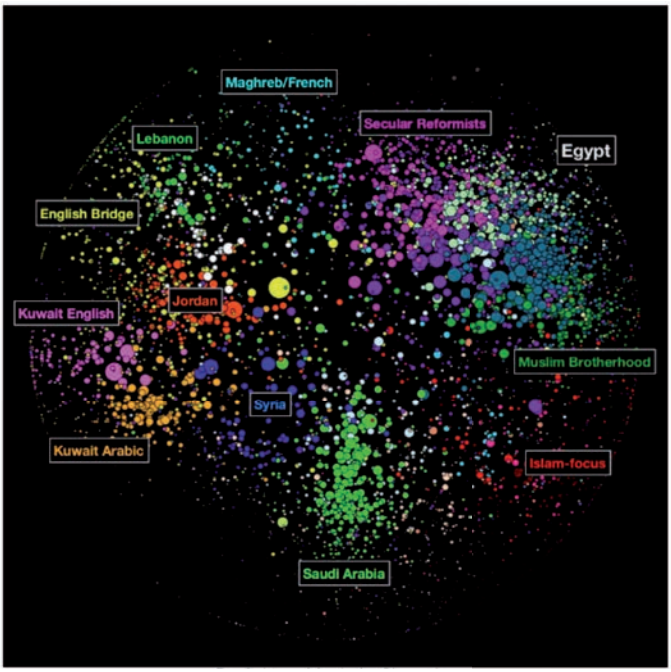

Figure 6: Visualization depicting 'attention clusters' in the Arabic blogosphere in order to understand the influence of blogs on political discourse.

The analytical ideal type at the opposite end of the continuum is conceptualized as '*training*' because it builds on the idea that "[…] it is imperative that the analyst "train the algorithm" […]" (UN2). It is an alternative to the approach of 'following' because

it suggests guiding the algorithm by a priori categories in order to make sure that it returns meaningful and useful visualizations. This is a way to prioritize the unique competencies of human intuition in interpreting semantics and social dynamics and the underlying claim for the relevance of the approach is that it is "[…] really difficult to have good results with purely automated approaches" (L1 + R2; MA1). The tag-clouds in Figure 4 are are examples of visualizations that reflect the approach of 'training' because they are built by programming algorithms to detect emotions around predefined crisis-categories such as 'food'. Tweets that were consistent with the intuition of the analysts about what belongs to this category were used to train the algorithms and to ensure that the visualization was "[…] aligned with project objectives" (UN2). The approach of 'training' is, in that sense, a way of ensuring resonance with the situation in which the visualization is to be used. Ultimately, it is a way to emphasize that "[…] at the beginning you always have a human decision (L1)" that points the "[…] processing capacity at particular problems" (I1).

The approaches of 'following' and 'training' represent two opposite ways of meeting the need to integrate automated pattern recognition into the process of technical commensuration. They pinpoint a central trade-off between the need to challenge dominating distinctions by colouring or structuring web-based visualizations on the basis of emergent categories and the need for visualizations to reflect distinctions in the world that resonate with their readers. Both approaches enroll software agents in the organization of information, but the way the agents are pre-programmed are quite different. The approach of 'training' uses expert guidance to program software on the basis of predefined semantic classifications that are relevant for the social dynamics that are visualized. This is different to the approach of 'following', where the pre-programmed elements are grounded in theories about the mathematical properties of the social world. This difference, is for instance, reflected in the difference between programming a semantic software agent to look for the occurrence of specific words in

a text because an expert has suggested them as relevant for the specific topic of interest; and programming it to find words that occur next to each other, and then to use such patterns to find related words and develop new categories. Such programming choices would result in quite different ways of guiding attention to the topic of interest.

5. LEGITIMIZATION STRATEGIES AND THEIR UNDERLYING ASSUMPTIONS

Technical commensuration was earlier defined as involving the production, calibration, and validation of data. The previous chapter has shown how choices about production and calibration need to comply with certain constraints set by digital traces and their affordances, and it has shown how such conditions of possibility for practicing digital methods can be handled in different ways. The choices made in the process of technical commensuration may to some extent be shaped by such conditions, but the identification of the different ideal types illustrate that they leave a flexibility for constructing visualizations that will result in quite different modes of social attention. The choices made in the process of technical commensuration are therefore also far from being determined by the technology. They are also influenced by assumptions about the proper ways of producing knowledge about the social world. The formulation of such assumptions has to do with the validation of data and the need for visualizations to be legitimate in the contexts in which they are to be used. Two themes receive attention in relation to the legitimation of visualizations across the cases: One is the need to establish a point of reference—a benchmark—against which to evaluate the usefulnes of digital data and make it 'hard' enough to be an accepted basis for decision-making; the other is the need to ground the usefulness of the visualizations in assumptions about the ontological characteristics of the world they are supposed to depict. This chapter provides a conceptualization of the two most different strategies to

address these themes across the cases, and it shows how these opposite legitimization strategies are rooted in quite different epistemological and ontological assumptions.

5.1 EXTERNAL CORRESPONDENCE IN A STABLE SOCIAL ENVIRONMENT

A prominent strategy with which the question of benchmarks is addressed across the cases is to argue that legitimate visualizations need to offer procedures through which a correspondence between the used digital traces and the external world can be validated. This legitimization-strategy builds on the epistemic assumption that valid data is conditioned upon the existence of benchmarks that are external to the tools through which it is produced. In the case of web-based visualizations, this assumption results in calls for the existence of some kind of offline point of reference through which it is possible to ensure the validity of the data. This legitimization-strategy can be denoted as 'external correspondence' and it is visible in two forms across the cases.

One form is the reliance on expert validation that we have already encountered in the approach of 'structured channelling'. The choice of enrolling experts into the legitimization-strategy reflects a commitment to the assumption that data can only be a legitimate basis for decision-making if it is transparent enough for a competent expert to trace it back to its (offline) source and evaluate its validity. It is only when the competencies of experts are clearly identified and when data is transparent that it is possible to provide a valid translation of the external world into bits of data to be processed by a computer (STI2). This criteria for data quality is formulated in quantified terms by one of the interviewees who argues that the anonymity of a source makes its "[…] information value go down with 50 percent […]" and lack of knowledge about the source makes it go "[…] down with another 25 percent" (R2). If one is meeting the request for external correspondence through expert validation, one

is, accordingly, focused on identifying honest brokers of verified information to legitimize the data.

It has already been noted that this take on data benchmarks fits the choices of 'structured channelling' outlined above, and it is grounded in an ontological belief in a social world with more or less stable channels, genres, experts, and classifications. In such a world, it is not necessary to call the fundamentals of social analysis into question when faced with new forms of data such as the digital traces that web-based visualizations rely upon. As put by one of the interviewees: "The search strategies remain the same despite the information format […]" (R1). The methodological foundations of social analysis remain the same even though we have entered a digital world. This take on the world also entails that social analysis should continue to have explanatory and predictive ambitions. "[…] Analysis is explaining why something has happened [and] predicting what might happen in the future" (R1), argues the same interviewee. Such ambitions of prediction imply a certain level of stability in the world that is the object of prediction.

The other form in which the legitimization-strategy of external correspondence arises in the data is characterized by substituting the focus on honest brokers for a focus on honest signals. The underlying argument is that human involvement in the process of data selection is often a source of bias rather than a source of validity. Digital traces are seen as a legitimate source of data precisely because the people that leave digital traces are not obstructed by a researcher. They are argued to represent "[…] spontaneous conversations" (L1) and be the result of situations where people are "[…] broadcasting how they feel, what they do and what they think" (D1). Web-based visualizations are conceived as legitimate analytical tools because they have the potential to "[…] reflect our inner human nature" (I1) and because they are not "[…] based on inferences" (MA3). In short, it is argued that there is no researcher bias involved in the translation

from the way people think and behave to the digital traces signifying these thoughts and behaviours. This is explicitly contrasted with methods like focus groups that are argued to be "[…] artificial environments […]" (D1). This trust in honest signals is quite a different way of ensuring external correspondence than the proposed trust in expert validation, and it does not entail the same belief in the stability of the fundamental classifications in the world. However, its focus on correspondence implies the existence of more or less stable beliefs that reside in the individual. These beliefs are then assumed to be transmitted in an unbiased way through the media platforms and software crawlers that function as the basis for the visualizations produced. In that sense, the connection between correspondence and stability is upheld in the argument for honest signals.

5.2 PRAGMATIC COHERENCE IN FLUID REALITIES

An opposite strategy to legitimize data benchmarks is to substitute the criterion of external correspondence with a criterion that can be denoted as 'pragmatic coherence'. It is an alternative way of evaluating data than the abovementioned focus on whether its correspondence to some external phenomenon is ensured by expert validation or the lack of researcher bias. The underlying assumption behind 'pragmatic coherence' is that digital traces are neither transparent nor honest; it is readily accepted that they are always biased and messy. When Global Pulse uses tweets as signals of crisis-related stress in Figure 2, it is, for instance, explicitly acknowledged by the project-leader that Twitter is a platform that has "[…] a specific culture and demographic [that] change over time and varies by topic, location, and other factors" (UN2). Tweets are seen as cultural products rather than honest signals, but they are still argued to be legitimate data to base decisions upon. Their legitimacy, however, depends on the analyst having a solid knowledge of the specific culture around their production (UN1). The legitimization-strategy of pragmatic coherence simply builds on the assumption that it

is possible to construct useful benchmarks that are coherent with this culture and its potential biases.

This strategy opens for the possibility of constructing benchmarks that are internal to the tools that produce the data. The Global Pulse project is, for instance, based on the argument that "[…] the most straightforward analysis [is] based on daily anomaly detection" (UN2). The example given to explain this analytical strategy is that if a person knows the streets around his or her hometown, he or she will be able to spot tiny changes that outsiders would not detect. Such changes are not representative of anything but they indicate "[…] something odd, some anomaly, something that looks a little unfamiliar, a little suspicious, a little concerning" (UN1). The main argument behind the way the UN legitimizes the strategy of anomaly detection is that crisis signals can only be captured in a timely manner if the analyst drops demands for correspondence and increases sensitivity towards anomalies. Such sensitivity is presented as the key competence needed to utilize the intelligence potential of digital traces without slowing their use down by adhering to traditional quality indicators. This approach to data benchmarking is also resurfacing in other projects that argue for the potential of using web-based visualizations even though they explicitly accept that "[…] people don't act the same way online [as] in their real life and [they] won't say exactly what they think […]" (L1). In contrast to the argument for honest signals, it is accepted that "[…] you don't have access to their intimate representations and thoughts" (L1).

The underlying ontological assumption that legitimizes this strategy of internal calibration and pragmatic coherence is that analytical devices need to function in a social world that is increasingly fluid. An argument that reoccurs across the cases is that new communication technologies are "[…] changing the nature of information [in a way that] reflects a larger, structural remaking of society whose end state we cannot

predict" (I2). The ambition that social analysis should entail prediction is sacrificed in the confrontation with a world that presents analysts and strategists with "[…] situations of uncertainty [and] ambiguity" (I2). The Secretary-General of the UN echoes this position by stating that the world is increasingly "[…] volatile and interconnected [because] the impacts of [a] crisis [is] flowing across borders at unprecedented velocity" (UN5). He argues that tools like surveys and census data are too slow at detecting signals of emerging crises in due time. An example of such a signal is a mother who takes her child out of school. Within the UN, this is considered to be an 'early signal' of economic problems, and the argument for experimenting with web-based visualizations is that this mother will communicate about her choice through a traceable media device a long time before a traditional survey can capture it (UN1). Such possibilities prompt the Secretary-General to conclude that "[…] traditional 20th-century tools for tracking […] development simply cannot keep up […]" (UN5).

This also implies that analysts who monitor the world on the basis of '20th centuty tools' simply "[…] no longer have a monopoly on the knowledge" (I2). The decline of this monopoly is argued to lead to a world of social analysis that is bound to be "[…] interactive, networked, info-rich [and] collaborative" (D2). Organizational decision-makers will therefore have to deal with a situation where a diverse set of actors has the competencies to browse through data. It is argued that this creates an increasing demand for "[…] more intelligence, more quickly, and more often" (I2). This has the consequence that "[…] short-term situational assessments will likely be given preference over long-term strategic projections" (I2). The legitimization-strategy of pragmatic coherence, accordingly, builds on the assumption that digital choices made in the process of technical commensuration must differ from the methodological choices made in a situation where confidential and validated data were used to make long-term projections. They must be adapted to take advantage of quick data streams

from various sources, and the argument is that this is most efficiently done though the strategy of pragmatic coherence.

6. VISUALIZATIONS BETWEEN TECHNICAL CONDITIONS & EPISTEMIC ASSUMPTIONS

”Organizations are accounts of the change that is happening around them” (D2), argues one of the interviewees. If this is true, it could be added that the accounts of what is happening are heavily shaped by the analytical devices through which organizations make sense of this change. Web-based visualizations are increasingly used as such a device in a diverse set of organizations, and the way they guide the attention of their users is shaped by the choices taken in the process of technical commensuration. The analysis above has illustrated how such choices are influenced by two quite different mechanisms. One is the condition of possibility set by the technologies involved in making digital datasets apt for computerized analysis. The other is the need for project leaders to ground these choices in legitimatization-strategies that have a resonance in the organizations (and societies) within which they are meant to travel. As the director of Global Pulse puts it: “[…] It is not just about getting the data; it is also […] about the organizational capacity to facture a snapshot of these types of information in the context of their on-going policy development planning” (UN1).

The need for distributing data formats to third-party actors, and the need to find a proper level of trust in automated techniques, were identified as two influential conditions that will influence most future engagements with web-based visualizations. These conditions are an outcome of the fact that digital traces come with affordances that set different conditions of possibility for empirical analysis than the kind of data obtained from, for example, surveys and focus groups. They open the possibility for

quicker data streams, but such streams are often produced on proprietary platforms and they come in a scale that is difficult to handle through non-automated procedures. The act of integrating such data streams into practices of social analysis involves a need to conduct the work of technical commensuration within the conditions of possibility set by the relevant technologies. It involves a need to comply with current power structures in digital data ownership, the need to cope with rapid changes in the technical infrastructures on which data is left, the need to work within the limitations of API's in order to harness data, the need to balance machine intelligence and human intuition in the processing of data, and so on. Organizations that use web-based visualizations as an analytical device must accordingly find ways to act in a situation where the competencies to produce, calibrate, and validate data are radically distributed. This is not least true for policy-oriented organizations that will increasingly experience that much relevant data on public behaviour is locked in the hands of private Internet companies.

The identification of the continua of ideal-type approaches to handle these conditions and their grounding in quite different epistemic and ontological assumptions, however, showed that there is a degree of flexibility in the way these technical conditions are dealt with in the construction of web-based visualizations. A project that prioritizes structured data formats and transparent procedures for validating the correspondence between digital traces and their offline counterparts will, for instance, result in quite different visualizations than a project that prioritizes the potentials of 'adaptive tracking' and grounds the legitimacy of the visualizations through the strategy of pragmatic coherence. When looking at the way the eight cases in this paper manage the interplay between technological constraints and the need for legitimatization, one can roughly see the picture of two quite different ways of steering the development of web-based visualizations, and these two ways highlight an important divide within digital methods.

The first way reflects the ambition of using the rise of digital traces as an opportunity to remediate[18] established analytical practices. This way of steering web-based visualizations is ultimately grounded in assumptions about a stable world that is best analysed through structured data formats and expert classifications. Such formats and classifications should be institutionally validated and have a transparent connection to the offline world that can be measured in ways that ensure classic quality criteria like validity and reliability. The call for such a remediation is to a large extent characterized by evaluating choices taken in the process of technical commensuration with reference to accepted epistemic assumptions and knowledge practices. An example of this is the way the approach of 'training' was defended on the basis of a need for visualizations to reflect tested and accepted categories that resonate in the contexts in which they are to be used. The approach of 'structured channelling' was similarly legitimized with reference to the need for maintaining tested epistemic standards and norms despite changes in the type of data used to generate knowledge about the social world. The argument is that such standards and norms should be transferred to the new medium.

The other way of steering the development of web-based visualizations reflects the ambition of using recent changes in the environment of data and information as an occasion for reconfiguring established analytical practices. This ambition is reflected in the ideal types of 'adaptive tracking' and 'following' that ultimately need to be legitimized through a more pragmatic conception of knowledge. The call for such a reconfiguration is to a large extent characterized by evaluating choices taken in the process of technical commensuration with reference to technological developments. Technologies and their affordances are given agency, as they are presented as drivers of an increasingly fluid world that requires a reconfiguration of the modes of thought

[18] It should be clarified that the word 'remediation' is not used in the sense to "correct a deficiency". It is rather used in the same way as it is often used in media studies, namely to denote the fact that established social practices are often translated into new media.

and inquiry that were tied to previous analytical tools. For instance, it was emphasized that analytical practices must adapt to a situation where much relevant data are distributed and apt for analysis, and where the rapid spread of externalities requires faster data flows in order for organizations to be able to alter the outcomes. The argument is that the world demands methods that scale with data and that established analytical practices can be an obstacle to achieving this goal.

The results of the analysis and the reflections above can be summarized in three concluding statements. The first is that the stabilization of web-based visualizations should be approached as a process that is shaped by technical affordances, the conditions they set for possible analytical methods, and the resonance of the epistemic and ontological assumptions needed to legitimize them. The second statement is that the respective balance given to each of these influences in the process of technical commensuration will influence the way web-based visualizations come to guide the attention of their users. The third statement is that the analytical conceptualizations of conditions of possibility and continua of ideal types presented in this paper are a useful starting point for studying this balancing act in more depth and in specific contexts. The identified conditions of possibility indicate the overall frame within which this act takes place, and the continua of ideal types indicate important lines of disagreement as to how web-based visualizations can be constructed within these challenges. The vocabularies derived from the empirical analysis can therefore evoke a sensitivity towards the central trade-offs that characterize this disagreement.

The general and non-situated scope of this paper, however, makes it only a first step towards understanding the extent to which new forms of data flows have an effect on organizational attention. Every construction of web-based visualizations will have to balance the different influences and trade-offs according to the situation in which it is produced. Such situations will obviously be different depending on whether the visualization is to be used in the military, a branding agency, or in a policy unit. Every

situation will have its own problems and thereby its own reasons for balancing the influence of affordances, conditions, and existing assumptions in unique ways. The present paper does not provide any such situated insights but it provides an analytical vocabulary on which to build such situated analyses of, for instance, the use of web-based visualizations for the purpose of policy-intelligence.

References:

Adkins, L & Lury, C. 2009. "Introduction: What Is the Empirical?" *European Journal of Social Theory* 12(1): 5-20

Adkins, L. & Lury, C. 2011. "Introduction: special measures". *The Sociological Review*, 59: 5–23. doi: 10.1111/j.1467-954X.2012.02051.x

Anderson, Chris. 2008. "The End of Theory: The Data Deluge Makes the Scientific Method Obsolete", *Wired Magazine,* 16.07.

Brin, Sergey & Larry Page. 1998."The anatomy of a large-scale hypertextual Web search engine" *Computer Networks and ISDN Systems*, 30 (1-7): 107-117.

Bryman, Alan. 2004. *Social Research Methods,* 2nd edition, Oxford University Press.

Carusi, A. 2009. Philosophy Engines: Technology and Reading/Writing/Thinking Philosophy, *Discourse*, 8(3), Available at SSRN: http://ssrn.com/abstract=1505970

Flyvbjerg, Bent. 2004. "Five misunderstandings about case-study research" *Sosiologisk Tidsskrift*, 12(2): 117-42

Gane, N. 2011." Measure, value and the current crises of sociology", *The Sociological Review*, 59: 151–173. doi: 10.1111/j.1467-954X.2012.02054.x

Glynn, Carroll et al. 2004. *Public Opinion*, 2nd edition, Westview Press, USA

Granovetter, M. 1973. "The strength of weak ties", *American Journal of Sociology*, 78(6), 1360-1380

Hutchby, Ian. 2001. "Technologies, Texts and Affordances", *Sociology* 35: 441–56.

Latour, Bruno & Woolgar, Steve. 1986. *Laboratory life: The construction of scientific facts.* 2d ed. Princeton, NJ: Princeton University Press

Latour, Bruno. 1990. "Visualisation and cognition: Thinking with eyes and hands". In *Representation in scientific practice,* ed. M. Lynch and S. Woolgar. Cambridge: MIT Press

Lazer, David et. al. 2009. “Computational Social Science” *Science Magazine*, 323: 721-723.

Levin, P., & Espeland, W. N. 2002. “Pollution futures: commensuration commodification and the market for air” in *Organizations, policy, and the natural environment: Institutional and strategic perspectives,* ed. A. J. Hoffman & M. J. Ventresca: Stanford: Stanford University Press.

Manovich, Lev. 2008. “Software takes command”, Online Publication, Assessed January 20: http://lab.softwarestudies.com/2008/11/softbook.html

McKinsey Global Institute. 2011. *Big data: The next frontier for innovation, competition, and productivity*. http://www.mckinsey.com/insights/mgi/research/technology_and_innovation/big_data_the_next_frontier_for_innovation. (August 1 2012)

Madsen, Anders K. 2012.”Web-visions as controversy-lenses” *Interdisciplinary Science Review*, 37(1): 51-68

Manovich, Lev. 2008. “Software takes command”. http://lab.softwarestudies.com/2008/11/softbook.html. (January 20 2012).

Marres, Noortje. 2011. “Re-distributing methods: digital social research as participatory research, Sociological review”, Goldsmiths research online

Marres, Noortje. 2012a. “The Experiment in Living.” In *Inventive Methods: The Happening of the Social*, ed. C. Lury and N. Wakeford. London: Routledge.

Plesner, U & Horst, M. 2012. “Before Stabilization: Communication and non-standardization of 3D digital models in the building industry”, *Information, Communication & Society*

Savage, M. & Burrows, R. 2009. “Some further reflections on the coming crisis of empirical sociology”, *Sociology*, **43**(4): 765–775.

Uprichard, E. 2011, “Dirty data: longitudinal classification systems”. *The Sociological Review*, 59: 93–112. doi: 10.1111/j.1467-954X.2012.02058.x

World Economic Forum (2012), *Big Data, Big Impact: New Possibilities for International Development*. http://www3.weforum.org/docs/WEF_TC_MFS_BigDataBigImpact_Briefing_2012.pdf. (August 1 2012)

Documents used as empirical data to supplement the interviews:

Andjelic, Ana. 2010-2012. “I [love] Marketing”. Blog. http://anaandjelic.typepad.com/ (February 27 2012)

Global Pulse. 2011. “Streams of Media Issues - Monitoring World Food Security”. http://www.unglobalpulse.org/projects/news-awareness-and-emergent-information-monitoring-system-food-security (January 11 2012)

Global Pulse. 2011. “Using social media and online conversations to add depth to unemployment statistics“.http://www.unglobalpulse.org/projects/can-social-media-mining-add-depth-unemployment-statistics (January 11 2012)

Global Pulse. 2011. “Twitter and perceptions of crisis related stress”. http://www.unglobalpulse.org/projects/twitter-and-perceptions-crisis-related-stress (January 11 2012)

Kelly, John et.al. 2009. “Mapping the Arabic Blogosphere: Politics, Culture, and Dissent”. Berkman Center Research Publication. http://cyber.law.harvard.edu/publications/2009/Mapping_the_Arabic_Blogosphere (November 13 2011).

Kelly, John and Bruce Etling. 2008. “Mapping Iran’s Online Public: Politics and Culture in the Persian Blogosphere, Berkman Center Research Publication. http://cyber.law.harvard.edu/publications/2008/Mapping_Irans_Online_Public/ (November 13 2011).

Kelly, John. 2008. “Pride of place: Mainstream Media and the Networked Public Sphere, Berkman Center Research Publication. http://cyber.law.harvard.edu/sites/cyber.law.harvard.edu/files/Pride%20of%20Place_MR.pdf (November 13 2011).

Ki-Moon, Ban. 2011. “Secretary-General's remarks at General Assembly Briefing on the Global Pulse Initiative. http://www.un.org/sg/statements/?nid=5668 (January 11 2012)

Pallaris, Chris. 2009. “OSINT as Knowledge, Activity and Organization- Trends, Challenges and Recommendations”. http://www.eurosint.eu/system/files/docs/osint-knowledge-activity-organization.pdf (February 27 2012)

Pallaris, Chris. 2011. “The Four Architectures of Competitive Intelligence, presentation at 360 Degree Indian CI Conference (February 27 2012)

Porter, Alan and Stephen Carley. 2011. “A Forward Diversity Index”. *Scientometrics,* 90(2): 407-427

Porter, Alan et al. Forthcoming. ”Forecasting Innovation Pathways:
The Case of Nano-enhanced Solar Cells”, Technological Forecasting & Social Change

Porter, Alan and John Garner. 2011. “Assessing the Human and Social Dynamics Program□Exceptional
Cross-disciplinarity. Paper presented at Atlanta Conference on Science and Innovation Policy.

4.2 Discussion of Paper One

It has already been indicated in section 4.1 that Paper One was written for a specific journal, and that any relations between its empirical findings and the framework of 'web-vision analysis' were omitted in the review process. It has, however, also been indicated that such a relation exists and this section will provide two discussions that make it explicit. Section 4.2.1 will argue that the analytical continua identified in the paper can be used to illustrate limitations in some of the theoretical vocabularies introduced in Chapter II. It will more specifically emphasize that the tradeoffs highlighted by these continua are not adequately captured if web-based visualizations are thought of from the perspective of 'second-degree objectivity' or as enablers of a 'rise of empiricism'. Section 4.2.2 will build on this argument and suggest that the concept of 'web-visions' is a more useful theoretical foundation if one wants to make sense of the choices that the project leaders make in relation to the trade-offs identified in the paper. It will more specifically take a closer look at the crisis-monitor produced by the UN's Global Pulse and argue that the choices involved in the production of this visualization are better understood through some of the concepts drawn from Cooley and Gibson than any of the concepts introduced in Chapter II. Furthermore, it will use the example of the crisis-monitor as a starting point for discussing the similarities and differences between the concept of 'web-visions' and the concept of 'lively visualizations', with which it shares important characteristics.

4.2.1 The Identified Continua as an Opportunity to Reflect on 'Second-Degree Objectivity' and 'The Rise of Empircicm'

Paper One identified two analytical continua on which project leaders engaged in the construction of web-based visualizations must place their projects. It was argued that it

is necessary for project leaders to take positions on these continua because the technologies used to harness digital traces set specific conditions of possibility for their use. One condition is that the process of data formatting must be distributed to third-party actors, and it was argued that this creates a trade-off between, on the one hand, prioritizing transparency and structure in the way data is collected, and on the other hand, prioritizing the pace and adaptability of the data formats that are repurposed. Another condition is that it is necessary to automate some parts of the data analysis, and it was argued that this creates a trade-off between, on the one hand, trusting and following the algorithms to reveal new aspects of the world, and on the other hand, making use of well-established metaphors that can shape the visualizations and make them resonate with on-going discussions in the organizations. On the basis of its 'most different research design', the paper argued that these trade-offs are not bound to the creation of web-based visualization in a specific context. They reoccur across different projects, and they are to be understood as general trade-offs that proponents of digital methods are bound to engage with. The general character of these trade-offs makes it relevant to discuss the extent to which the vocabularies introduced in Chapter II are useful for making sense of them. The trade-off connected to the first continuum will be used to discuss the concept of 'second-degree objectivity', whereas the trade-off connected to the second will be used to discuss the idea of digital data as enabling a 'rise of empiricism'.

The first analytical continuum illustrated that a trade-off between 'structured channelling' and 'adaptive tracking' is central to visualization projects across very different organizational contexts. When looking back at the way the concept of 'second-degree objectivity' was introduced in Chapter II, it is debatable whether it provides a theoretical framework that enables researchers to be sensitive towards this aspect of the production of visualizations. The reason being that the analytical continuum entails that two of the central prescriptions of 'second-degree objectivity'

are often in internal conflict when it comes to the practical production of web-based visualizations. The first prescription is the suggestion to build web-based visualizations (more specifically controversy maps) that are reversible and can be traced back to their original source. The second prescription is the suggestion to build visualizations that follow the native language of the actors involved in the issue depicted. The argument to be made against the concept of 'second-degree objectivity' is that these two prescriptions echo the ideal types at each end of the analytical continuum between 'structured channelling' and 'adaptive tracking'. The first echoes the way 'structured channelling' emphasizes the need to build visualizations upon channels where the production and segmentation of data has a transparent structure. The second echoes the way 'adaptive tracking' emphasizes the need to build visualizations upon adaptive data formats that allow for following social dynamics without starting from a priori categorizations of relevant and irrelevant channels and actors.

This makes it interesting that Paper One shows how the two ideal types—and thereby the two prescriptions of 'second-degree objectivity'—are often in internal conflict. To most project leaders, they represent a trade-off because the most adaptive formats are often owned by private companies and they are not particularly transparent and traceable. This can, for instance, be illustrated by taking a closer look at the choices made in the construction of the visualization depicted in Figure 4 in Paper One. This visualization is built as a crisis-monitor by the UN's Global Pulse. It gets its data by harnessing Twitter's API, and the choice of using this data source represents a trade-off that makes it impossible to follow both prescriptions of 'second-degree objectivity'. One is the prescription to build on transparent data sources and the other is the prescription to follow native vocabularies. In the case of UN's crisis-monitor, it is clear that it is the latter prescription that is prioritized. The argumentation for using Twitter's API as the provider of data formats is that it enables a form of dynamic anomaly detection that is more suited to engage in today's fast-paced crisis-developments than

techniques like interviews and surveys. It is a data format that meets the prescription to follow the actors involved in the crisis because the central metadata that is used to segment Twitter's data, such as hashtags (#) and replies (@), are generated by the users and used on mobile devices.

The fact that Paper One presents such priorities of 'adaptive tracking' as belonging on one end of an analytical continuum, however, indicates that they stand in a trade-off with priorities such as transparency and structure in the dataset. If we continue with the specific example of Twitter's API, this trade-off is visible in several different ways. It is, for example, impossible to trace the data obtained from Twitter's API back to the context in which it was produced, and this makes it impossible to ensure that accounts and their users are equivalent. Some users have many accounts, some accounts are used by multiple people, and some accounts are run by robots (boyd & Crawford 2011). These aspects of Twitter's data are non-transparent to the UN when they harness it from the API, and there is no way to trace the provenance of the data. Furthermore, it is non-transparent as to how Twitter filters the data it pushes through its API. It is well known that it is only a fraction of the tweets that are made available through the API, but the selection-criteria are unknown (boyd & Crawford 2011). It could be a random sample or a sample from a particular segment of the network, but the answer to this question remains unknown to the project leaders at the UN. Finally, it is important to note that Twitter's interface is designed to make people communicate in a specific way, and that the design choices are not made for providing good crisis-indications. This means that the interfaces and the API are constantly changing for reasons that have nothing to do with crisis-monitoring and that are hard to keep track of.

An empirical finding from Paper One that is relevant to the overall discussion in this dissertation is, accordingly, that the two central prescriptions of 'second-degree

objectivity'—that of following the actor language and that of ensuring traceability—are often in conflict in the practical construction of web-based visualizations. Twitter's API, for instance, provides a data format that is well suited for meeting the first prescription, but the way it delivers the data makes it very hard to 'zoom' in and trace the data in the manner suggested by Venturini and Latour. This finding makes it relevant to discuss whether the metaphor of a 'map' and the concept of 'second-degree objectivity' are useful vocabularies to use as the theoretical foundation from which to understand the potential of web-based visualizations in this context and whether they serve as useful guidelines for their construction.

From the findings in Paper One, it can at least be argued that the prescriptions of 'second-degree objectivity' are a problematic foundation from which to discuss the construction of visualizations outside of the project of 'mapping controversies'. The relevance of the vocabulary seems to be confined to this project, and the reason for this can be traced back to two reoccurring characteristics in the way Latour and Venturini build their argumentation. The first characteristic is that their conceptual arguments about mapping are most often based on general descriptions of data properties. If we look at the argumentation for the traceability of data sources, it is, for instance, based on a description of the mathematical properties of digitized content. Chapter II showed how both Latour and Venturini emphasized that the binary and mathematical foundations of digital data offer a unique opportunity for constructing maps that enable their users to trace their relationship to the original substances from which they were constructed. This claim is admittedly true 'in principle' when one looks at the abstract characteristics of digital data, but Paper One shows that reality is perhaps not as smooth. Traceability often comes at a cost of losing other desirable data properties.

This is not to say that Latour and Venturini do not acknowledge that the quality of information technologies is crucial to the possibility of constructing good maps. In fact

they explicitly argue that this is the case. However, a second interesting characteristic of their theoretical work is that they build their conceptual arguments on an assumption about the existence (or future existence) of information technologies with better quality. Chapter II illustrated how their introduction of Tardian sociology is framed as fitting for a time where data sources are getting better and better. The gist of their argument is that whereas the data sources in the times of Tarde were not granular enough for him to practice his own sociology, we are now in a situation where digital data provides the opportunities to do so. The argument seems to be that if data sources continue to develop in the direction they have done, then it is possible for Tardian sociology to be the sociology of the digital future. The suggestion to use the concept of 'monads' to describe web-based visualizations and provide the theoretical foundation for the way they should be used as a tool of social inquiry is, accordingly, based on a hope for the existence of digital data streams that live up to their mathematical potential of being both traceable and indicative of the inner life of the monads—or what we saw Latour referring to as the "[…] precise forces that mould our subjectivities and the precise characters that furnish our imaginations […]" (Latour 2007). It can once again be argued that the trade-offs pinpointed in Paper One indicate that the reality of the construction of visualizations is rarely so smooth.

It should be emphasized that this way of using the empirical findings of Paper One to discuss the concept of 'second-degree objectivity' does not provide any devastating critique of the project of controversy mapping (to which it is tied) if this project is understood as a self-contained normative project. As mentioned earlier, it is quite clear that the project is undercut by a specific democratic ambition of making controversies navigable for the public in a way that brings out their complexity while at the same time making them simple enough to engage with. This is what Latour (2010) refers to as his 'compositionist manifesto', and his argument is that digital data has properties that make the construction of good compositions more realistic than it otherwise would

have been if conducted through other forms of data. It has properties that *in principle* make it possible to adhere to the Tardian prescriptions for tracing the social world. It is this possibility that Latour and Venturini invite us to pursue.

Such a normative ideal cannot be criticized with reference to the existence of specific empirical trade-offs that reoccur across organizational contexts where digital methods are being appropriated. However, such trade-offs can serve to illustrate how the ideal is hard to enact when it comes to the practice of constructing web-based visualizations in organizations. If one were to evaluate the concepts of 'second-degree objectivity' as a pragmatic vocabulary with which to make sense of the way web-based visualizations are—and could be—produced outside the project of controversy mapping, it would, therefore, be more problematic. Pragmatic concepts are characterized by not being derived from principles and ideals but rather taking their point of departure in the way people act in the world. It was outlined in section 1.2 that they are meant as interventions that can stimulate useful reflections on these practices. It is not clear from Latour and Venturini's writings to what extent they envision Tardian sociology to be a relevant framework outside controversy mapping, but they do occasionally write about it as a general framework from which to understand the possibility of digital methods. Two points can thus be taken away from the discussion: First, that the prescriptions they derive from their Tardian foundation run the risk of being too demanding for this purpose; and second, that there is a need for a theoretical vocabulary that conceptualizes web-based visualizations on the basis of practice rather than ideal. The concept of 'web-visions' will be argued to be a candidate for such a vocabulary in section 4.2.2 below.

Before reaching that argument, we will take a look at some theoretical points to be drawn from the detection of the second analytical continuum in Paper One, which was presented as a balance between the choice to follow algorithms and to train them when

automating the analysis of digital data. This continuum is an empirical finding from which it is possible to reflect on limitations in the modes of thought and vocabularies that were introduced as part of the 'rise of empiricism' and the 'end of theory' in Chapter II. If we look at the suggestion by Anderson and others to think about web-based visualizations as enabling a rise of theory-free empiricism, it seems that they think of web-based visualizations in a way that is similar to the viewpoints reflected in the ideal type of 'following'. Their argument is that people doing social inquiry with digital traces should solely let their attention be guided by data patterns because the properties of big digital data flows make it possible to sidetrack theoretical assumptions and other human prejudices.

The identification of the second continuum in Paper One, however, problematizes this way of speaking about web-based visualizations for two reasons. The first is that the project leaders express a need to balance the approach of 'following' the algorithms with a need to train them. Reasons for this is, for instance, that automated results are too poor to be useful, and that they feel a need to produce visualizations that resonate with already existing theories and classifications of the world. The point is that it is hard to push atheoretical methods in organizational environments that are used to approach the social world through established theoretical distinctions. The existence of such a balancing act across different projects is a pragmatic reason for being critical towards the idea of thinking about web-based visualizations as enabling a rise of empiricism.

However, the discussion of the analytical continuum between 'following' and 'training' can also be used as a foundation for a more principal argument against the take on visualizations that Anderson is representative of. The paper shows that even if visualization projects adhere to the prescription of 'following' the algorithm, they cannot escape the necessity of pre-programming algorithms on the basis of theoretical assumptions. It was argued in Paper One that projects that base their construction

choices upon the approach of 'following' are characterized by substituting a reliance on theoretical assumptions about the specific topic in question with a reliance on more general theoretical assumptions about, for instance, the mathematical properties of networks, language, and so on. If we look at the example of the co-word analysis that was discussed in section 2.4 it is, for instance, an attempt to conduct semantic analyses without starting from theoretically laden keywords, but it is still built on theoretical assumptions. These are just not assumptions about the specific words that are of interest to a specific issue, but rather assumptions about the formal properties of language. One such assumption is that words with no more than three words between them (a so-called window of three) are semantically related. In a similar vein, it can be argued that Google search mechanisms substitute the assumptions of experts about what constitutes relevant information with theoretical assumptions about what an information-sharing network looks like and which mathematical properties it can be said to have. However, the fact that theories become non-topical does not mean that they are not theories, and the ambition of 'the end of theory' is accordingly only sensible if it is meant to say something about topical theories.

These arguments against the end of theory conclude the discussion of the ways in which the findings of Paper One pose challenges for the vocabularies of Anderson, Latour, and Venturini. This discussion has laid the ground for reflecting on the extent to which the concept of 'web-visions' can provide a theoretical foundation from which to meet some of the challenges that this subsection has focused on. Section 4.2.2 will argue that its roots in the thoughts of Cooley, Gibson, and Espeland make it a promising alternative to the concepts discussed above, and it will continue using the example of the crisis-monitor at the UN to make this point. Furthermore, it will illustrate that some of the characteristics that make the concept of 'web-visions' a promising source from which to analyse this specific visualization are characteristics

that it shares with the concept of 'liveliness' as it was introduced in section 2.4. A discussion of the relation between these concepts will therefore conclude the section.

4.2.2 'Web-Visions' and the Case of the Crisis-monitor in the UN's Global Pulse

Chapter III introduced selected thoughts of Cooley, Gibson, and Espeland as a theoretical grounding from which to talk about web-based visualizations as 'web-visions'. This subsection will discuss the extent to which this theoretical foundation allows for a different discussion of the empirical findings in Paper One than the discussion that would emerge from the concepts of 'second-degree objectivity' and 'the rise of empiricism'. It will argue that the theoretical lineage from Cooley, Gibson, and Espeland offer the possibility for posing different questions about the elements that web-based visualizations are composed of and the role they can potentially play as empirical tools of social inquiry. It will primarily make this argument by focusing more thoroughly on the crisis-monitor developed by the UN's Global Pulse.

The first thing to note is that the ontology of 'web-visions' introduced in section 3.2 fit the overall conclusion of Paper One, which is that it is necessary to see web-based visualizations as empirical objects that exist 'between technological conditions and epistemic assumptions'. If we look at Cooley's thinking, it is, for instance, clear that he promotes an ontology of experience that sees it as equally influenced by choices in the perceiving agent, the characteristics of the technologies that are used to see with, and the environment in which the perceiving agent is placed. Cooley conceived of experience as a system that is distributed across these selection mechanisms, and if we return to the example of the crisis-monitor made by the UN's Global Pulse, it seems that this is a useful foundation from which to interpret its ontological status as well. The reason for this is that the selection mechanisms that shape this visualization are distributed across the conditions of possibility set by Twitter's API and its metadata; the choices made by the UN's Global Pulse in their interaction with this data; and the

characteristics of the organizational environment in which the visualizations are to serve a function. The suggestion to conceptualize the crisis-monitor of the UN's Global Pulse as a 'web-vision' that exists in-between the triad of technological conditions, human intentions, and the characteristics of the environment is therefore a very relevant theoretical foundation from which to understand its ontological status.

Chapter III further argued that Cooley's thoughts on ontology can productively be supplemented with Gibson's suggestion to see the visions as 'ecological objects' that afford specific modes of seeing. He introduced the concept of 'ecological objects' to emphasize that perception is neither to be understood as a reflection of the quality of physical objects nor a reference to some subjective idea about the qualities of such objects. It is rather the outcome of a distributed system of 'information pick-up' that is shaped by objects in the world, mediums of information transfer, the capabilities of the perceiving agent, and his or her perception of the situation in which he or she is placed. The point Gibson wanted to make was that an elaborate and precise perceptual system depends on the alignment of these different elements. Looking back at the empirical findings in Paper One, we can see why it is promising to conceptualize the crisis-monitor made by the UN's Global Pulse as a 'web-vision' with an ontology that mirror Gibson's ontology of perception. The monitor is first of all built to enable the UN to 'see' crisis signals in a way that makes the organization more sensitive to such signals than it would be if it chose to see the world through other technologies. Its ontology can further be argued to mirror that of Gibson's visions, as it exists in-between the digital traces used as an aid for seeing the world, the conditions of the technologies through which these traces are harnessed, as well as the situation that the project leader of the visualization project finds himself in (and the way he perceives his role in it). A digital trace like the tweet can, for example, be said to offer a certain mode of experience that affords adaptive visions, but this affordance is meaningless if it is not understood in relation to the capabilities of the agent that is trying to perceive the

world through it. In the case of the crisis-monitor, this agent is the specific branch of the UN that works with early crisis signals, and it is clear from the paper that the visualization they produce is the outcome of a balance between technological conditions and epistemic assumptions in the organization. A balance that is shaped by the situation in which the visualization is to be used and the way the project-leader interprets this situation.

The suggestion to conceptualize web-based visualizations as 'web-visions' accordingly involves looking at the world as being full of digital traces with specific affordances, while at the same time emphasizing that these affordances need to be seen in relation to the capacities of the perceiving agent that engage with specific technologies in a specific situation. Talking about the UN crisis-monitor as an effective and useful 'web-vision' of crisis signals would entail talking about it as ensuring a successful alignment of such a distributed set of actors. It is the dilemmas and actors involved in this practical work of alignment—and the characteristics of the visions that arise from it—that is of interest to a 'web-vision analysis'. Paper One focused on attempts to make such alignments and it can therefore be said to be guided by tenets of the frameowk of 'web-vision analysis'. This is why its findings make it possible to outline some of the characteristics that make 'web-vision analysis' distinct from the vocabularies of Anderson, Latour, and Venturini.

The identification of the two analytical continua, for instance, illustrates why 'web-vision analysis' does not look at web-based visualizations as tools that will enable a rise of theory-free empiricism. The distributed ontology of 'web-visions' entails that they are active constructions that are shaped by a distributed set of actors. This also means that the work of theory is distributed rather than eliminated. Web-based visualizations are seen as empirical tools that can take many different directions and carry many different theoretical points depending on the way the elements of the distributed system are aligned. The framework of 'web-vision analysis' also offers an

alternative to the suggestion of interpreting web-based visualizations on the basis of Tardian sociology. For example, it may be true that the abstract mathematical properties of digital traces affords the construction of traceable maps, but the choice of rooting the concept of 'web-visions' in Gibson's work makes it clear that the affordances of digital data are not interesting in themselves. They are only interesting insofar as they influence the creation of a 'web-vision', which is understood as an ecological object that exists in-between the characteristics of the digital traces and a distributed set of other actors. This take on visualizations fits the empirical findings of Paper One well.

The discussion on the relation between the findings of Paper One and the framework of 'web-vision analysis' have so far highlighted the relevance of Cooley and Gibson's ontological thinking. However, if we continue reflecting on the crisis-monitor developed by the UN's Global Pulse, it can plausibly be argued that the central tenets of Gibson's epistemological thoughts—as they were introduced in section 3.3—are an equally relevant foundation from which to understand and evaluate this visualization. Gibson argued that the detection of invariant structures in a changing environment is the key competency one needs in order to perceive the world. His basic suggestion was to conceptualize the perceiving agent as a 'sampling point' that extracts invariants from the world by moving around and engaging with it. Gibson's point was that it is through such activity, rather than through passive reception of external stimulus, that one can obtain fixed points with reference to which the chaos of the environment can be organized. Therefore, it is also with reference to this organizing activity—and not with reference to an external world with which perceptions are supposed to correspond—that the epistemic merit of perceptual systems should be evaluated. Just as in Cooley's work, it is discriminatory, selective, and organizing skills rather than representational skills that are in focus when Gibson speaks about the quality of perception.

Returning to the example of the crisis-monitor developed by the UN, it is once again better understood by deploying the epistemological thoughts of Gibson than by deploying the vocabularies discussed above. In short, it can be argued that this visualization is precisely argued to gain precision through the detection of invariant structures from the constant flow of data harnessed from Twitter's API. In the paper, we saw how the monitor is set up to spot crisis signals through a detection of anomalies inside the data flowing from the API. Because of the non-transparent character of the data flow, and because of the constant changes to Twitter's interface, it was an explicit choice in the construction process to give up the idea of having external benchmarks to judge the result of the visualizations up against. The alternative choice was to use a distributed system of technological and human actors to build a visualization that is sensitive towards normal fluctuations in word patterns in the data coming from the API. These fluctuations are then used as invariant structures against which changes in crisis-sentiment can be detected.

In the specific case of the crisis-monitor, an example of such an invariant structure is that people tweet negatively about their economy around the first of each month when bills are to be paid, and that this negative sentiment declines throughout the month. The extraction of such an invariant from the data allows the user of the crisis-monitor to refrain from over-interpreting a spike in negative sentiment at the beginning of a month and to focus on whether it is sustained longer than is normally the case. This invariant can even be built into the algorithm that colours the monitor. The visualization can, for instance be programmed in a way so that it takes more negative tweets about the economy to ignite a red colour (which indicates an emerging crisis) at the beginning of the month than at the end of the month. Examples like this to indicate that the crisis-monitor is productively interpreted as a 'web-vision' that extracts invariants from the flow of tweets.

If we follow Gibson's epistemology, it also means that it does not make sense to evaluate the monitor on the basis of whether or not it provides a representative sample of a specific crisis-prone population; whether or not the tweets can be traced back to their sources; or whether or not they are honest signals. In fact, it is explicitly stated by the project leader connected to this monitor that it cannot live up to any of these criteria. Tweets are neither transparent nor honest. They are always biased and messy. They are cultural products that change over time, and the analytical challenge is to understand this fluctuating culture and to detect invariants in this fluctuation that are stable enough to build a useful crisis-monitor upon. This reflects both Cooley and Gibson's argument that experience and vision are something to be learned in practice and not a matter of having technologies that transmit external signals in an unmediated manner. Mediation and selection lie in a distributed system that is neither representative nor theory-free and the shape of web-based visualizations are not solely influenced by the people´s real and honest behavior as, for instance, Anderson and Pentland indicate.

The discussion about the extent to which 'web-visions' should be seen as representations will be taken up more thoroughly in the text around Paper Two, which is focused on representative ambitions in the construction of web-based visualizations in the social sciences. Before turning to this paper, however, it must be emphasized that the point made about invariances above is closely related to some of the discussions about the temporality of web-based visualizations that was introduced in section 2.4. One of the central concepts introduced in this section was that of 'live' methods, and from what has been discussed above, it is clear that the suggestion to see 'web-visions' as attempts to see the world through the extraction of invariances promotes a somewhat different way of approaching the dynamic character of digital

data. The thoughts of Gibson are, in other words, also a relevant foundation for taking a discussion of this theme of digital methods.

Gibson can more specifically be drawn upon to emphasize the necessity of a dynamic engagement with data that is in constant movement. One of Gibson´s central points is that it is only when the whole perceptual system—not just the world—is in movement that it is possible to detect invariant structures. This connection between the active analyst and the possibility of seeing is not as central to the methods that were characterized as 'live' in section 2.4. Most of these focused on the extent to which it is possible to scrape fresh data from the web rather than on the dynamic creation of the benchmarks against which this data were to be evaluated and interpreted. The theoretical focus is on movement in the data streams an not in the analyst and Gibson´s thoughts on perception can be used to pinpoint that any experience of data that is moving in real time is dependent on an active production of fixed points against which to understand this movement on the part of the analyst.

Section 2.4 does, however, end with a review of thoughts on temporality that have a closer resemblance to the way Gibson's epistemology suggests thinking about the dynamic characteristics of web-based visualizations. Uprichard's concept of 'presentism' is, for instance, used to argue that real time accounts of the world tend to overlook the fact that temporal orders are derived from social practices. She uses this argument to make the important point that temporality is not something external to the technologies through which it is produced and the events they order. It is rather a phenomenon that is structured by the interrelations between technologies, events, and practices. Uprichard explicitly argues that the temporal order enacted by real time streams of tweets is derived from the interaction between those observing twitter streams, those acting upon them, and those tweeting. The temporal order of 'presentism' is, in that sense, argued to be a distributed phenomenon that can be

disaggregated and subjected to criticism. The 'liveness' in 'live' methods is not something that is external to the analyst. It is actively produced in a way that is similar to the way Gibson thought of the production of perception.

The suggestion to interpret dynamic web-based visualizations as Gibsonian 'web-visions' does not perhaps provide a satisfactory answer to Uprichard's critique. However, it provides a framework for understanding dynamic flows of data that puts more emphasis on cultural and social aspects of temporality than many other vocabularies connected to 'live' research. It acknowledges that the temporality of 'web-visions' is derived from a distributed set of actors that interact with each other in ways that are constantly changing. The refusal to approach the real time as something that is external to these interactions and the call for a more social analysis of the temporal order constructed by these interactions is therefore incorporated in the suggestion to conceptualize web-based visualizations as 'web-visions'. In relation to Uprichard's critique of the lack of historical awareness of live methods, it could be argued that the practice of extracting invariances from data flows necessarily involves looking back at the history of these flows.

The framework of 'web-vision analysis' can accordingly be used as a starting point from which to discuss some of Uprichard's critiques of real time research and construct alternative takes on the temporality of web-based visualizations than the one suggested by proponents of 'live' methods. The way this is done is also not far from the way Marres and Weltevrede use the concept of 'liveliness' to suggest a form of real time research that leaves the focus on the 'now', which characterizes most real time research. In section 2.4, it was illustrated how the concept of 'lively' research is argued to be a different form of real time research than 'live' research because it is focused on the way data streams fluctuate over a specific period rather than driven by an interest in identifying 'current', 'instant', and 'fresh' data streams. In the case of Twitter, this

difference is exemplified by the difference between scraping its API for the currency and frequency of a specific term such as ‘crisis’ and scraping it with the aim of identifying the social variation in the semantic networks around that term. The point of making the distinction between ‘live’ and ‘lively’ is that it is quite possible that a term like ‘crisis’ has a high ‘currency’ and could be mentioned often, while at the same time be very ‘un-happening’ in the sense that the social forms of variation around the concept stay the same. If one looks for the ‘liveliness’, one is not interested in the former dynamic unless it reflects the latter, and it is therefore a more social mode of real time research.

The way the framework of ‘web-vision analysis’ suggests handling the dynamics of digital data streams has important similarities to the suggestion to look at the ‘liveliness’ of such streams. It has just been argued that the crisis-monitor of the UN’s Global Pulse can be seen as an example of a ‘web-vision’ because the characteristics of the temporal order it creates are tied to the cultural characteristics of the software tools it is built upon. This is similar to the way Marres and Weltevrede tie the difference between ‘live’ research and ‘lively’ research to the difference between software set up to do frequency analysis and software set up to do co-word analysis. The point is that different technologies will produce different temporalities, and this is fully consistent with the framework of ‘web-vision analysis’, which is ultimately grounded in Cooley’s interest in the relation between information-technology and the environment of experience. Another argument that has been made above is that Gibson’s thoughts on the role of invariances in the way we perceive changes in the world are also very relevant in relation to interpreting the crisis-monitor of the UN’s Global Pulse. The reason for this relevance is that this monitor is explicitly intended to become more and more elaborate by detecting reoccurring fluctuations in data patterns backwards in time. This is again quite similar to the meaning that Marres and Weltevrede attach to

the idea of 'lively' research since this form of real time research is precisely characterized by focusing on fluctuations in data rather than on their freshness.

However, there is at least one way in which the concepts of 'web-visions' and 'lively visualizations' differ from each other—the former highlights the role of invariants, whereas the latter emphasizes the role of variance. What distinguishes the concept of 'web-visions' from 'lively visualizations' is that it follows Gibson's argument that any detection of variance must be preceded by an attempt to derive invariants from the stream of data. It is only through the specification of invariant structures that it becomes possible to talk about variance. Any 'web-vision' must therefore start by deriving invariants from digital data streams, and the anomaly detection in the crisis-monitor is one example of how this can be done. This discussion about temporality will be continued in the meta-text around Paper Three, which presents a longitudinal study that follows changes in 'web-visions' of synthetic biology over the time span of a year. For now, it is enough to note that the focus on the notion of invariances in the framework of 'web-vision analysis' should not be seen as a return to an ontology focused on stability. The theoretical roots of this concept are buried in the work of Gibson, who had a firm interest in detecting flux, and the concept continues his argument that in order for something to be considered fluctuating there needs to be an invariance to judge the flux up against.

Chapter V: 'Web-Visions' & Social Scientific Studies of Technological Development

This chapter of the dissertation is structured around the second of the three papers, which will provide empirical inputs to the development of the concept of 'web-visions'. It has already been mentioned that the three papers are organized as a 'funnel' that starts with empirical insights into general conditions for constructing web-based visualizations and ends with concrete attempts at producing 'web-visions'. Chapter IV has just provided a discussion of the central findings in Paper One, which provided an analysis with a broad empirical focus. It included a variety of different examples of web-based visualizations from a broad range of organizational contexts in order to detect similarities across these cases. Paper Two, which is the centre of this chapter, has a more narrow empirical focus. It is entitled 'Web-visions as Controversy-Lenses', and its empirical scope is limited to looking at recent attempts within the social sciences to repurpose hyperlinks and network-visualizations in order to understand the development of emerging technologies. It will be preceded by a short introduction in section 5.1, and it will be followed by a more comprehensive discussion of its relevance to the project of developing a framework of 'web-vision analysis' in section 5.2. This discussion will mirror the discussion in section 4.2 in the sense that it will relate the findings of Paper Two to the four themes of digital methods research outlined in Chapter II and the concepts derived from Cooley, Gibson, and Espeland in Chapter III.

5.1 Background on Paper Two

It has already been argued above that the choice of writing a paper-based dissertation brings with it certain challenges in terms of weaving together a coherent argument

from papers that have, to some extent, lived separate lives in their own peer-review processes. Another challenge of tying the three individual papers of this dissertation together into a coherent whole is that they have been written and published at different times in the three-year dissertation work period. For instance, Paper Two was already presented at a conference entitled 'Visualization in the Age of Computerization' at Oxford in March 2011. It was thereafter published in a special issue of the journal 'Interdisciplinary Science Reviews' in March 2012. The main argument in Paper Two was, accordingly, constructed one year into the dissertation process. This was before I had even begun to relate the topic of web-based visualizations to the writings of Cooley, Gibson, and Espeland. However, it was around this time that I started to think about them as 'web-visions' and began to distinguish a framework of 'web-vision analysis' from other frameworks in the field.

Since Paper Two appears here in the version in which it was published, it will inevitably reflect a somewhat immature discussion of the concept of a 'web-vision', which is not informed by the theory introduced in Chapter III. For instance, it will make use of the metaphor of visions without grounding it in the perceptional theory of Gibson, and it will refer to writings within economic sociology without mentioning the concept of commensuration. It will even contain formulations that seem slightly inconsistent with the theoretical grounding given in Chapter III. One example is that it defines 'web-visions' as filter-driven modes of seeing. This wording may seem at odds with the focus on the distributed agency of experience and perception that was highlighted as important aspects of both Cooley and Gibson's work in Chapter III. Such inconsistencies will be discussed more thoroughly in section 5.2 after the paper. It will be argued that they are at a conceptual level and therefore do not ruin the relevance of the paper to the overall discussion of this dissertation.

The specific contribution that Paper Two makes to this overall discussion is to show how seemingly similar attempts at using web-based visualizations in social scientific studies of emerging technologies exhibit important differences in terms of the logic with which they produce visualizations and the extent to which they aim for these visualizations to live up to methodological criteria of representation. These will be the central issues in the discussion of the paper in section 5.2, and even though Paper Two is narrowly focused on a specific use of web-based visualizations within the social sciences, it will be argued that its findings are relevant outside of academia as well. It has already been noted several times that approaches to digital methods are travelling back and forth between academia and other sectors, and this process of travelling gives the discussion of web-based visualizations in the social sciences a broader relevance as well. The choice of using an analysis of developments within the social sciences as a stepping stone for more general discussions is motivated by the fact that methodological choices are often clearly explicated within this field.

Paper Two uses this explicitness to detect 'micro-differences' in the construction choices beneath web-based visualizations that otherwise seem very similar. The similarity between the cases discussed is, in fact, an important part of the research design of the paper, and it sets it apart from Paper One. Whereas the latter looked at 'most different' visualization projects across different organizational sectors, it is a deliberate choice to look at visualizations that share important characteristics in Paper Two. The discussed visualizations are all built by social scientists in order to make sense of emerging technologies; they are all grounded in a relational ontology; and they rely on links and network visualizations as their main empirical tools. The rationale of such a 'most similar' research design is to find interesting differences despite such similarities, and this is what Paper Two does. It builds a typology of different approaches to construct web-based visualizations and uses this typology as the basis from which to introduce the concept of 'web-visions'.

The detection of differences beween visualizations that seem similar on the surface is used as a warning against talking about a coherent movement of digital methods and as an indication of the need to conceptualize the differences between distinct approaches. In that sense, the paper will repeat some of the points made in Chapter II and III, but it will provide a more thorough ground for discussing the relation between the concept of 'web-visions' and takes on research design and representative ambitions in related approaches. It will also introduce a distinction between 'myopic visions' and 'hyperopic visions' when it talks about 'web-vision analysis'. This distinction illustrates a need to draw distinctions between different types of 'web-visions' as well. The specific distinction is only relevant to the type of hyperlink visualizations discussed in Paper Two, but the argument of working with distinctions between different kinds of 'web-visions' will be argued to have a more general relevance for the overall discussion of the dissertation. This discussion will be initiated towards the end of Paper Two and followed up in section 5.2 after the paper as well as in section 6.2 after Paper Three.

Paper Two:

'Web-visions' as Controversy-Lenses

Anders Koed Madsen
Department of Organization, Copenhagen Business School
Mail: akm.ioa@cbs.dk

[Published in Interdisciplinary Science Reviews, Vol. 37 No. 1, March, 2012, pp. 51–68]

Abstract

Web-based visualizations are increasingly used by social scientists to study and manage emerging technologies and the controversies they ignite. The first part of this paper provides a methodological review of this trend and presents a typology that organizes influential analytical approaches according to the data they use to generate visualizations; the ontology they ascribe to them; and their proposed function. The second part presents 'web-vision analysis' as an analytical approach that has roots in different aspects of the reviewed approaches but nonetheless distinguishes itself in two ways. First, it translates the concepts of 'calculative spaces' and 'attention structures' from economic sociology into controversy-visualization. Second, it constructs visualizations on the basis of case-study logics. The third part illustrates how this approach ultimately leads to distinct empirical choices by reflecting on the process of constructing and interpreting 'web-visions' of synthetic biology made from January 2011 to October 2011.

Keywords

controversy, visualization, digital traces, synthetic biology, web-vision

Introduction

Digital traces, such as hyperlinks, are increasingly left by people as part of their communicative practices on the web, and this has not gone unnoticed by researchers and decision-makers interested in emerging technologies and the controversies they ignite. Universities, public intelligence units, and consultancy firms are attempting to extract meaning from such traces and synthesize them into visualizations that can provide insights into social dynamics around emerging technologies. The analytical approaches behind such visualizations may therefore come to shape the way we, as a society, discuss emerging technologies and draw boundaries around the information deemed relevant for understanding their development.

The first part of this paper provides a methodological review of five influential approaches to build such visualizations with the social sciences. It presents a typology that organizes these approaches according to the data from which they construct visualizations and the ontological status they assign to them. Even though they share relational metaphors of the social and rely on networked visualizations to depict social dynamics, the review identifies fundamental differences that indicate the various directions that the methodological trend of repurposing digital traces to organize social attention can take. Furthermore, it shows how these directions are grounded in assumptions about the type of knowledge a visualization can generate and the function it is supposed to serve.

The second part of this paper develops the framework of 'web-vision analysis'. It builds on a conceptualization of visualizations as filter-driven modes of seeing that have roots in some of the reviewed approaches, but nonetheless occupies a distinct position in the typology because of two analytical characteristics. First, it translates the concepts of 'calculative spaces' and 'attention structures' from economic sociology to

controversy-visualization. Secondly, it constructs visualizations on the basis of case-study logics. Both of these steps bring choices about starting points and software tools into the heart of the visualizing strategy in a way that challenges the ambitions of representation, which underlie the reviewed approaches in different ways. The third part of this paper illustrates how these analytical characteristics can guide empirical research by reflecting on the process of constructing and interpreting 'web-visions' of the controversy about synthetic biology from January to October 2011.

Analytical Approaches to Web-Based Visualizations

The visualizations reviewed in this section of the paper depict social dynamics around emerging technologies in different ways. Some are focused on scientific aspects of technology development and others on the public controversies they ignite. However, they share methodological roots in a relational view of social science, which highlights relations between entities rather than their individual characteristics (Emirbayer 1997). This leads them to rely on similar visual metaphors of the social world such as relational maps of coloured nodes connected by lines on a two-dimensional graph. But underneath the similar visual surfaces lie important differences, and each visualization reviewed exemplifies a general and distinct analytical approach to construct web-based visualizations. The two-dimensional typology illustrated in Figure 1 below positions these approaches in relation to each other on the basis of their choice of stratings points and the ontology they acribe to web-based visualizations. The next subsection will explain the two dimesnions in the typology and the subsequent section will decribe the approaches in the boxes and argue for their position in the typology

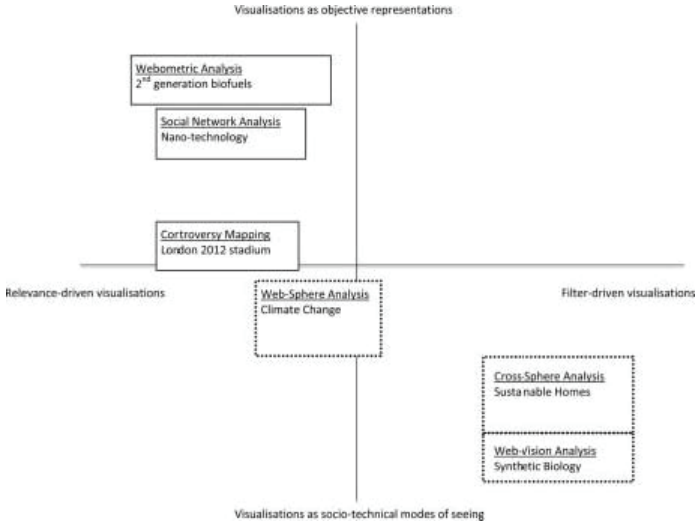

Figure 1: Typology filled with approaches to the construction of web-based visualizations in boxes that are positioned according to their starting points and the ontology they acribe to web-based visualizations. Each box contain the name of the approach (underlined) and a hint at the specific visualization that will be used to exemplify it below.

Explaining the Typology

The position of the approaches on the horizontal axis of the typology indicates the type of data from which they build visualizations. The choice concerning starting points is highly relevant because web-based visualizations are inevitably initiated from a pool of preselected data from which digital traces can be harnessed and synthesized. To the left on the horizontal axis we find visualizations that are 'relevance-driven' in the sense that they are initiated from data that are deemed relevant and reliable in relation to the technology of interest. The selection of starting points is based on knowledge about the technological development that is obtained prior to the construction of the visualization. To the right we find visualizations that are initiated from a specific information filter deemed worthy of interest. The visualizations are driven by an

interest in the specific filter rather than a belief in its capability to provide reliable data. The knowledge from which the researcher initiates the visualization concerns the filter and not the controversy per se. This is why they are denoted as 'filter-driven'.

The position of the approaches on the vertical axis of the typology indicates differences in relation to the ontological status they assign to the visualization. On the top we find approaches aiming for the visualization to be an 'objective representation' of something external. They uphold a distinction between the nature of the represented item and the human choices made in the process of representing it. These choices are supposed to be as unbiased as possible in order for the visualization to correspond to the phenomenon represented. The software tools used in the visualizing process are, in the same vein, approached as media that should ideally allow the represented item to appear without interfering with it. An analogue to this position would be that of a photographer who chooses her angle and lighting with an ambition of interfering as little as possible with the object photographed. In order to explain why a photograph looks a certain way, such a photographer would refer to the nature of the object photographed (Carusi *et al*. 2010).

Approaches at the bottom of the vertical dimension are interested in visualizations as 'socio-technical modes of seeing' in a way that is more akin to the interests we have in abstract and surrealist paintings. When looking at such a painting, the purpose is not to draw inferences about the nature of the object portrayed but rather to get an idea of how it was seen by the painter. We are interested in the mode of seeing and the sensemaking it conveys (Carusi *et al.* 2010). Whereas sensemaking in the case of a painting is often tied to the intentionality of the painter, it is more complex in relation to web-based visualizations because they are the result of a mix of technological, human, and social influences. Approaches at the bottom of the vertical axis are interested in visualizations as distributed socio-technical modes of seeing.

They have no ambition of distinguishing their shape from the human choices and technological systems that go into constructing them. The shape of the visualization is therefore not taken to be a consequence of the phenomena depicted. It is just as much a result of the active choices made by the producer of the visualization.

Filling in the Top-Left Corner

On the top-left side of the dimension, we find the approach of 'social network analysis' (SNA), which is interested in the structure of social networks that emerge from the relations that connect humans and organizations. The visualization in Figure 2 below is a quintessential example of the way this approach has been translated into the construction of web-based visualizations. It is constructed to enable a structural analysis of the communication network that makes up the debate about nanotechnology (Ackland *et al*. 2010). In order to understand its position in the typology in Figure 1 there is, however, a need to give a little more detail on the way it is produced.

The nodes represent websites and the ties represent hyperlinks. The nodes are shaped according to a pre-determined typology of organizations, and a statistical measure of their centrality in the network is calculated on the basis of the ties between them. The approach is positioned to the top of the vertical axis because the nodes and ties are interpreted as corresponding to clearly defined organizational types and communicative actions. The communicative structure of the debate about nanotechnology is assumed to be made up by such types and actions, which the websites and hyperlinks are supposed to represent in an unbiased way. This way of operationalizing a communication network leads to many insights such as that commercial info-sites about nanotechnology are more prominent in the debate than commercial producers of nanotechnology. To ensure that the visualization contains a

relevant and comprehensive set of organizations, it was initiated from twenty-five websites listed on the Merrill Lynch Nanotech index, which identifies companies that have their future profit tied to nanotechnology. The index was used as a trusted basis from which to visualize the relevant communicative network, and the demarcation of relevant organizations is accordingly a consequence of their relation to the relevant 'seed sites' listed in the index. This is the reason why the approach is positioned to the left on the horizontal axis.

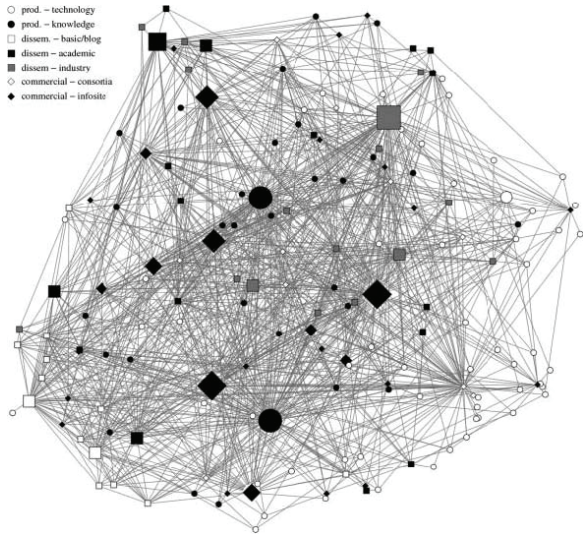

Figure 2: Visualization of communication structures in the debate about nanotechnology (Ackland *et al*. 2010).

When looking at Figure 1 we can see that the approach of 'webometric analysis' (WA) is positioned next to that of SNA the reaon is that it also promotes a macro-structural analysis of pre-defined social actors with predefined ties. Its position on the

top of the vertical axis is unambiguous because it approaches the online as a source for saying something about the offline, and it interprets hyperlinks as representing a specific form of loose networking between organizations (Thellwall 2009). A recent WA project, for example, aims at representing the scientific field of second-generation biofuels. The resulting visualization is presented as evidence of the fact that this field is loosely organized except for the central position of a set of international technology networks through which industrial firms collaborate (Thelwall *et al*. 2010). The authors of the visualization explicitly identify the potential biases of this evidence and the ambition is clearly to overcome such biases in a way that allows WA to get closer to the goal of creating objective representations of the scientific field in question. Its starting points are 150 websites that discuss second-generation biofuels, and they are identified through a triangulation of trusted sources that are subsequently validated by field experts. A central point is that these websites are only used as starting points if they contribute to a relevant and reliable sample. The explicit ambitions of correspondence between the online and the offline and the validation of relevance by human experts position WA even more to the top-left than SNA.

Controversy-Mapping as a Middle Ground

'Controversy-mapping' (CM) is presented as an alternative to visualizations that assume the existence of clearly demarcated actors and ties prior to the mapping. Figure 3 below is a well-developed example of the approach, and it is a snapshot of a simulation that illustrates how the controversy about the stadium built for the London 2012 Olympics has unfolded throughout time (Yaneva 2012). Similar controversy maps have also been constructed to depict other technological constroversies and the approach is getting institutional foothold in various

unversities around the world.[19]

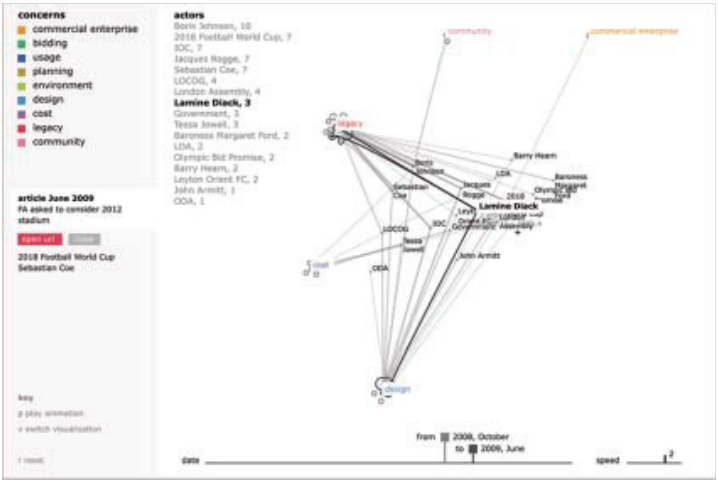

Figure 3: Snapshot of a simulation of the London 2012 stadium controversy (image provided by Albena Yaneva).

The first consequence of not working with pre-defined typologies of actors is that the nodes in the network are not necessarily humans and organizations. The Bird's Nest stadium of the Beijing Olympics is, for example, an actor that is argued to have had a great influence on the construction of the London stadium. The inclusion of such material actors entails that the ties cannot be social connections between organizations as is the case in visualizations constructed on the basis of SNA and WA. Instead of signifying intentional hyperlinks, the ties signify semantic relations between actors and themes in publicly available documents. These semantic relations are less stable than the social relations visualized by SNA and WA, and the actors gain their (fluid) identity in the mapping process rather than through a pre-defined typology. This represents a shift from a mimetic use of maps to a navigational use

[19] See http://www.mappingcontroversies.net/Home/MacospolParis

(Yaneva 2012). The ambition is to make sense of social phenomena in flux rather than to represent a pre-defined field of, for instance, communicators about nanotechnology.

With this move, CM takes a solid step towards interpreting web-based visualizations as modes of seeing and it is also positioned in the tradition of Actor-Network Theory (ANT), where every description is taken to be a constructed and performative intervention (Latour 2010a). However, CM is not placed at the bottom of the vertical axis, because it voices an ambition to construct visualizations that generate full and extensive controversy-maps. The simulation in Figure 3 is meant to encompass *all* actors enrolled in the controversy and *all* of the issues to which the design of the stadium are related. It is explicitly presented as a "[. . .] a new variety of representational techniques [that] simulates reality" (Yanava 2012). Figure 3 is, in that sense, an attempt to overcome the opposition between 'modes of seeing' and 'objective realism' that characterizes the vertical axis.

The attempt to overcome this opposition is also a general characteristic of the work done in the MACOSPOL consortium of which the visualization in Figure 3 is a subproject. The initiator of the consortium, Bruno Latour, has been a frontrunner in emphasizing how maps and descriptions are performative, but he has also stated that visualizations of controversies can be almost as precise as the description of a scientific fact (Latour 2007) and that the question of politics should be "[…] extended from representing people to representing controversies" (Latour, no date). The representational ambition voiced in these statements is tied to a conceptualization of a fact as the transformation of something material into a figure or diagram that succeeds in being circulated as an argument. A fact is connected to reality through a broad range of observation tools that superimpose many observational layers and multiply many datasets (Latour 2010a). In relation to controversy-mapping, this is labelled

'second degree objectivity' and it is only fulfilled when the full range of concerns around a given technology are revealed in a visualization that attributes each actor a visibility that fits its position and relevance in the dispute (Venturini 2010). This is what makes a visualization solid enough to be circulated. Despite acknowledging all the possible construction work involved in making a map (Latour 2005; Venturini 2010), CM still aims towards objective connections between the visualization and the world. However, objectivity is seen as something that can only be obtained through the presence of many objectors (Latour 2005).

Figure 3 and the approach of CM is in that sense a strange fit on the vertical axis, which it actually aims at overcoming. It is positioned in the middle because of its explicit commitment to creating full and representative controversy maps that are nonetheless performative modes of seeing. On the horizontal axis, it is positioned to the left because it is initiated from a trusted corpus of publicly available documents from official organizations, media sources, image galleries, and video portals. These documents are validated as being relevant to the controversy by a set of human coders. It is the ability of the coders to demarcate a comprehensive set of relevant actors that is the basis for using them as starting points.

Towards the Bottom-Right Corner

When looking at Figure 1 we can see that the approaches of 'web-sphere analysis' (WSA) and 'cross-sphere analysis' (CSA) each take steps towards the bottom-right corner of the typology. Instead of being driven by the question of whether traces on the web are valid representations of social networks or contribute to objective simulations of reality, these approaches attempt to learn about social dynamics by 'following the web' and the mode of seeing it provides (Rogers 2009). However, despite being closely related, the two approaches exhibit important differences to each

other and this is why CSA is positioned further down the bottom-right corner than WSA.

WSA aims at demarcating a set of web-resources that are relevant to a specific event or theme of interest (Schneider and Foot 2005). Despite being constructed before the concept of 'web-spheres' gained widespread popularity, Figure 4 below serves as a good example of this approach. Its theme of interest is the debate about climate change, and it depicts one step in the displacement of this debate from having the United Nations as the main addressee to being centred on the World Bank's funding of fossil fuels (Marres 2005). The visualization was made by following hyperlinks from organizational websites discussing an evaluation of the World Bank's activities, which is called the Extractive Industries Review (EIR). It is meant to depict the 'issue-network' that was active in the displacement of the debate and it illustrates how the involvement of NGOs, Nobel Laureates, and newspapers opened the issue of climate change for critical scrutiny on the web (and how it was subsequently closed again). By starting from relevant organizational websites and a specific report, it belongs to the left side of the horizontal axis. However, it is positioned a little more to the right than the approaches above because the web is at the centre of data selection. The criterion of relevance is balanced by an interest in specific media that render controversies public and traceable through a specific mode of organizing information.

The visualization in Figure 4 is purposely aligned with the 'bias of the web' because this bias allows the issue of climate change to be encountered in a reified state that is suitable for disclosing the attachments and associations of organizations involved in the 'public-ization' of the issue (Marres 2005). From the perspective of the vertical axis, we can say that WSA is interested in a specific socio-technical mode of seeing controversies. But it retains representative ambitions in the sense that it ultimately understands a web-sphere as a singular phenomenon that can be more or less

representatively uncovered by the researcher (Schneider and Foot 2005). Figure 4 reflects this understanding in its ambition of disclosing the issue-network, which depicts actors engaged in the controversy about EIR on the web and thereby also the publics that are sparked into being by this issue.

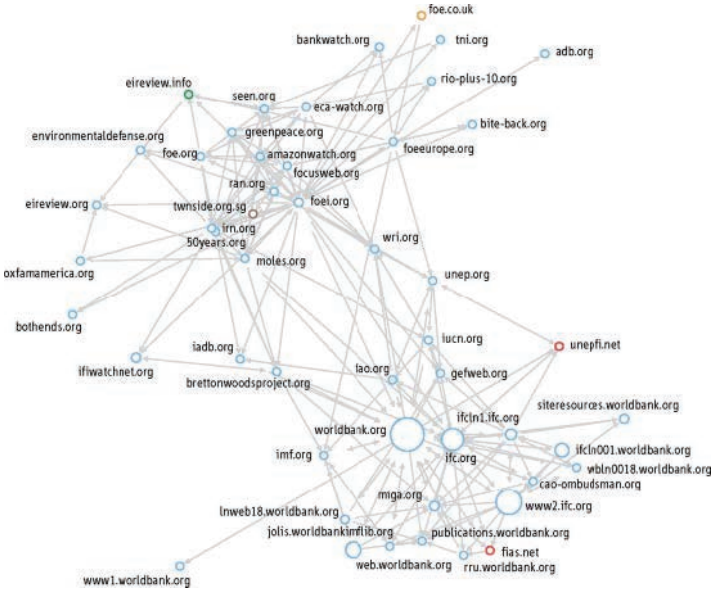

Figure 4: Visualization of the issue-network around the Extractive Industries Review (Marres 2005).

CSA is closely related to WSA, but it differs in that it compares the way objects are given meaning in different spheres on the web rather than demarcating a full set of relevant digital resources or a full issue-network. One CSA study, for instance, compares how the object of a 'sustainable home' is given meaning in the blogosphere with the meaning attached to it in a larger web-sphere. It shows how the discussion in the blogosphere is centred on the home as a space for activity, whereas the discussion on the web is centred on the fact that such homes are often new and purpose-built. CSA occupies a unique position on the horizontal axis because its starting points are determined by querying the information filters that dominate the spheres of interest. The strategy is to 'follow the filters' rather than following relevant organizational websites (Rogers 2009). The blogosphere is, for example, demarcated on the basis of links from the search engine Technorati. This filter comes to function as an 'epistemology engine' in the sense that its logic of organizing and ranking blog-content about sustainable homes is used as the ground for initiating the visualization (Marres *et al*. 2009). Whether or not Technorati returns relevant and reliable websites is not the driving factor. Such a benchmark of relevance is not established before the practice of visualizing. CSA takes one step further down on the vertical axis because the ambition of representation is reduced from representing issue-networks on the web to representing meanings attached to objects in sub-spheres of the web.

A Latent Third Dimension

The proposed function of the web-based visualizations is the basis for a latent third dimension in the typology, which is signified in the form of unbroken and dotted boxes in Figure 1. The unbroken boxes contain visualizations that aim at providing their reader with a basis for taking action in relation to the technological development in question. In SNA and WA this action is thought of in terms of policy-making and technology management. Figure 2, for example, concludes with a suggestion to the

producers of nanotechnology to engage in the debate, and the visualization is meant to help identify effective communication channels. The study of second-generation biofuels similarly aims to provide early warnings about the potential disconnection between sectors in the field, and it identifies technology platforms that can function as potential brokers to remedy this development.

CM is also oriented towards political action, albeit in a more democratic way than the managerial recommendations above. The London 2012 map is constructed as a democratic intervention that enables its readers to grasp the complexity of concerns around the stadium rather than feeding them with facts about it. The online version is interactive in the sense that it allows the user to rewind the composition of the map in time, to zoom in and out between different levels of aggregation, and to see details of the connection between the nodes (Yaneva 2012). The MACOSPOL visualizations are meant to establish a form of 'quasi-parliament' that depicts the arena within which it would be fair to settle the controversy in question (Latour 2011).

The dotted boxes contain visualizations with less action-oriented ambitions. They are produced to allow the viewer to better grasp the way technological controversies are organized on the web and how this organization may indicate something about the social and cultural development around emerging technologies. Figure 4 provides insights into the ways in which processes of issue formation mediate public involvement in politics, and the study of sustainable homes provides its reader with an understanding of the dynamics of mediation that shape the meaning of this object in different web-spheres. The visualizations of WVA and CSA shape the democratic sense of the reader in relation to the way information and knowledge is organized on the web, and they use the logics of the web to learn about the role of issues in democratic politics. However, their ambition is not to directly guide managerial and

democratic action.

The discussion so far has provided a background for the way the reviewed projects were positioned in the typology in Figure 1. Each of them has been introduced as an example of a general analytical approach that serves as the header of the box in which they are mentioned. Figure 1 also contains a punctuated box with the word 'web-vision analysis', which denotes an analytical approach that will be developed in the second part of this paper.

A Framework of 'web-visions'

This section will introduce 'web-vision analysis' (WVA) as an approach that builds upon some of the reviewed approaches while at the same time suggesting distinct ways of constructing, interpreting, and using web-based visualizations. The first subsection concerns the position of WVA on the horizontal axis. Taking its point of departure in the logic with which filters organize information on the web, it has clear roots in CSA, but it suggests approaching these filters as devices that give rise to calculative spaces. It thereby leaves the concept of 'spheres' in a way that has consequences for the way filters are used and interpreted as starting points. The second subsection concerns the vertical axis and it explains how these filters are conceptualized as giving rise to 'visions' that structure the attention of its user. This theoretical move has roots in the part of CM that emphasizes the performativity of descriptions, but it abandons the ambition of creating comprehensive visualizations of full controversies. The third subsection argues for embracing the incomprehensiveness of the visualizations by treating them as cases. The suggestion to use case-study logics as the basis for empirical choices about starting points and software tools in the visualization process is unique for WVA. The three subsections explain the distinct position that WVA occupies in Figure 1.

Information Filters as Distributed Calculative Devices

WVA follows CSA in using web-based information filters to choose the starting points of visualizations. However, it approaches them as devices that give rise to calculative spaces rather than web-spheres. The concept of 'calculative spaces' is taken from economic sociology where spaces are thought of as allowing actors to make distinctions between goods, to decide on common operating principles for establishing relations between them, and ultimately to assign value to them (Callon and Muniesa 2005). Besides providing the conditions for valuating goods, such spaces also include a mechanism that synthesizes acts of valuation into 'orders of worth' by organizing and ranking their importance (Stark 2011).

There are strong parallels between the devices that constitute markets and the filters that are used to choose starting points in WVA. The Google search engine is, for example, used as a starting point below to construct the 'web-visions' in Figure 5 below, and just as market devices assign prices to goods, so is the function of Google rankings to assign visibility and relevance to information in response to specific queries. It creates a 'market of relevance' that depends on a calculative space similar to the one economic sociologists have detected in the market of goods. In order for this market of relevance to organize the debate about any given technology, it needs information about the technology to be divided into clearly demarcated pieces of information expressed on webpages with unique URLs and unique timestamps. This process mirrors the way distinctions are made between goods in economic markets, and it makes each piece of information apt for receiving standardized markers of relevance such as hyperlinks.

It furthermore allows synthesizing mechanisms to generate a search results page that

locates some information in the centre of visibility, while leaving other sources in the dark. Like a market of goods, it gives rise to a calculative space of associations where the web-user is ultimately "[. . .] dependent on lists of ratings and rankings to navigate the uncertainties of finding what's valuable [. . .]" (Stark, 2011). A further similarity to the construction of markets is that this space is assembled by human as well as non-human actors. On the human side, we find web-masters forging hyperlinks and building websites as well as web-users following these links in specific patterns. The non-human side is dominated by the PageRank algorithm, which is the backbone of Google. Both types of actors play a role in organizing the 'market of relevance' that draws boundaries around a given issue.

On the basis of these comparisons to markets of goods, it is decided to define the filters that are relied upon to choose the starting points of WVA as 'delineation devices':

> A delineation device is an entry-point to the web that organizes digital traces left by a distributed set of actors in order to establish a space where information can be divided into detached digital objects to which values of relevance can be assigned.

Different delineation devices lead to different judgments of relevance because they take different acts of valuation into account. WVA is solely focused on the relationship between the calculative characteristics of such devices and the modes of seeing they create. It is strongly inspired by the way proponents of CSA approach devices such as Technorati as 'epistemology engines' and their suggestion to compare the visibilities they offer. However, WVA suggests that detailed analyses of the calculative characteristics of the filters should be a more explicit part of the basis on which they are selected. Technorati may be an entrance to the blogosphere but so is Google Blog Search, and the differences produced by the alternative calculative spaces is the focal

point in WVA. This is different from focusing on the way they serve as entry points for a potential common sphere such as the 'blogosphere'.

'Web-visions' as Structures of Attention

The outcome of a delineation device is the 'web-vision' of the person using it, and it is defined as follows:

> A 'web-vision' is the specific actors, themes, and documents that become visible to a user when entering the web through a specific delineation device at a specific time.

This concept is also inspired by recent developments in economic sociology, where the concept of 'screened visions' is used to denote a situation where some information is revealed to a trader looking for information about stocks on a computer, while other pieces of information are screened away from her view. These visions are argued to be relational in the sense that "the very process of focusing on an object entails *locating* it in a field of other objects" (Prato and Stark 2011). Such a relational screening is central to 'web-visions' that also structure the attention of the reader.

In the specific case of Google, WVA suggests operating with two distinct types of visions. If a user types "synthetic biology" in the search box of Google, it will return a list of URLs that are ranked according to specific criteria of relevance. This list of URLs is the most immediate way in which the device makes this controversy visible and it is therefore conceptualized as the '*myopic vision*' it provides its user with. From this list of URLs, the user can follow a selection of hyperlinks in order to explore the controversy further. Through this exploration, he or she will encounter a specific range of actors, themes, and documents that form a specific narrative. This scope of extended visibility is denoted as the '*hyperopic vision*' of the device.

Whereas the myopic vision is largely an effect of the delineation device, the hyperopic vision is just as much an effect of the way the researcher chooses to operationalize it. The search results page is given by Google but the visual depiction of the hyperopic vision is tied to choices about the software that is set to crawl the hyperlinks. It is a performative description in the sense that is highlighted by Latour, and WVA draws upon this way of thinking in emphasizing the need for a more explicit focus on the software choices behind visualizations than the reviewed approaches have.

Looking at Figure 1, it is clear that approaches at the top of the vertical axis discuss such choices within the tradition of minimizing bias in the ambitions of representing specific social dynamics, and even WSA and CSA seem to suggest that there is a link between the settings of a crawler and the type of network it depicts (Govcom no date). The choice between different default settings in the crawler is motivated by pre-defined notions of network types in the sense that a specific setting is argued to return a 'social network', whereas another setting returns an 'issue network'. This way of connecting settings to network types seems to be in line with the idea that specific starting points (such as Technorati) are connected to specific spheres. There is, in other words, an ambition of representing something already defined. It is similarly in the discussions of software choices that CM exhibits its realist ambitions. For example, we see software tools presented as a means for detecting the partisanship of stakeholders and assigning them a place in a controversy-map that fits their real position (MACOSPOL no date). Rather than building on a priori ideas about, for instance, types of networks and spheres, WVA ultimately suggests tying software choice to a desired mode of seeing. As we will see below, this is done by treating visualizations as cases rather than representations.

Case-Study Logics as the Heart of Visualization

The methodological consequence of moving the characteristics of delineation devices and software tools closer to the heart of the visualization strategy is to ground choices about them in the logic of case selection (Flyvbjerg 2004). Instead of thinking about them as tools for obtaining reliable representations, as tools for achieving 'second-degree objectivity', or as entry points to pre-defined spheres and network-types, they are thought of as giving rise to 'web-visions' with quite specific calculative characteristics. 'Web-visions' are cases that result from deliberate combinations of devices and tools, and the mode of seeing that results from these combinations is the basis of their potential relevance. Specific combinations may, for example, produce visions that are 'least likely' or 'most likely' to make specific aspects of a technological development visible or visions that are 'paradigmatic' in the sense that they depict a common mode of seeing in relation to a specific technology (Flyvbjerg 2004).

An empirical example of how this methodological logic can be used will be given below, but the central argument is that the researcher is left with an arsenal of variables that can be used to manipulate the construction of 'web-visions' in a quasi-experimental fashion. The mode of seeing that a given 'web-vision' produces can, for example, be tweaked by altering the logic of filtering in the delineation device, the country of origin of the device, the language used to query the device, or the settings of the web-crawler used to construct the visualization. These variables are the a priori knowledge from which the visualization starts. The next section will outline the details behind the construction of concrete hyperopic visions in order to make clear how the approach differs from the reviewed approaches in the way it guides empirical choices and interpretation in relation to the practice of visualizing.

'Web-visions' of Synthetic Biology

The 'web-visions' shown in Figure 5 below are parts of a larger longitudinal study that follows 'web-visions' of synthetic biology, which is the latest attempt to bio-engineer organisms with useful functions such as improved photosynthesis in plants. Since The J. Craig Venter Institute succeeded in producing a synthetic cell in May 2010, different actors—among whom Barack Obama is one of the more prominent—have debated the benefits and drawbacks of synthetic biology. The process behind the construction of these 'web-visions' highlights the centrality of delineation devices and software tools in the research design and illustrates how case-study logic can be utilized as a research strategy when producing such visions.

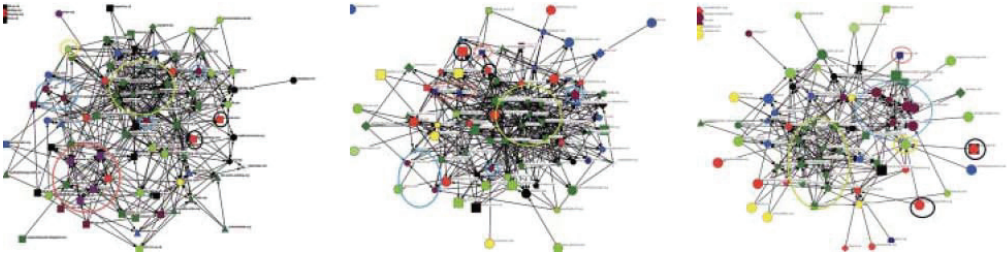

Figure 5: 'Web-visions' of synthetic biology produced by the author in (a) January 2011, (b) April 2011, and (c) June 2011. A larger version of the visualizations and details about the colouring of nodes can be provided by the author.

Delineation Devices as Starting Points

When it comes to starting points, we saw in Figure 1 that many of the reviewed projects take their point of departure in relevant and reliable organizational websites.

WVA delegates this choice to delineation devices, and the 'web-visions' in the longitudinal study are produced having google.co.uk, google.com, wikipedia.com, and google.com/blogsearch as their starting points. The reasons for choosing the specific starting points were grounded in their case-related characteristics.

The first characteristic concerns their status as 'paradigmatic cases' of the kind of entry points to the web that people use in the United Kingdom—a country in which public discussion of biotechnology has a strong history. Because these devices generate paradigmatic visions, they make it possible to reveal the narratives and actors that are made visible to British web-users. The choice of starting points was based on data about web-usage in the UK from alexa.com, and they were queried for the term "synthetic biology" because Google Insights, Blog Pulse, and Wikipedia proved this search term to be more frequently used than similar terms such as "synthetic life" or "constructive biology".

The second reason for choosing them was that each of them has calculative characteristics that make them 'most likely' or 'least likely' cases in relation to a specific research interest in the geography and fluidity of the controversy. The visions produced through google.co.uk are, for example, 'most likely' to make British actors and themes visible in comparison to the other visions. If such actors are not visible in the google.co.uk visions, one may suspect that they are not visible in the other visions either. The visions produced through wikipedia.com are, in a similar fashion, 'least likely' to change rapidly from month to month compared to the other visions because its consensus-based filtering makes it a less fluid calculative space. Fluidity in these visions would therefore be a good indication of a highly active controversy.

After deciding on delineation devices and search terms, the myopic visions of the

chosen delineation devices were operationalized. In Google and Google Blog Search, they were taken to be the top twenty URLs returned in the search results page after depersonalizing the search, and in Wikipedia it was taken to be the URLs listed in the 'external links section'. Despite looking rather simple, the process of creating a myopic vision involves choices about case selection, search terms, and depersonalization that delegate narrative power to a range of software tools. This serves to show that a researcher can 'follow the medium' in many ways. Even though these choices ensure that the 'web-visions' have specific desired case characteristics, they do not in any way ensure that they are representative pictures of the discussion about synthetic biology in the UK, on the web at large, nor in a web-sphere connected to a specific device. The visions are also far from being comprehensive maps of the controversy about synthetic biology. They are only interesting because the choices made in the process of their construction allow for a structured comparison between visions that are manipulated to have distinct characteristics.

Software Tools and the Construction of Modes of Seeing

The hyperopic visions were constructed by crawling the web from the URLs in the myopic visions, and the next crucial decision was therefore to decide how to set the parameters of the software tool when carrying out this crawl. The visions were produced using the Issue Crawler[20] and their construction began by enforcing a structural and a semantic criterion (Marres and Rogers 2005). According to the structural criterion, a URL could only belong to the hyperopic vision if it received more than one link from the other URLs in the vision, and the crawler was therefore programmed to conduct a co-link analysis that discards all URLs receiving less than

[20] http://www.issuecrawler.net/

two inlinks. According to the thematic criterion, a URL could only belong to the hyperopic vision if it actually mentioned the issue of synthetic biology. All the URLs that fell within the boundary of the structural criteria but did not mention synthetic biology were therefore taken out of the visualization.

The application of these criteria determined which URLs became visible in the hyperopic visions depicted in Figure 5. The next choice was how the hyperlink-networks returned from the crawler should be shaped, coloured, and cleaned. It was decided to shape the visualization through a spring-based algorithm that measures distances between nodes and to colour the nodes manually on the basis of categories such as 'geography' and 'organizational types' deemed relevant by the researcher. It was finally decided to 'clean' the visualizations by removing elements that the crawler had 'incorrectly' put in there. For example, there were an enormous number of ties to Creative Commons because most websites use their licence to publish text in a way that is completely unrelated to the controversy about synthetic biology.

The important point is that these choices have huge impacts on the shape of the visualizations, and they inevitably create a specific mode of seeing that guides the attention structure of the person reading the map. By only retaining sites that receive inlinks from at least two seed sites and mention synthetic biology, the structural and semantic criteria narrowed the scope of the hyperopic vision. The networks presented as hyperopic visions are accordingly to be understood as a mode of seeing that reflects well-connected URLs. The main methodological reason for composing the visualizations in this way was, once again, that this narrowing had the consequence of making the visions 'less likely' to be different to each other when compared. Using software choices to make the visualizations as similar as possible allows for more solid interpretations of the differences that become visible *despite* this choice. Again, it

should be emphasized that such choices cannot be defended in terms of representing full controversies, specific types of networks, or specific web-spheres. They are rather to be thought of as strategic menipulations of the visualizations produced.

Interpreting 'Web-visions'

The 'web-visions' in Figure 5 above are three hyperopic visions from the longitudinal study, and even though their visual surface is similar to the visualizations reviewed in the beginning of the paper, it has been explained how the strategy behind their construction is different. They were produced by following google.co.uk in January, April, and June 2011 using the steps described above. The discussion below will illustrate how such 'web-visions' must be interpreted in a way that is tightly coupled to the choices made in the construction process. However, it will only comment briefly on the characteristics of the visualizations, and it will not go into a full qualitative analysis of the assemblages created around synthetic biology. In a full empirical analysis, this would be necessary but it is not mandatory for understanding the logic of the methodological approach.

Of all the 'paradigmatic cases' followed, it was argued that google.co.uk is the calculative space that is 'most likely' to make UK actors and themes visible. The nodes were therefore shaped according to their geographical origin in order to make it possible to focus the attention of the reader on this aspect. When doing that, it becomes clear that the visibility of UK-based websites (square nodes) is highly fluid across the three timeslots. From January to June 2011, the percentage of UK-based sites in the visions dropped from 39.5 to 13.5 per cent, whereas the percentage of US-based sites rose from 33.5 to 66 per cent. These numbers represent a process in which a tight cluster dominated by UK-based funding agencies such as BBSRC, EPSRC, The Wellcome Trust, and MRC slowly disperses. The circles in Figure 5 highlight this

development, and they also illustrate how a cluster of US-based governmental actors, led by The National Center for Biotechnological Information, gains visibility instead.

Accompanying this shift, it is also possible to detect a shift in the visibility of actors that belong to the category of 'Policy advice, social science or public engagement'. Their share of the overall vision rose from 8 per cent in January to 15 per cent in June 2011, and a closer inspection reveals how this rise covers an institutionalization that makes British actors in this category less visible as well. In both January and April 2011, we can see that UK-based designers and artists such as Daisy Ginsberg and James King are central in posing social and ethical questions about synthetic biology through their project called 'Synthetic Aesthetics'. In August they are, however, substituted by actors such as The Hastings Center and the ETC group, both of which have a history of working with social aspects of biotechnology in North America. The darker circles in Figure 5 highlight this shift.

Throughout the sampling period, the development in the 'web-visions' has the consequence that the visions of google.co.uk increasingly become similar to the wikipedia.com visions from January to June (these are not shown, however). As expected, the wikipedia.com visions are quite stable throughout the period. US actors already make up 66 per cent of the vision in January, and The Hastings Center and the ETC Group are visible actors throughout this whole period. The reason for the increasing similarity between the visions generated from the two delineation devices may be that Barack Obama requested The Presidential Commission for the Study of Bioethical Issues to make a report about synthetic biology, which was published in December 2010. The websites that make up the US governmental cluster that we saw gain visibility in the June version of the google.co.uk vision are all mentioned in this report. An effect of their visibility, as well as the institutionalization of the social actors, is that The J. Craig Venter Institute occupies a far more central role in June than

in January 2011(marked in circles in the January and June visions in Figure 5).

If this interpretation is correct, it serves to show that action on the part of big institutionalized American actors has the potential to shape the calculative space generated by google.co.uk quite drastically. A complementary study of a google.co.uk vision with a different search language than English could reveal the extent to which this influence is due to shared semantics. Stability in the German version of Google during the same timeslot would, for example, indicate that the public visions of UK users are influenced by the fact that the British and American language is semantically similar. Such differences would be even more striking if the structural and semantic criteria explained above were enforced because they make the visions less likely to be different.

The details and validity of these findings are, however, not what is of interest in this paper. The important point to make is that these insights are tightly coupled to case-study logics, and that they seem to position WVA as being less action oriented than SNA, WA, and CM in relation to the third dimension of the typology. They are reflections on calculative and mediated spaces. But the research strategy may also enable the WVA to inform political and managerial action in a way that has nothing to do with representation or 'second-degree objectivity'. Taking the visions of Wikipedia, we have, for example, seen that they are very stable over time and continually include a quite institutionalized set of actors. This is a consequence of the fact that the calculative space of Wikipedia is built around consensus. Since the visions based on Wikipedia are 'least likely' to be fluid, it will be a good proxy of a dynamic controversy if the wikipedia.com vision were suddenly very fluid. Such insights could guide a useful monitoring of technological development that is quite different to the approaches reviewed earlier.

Conclusion

This paper started by reviewing influential analytical approaches to constructing web-based visualizations of social dynamics surrounding emerging technologies. It provided a three-dimensional typology along which these approaches were positioned according to the data from which they initiated the visualizations, the ontological status they ascribed to them, and their proposed function. On the basis of this review, this paper developed the framework of WVA (Web-based Visions Analysis). It was highlighted how it draws on the filter-driven organization of information emphasized by CSA (Cross-Sphere Analysis), and on the way CM (Controversy Mapping) puts focus on the performativity of descriptions. The concepts of 'delineation devices', 'calculative spaces', 'myopic visions', and 'hyperopic visions' were, however, introduced in order to position WVA as a distinctive approach that conceptualizes visualizations as socio-technical modes of seeing that are tightly connected to choices about starting points and software in the construction process. WVA was argued to most distinctively differ from the reviewed approaches in suggesting the use of case-study logics as the basis for making empirical choices about startingpoints and software seetings in the process of constructing and interpreting visualizations.

The details of the construction of three 'web-visions' of synthetic biology were then outlined. Using google.co.uk as the starting point, they illustrated how case-study logics can be utilized in a concrete research design. The visions were constructed because they illustrate a specific calculative space that influence the attention of many people in the UK. Google.co.uk was furthermore followed because it is the 'most likely' of the delineation devices used in the UK to resist the American influence described. Its changing shape from January to August 2011, accordingly, provides insight into how the potential 'attention structures' of British web-users are changing over time. Besides generating such media-specific insights, it was also argued that

knowledge about the characteristics of calculative spaces have the potential to inform political and managerial action in a way that has nothing to do with representation or 'second-degree objectivity'. Existence of fluidity in the wikipedia.org vision was, for example, argued to be a good proxy for detecting active controversies because it would normally change slowly due to its consensus orientation. Based on the review, the theoretical discussion, and the empirical insights, it was argued that WVA offers additional and different analytical strategies for constructing and interpreting web-based visualizations of emerging technologies.

Bibliography

Ackland, Robert, Rachel Gibson, Wainer Lusoli, and Stephen Ward. 2010. Engaging with the public? Assessing the online presence and communication practices of the nanotechnology industry. *Social Science Computer Review* 28(4): 443–65.

Callon, Michel and Fabian Muniesa. 2005. Peripheral Vision — Economic Markets as Calculative Collective
Devises. *Organization Studies* 26(8): 1229–1250.

Carusi, Annemaria, Novakovic, Gordana and Webmoor, Timothy. 2010. Are digital picturings representations?
EVA2010 Conference Proceedings. Available at SSRN: http://ssrn.com/ abstract=1929438

Emirbayer, Mustafa. 1997. Manifesto for a relational sociology. *The American Journal of Sociology* 103(2): 281–317.

Flyvbjerg, Bent. 2004. Five misunderstandings about case-study research. *Sosiologisk Tidsskrift* 12(2): 117–42.

Govcom.org. no date. Issuecrawler.net-Scenarios of use for NGOs and other researchers. Accessed November 29th 2011. http://www.govcom.org/scenarios_use.htm Latour, Bruno. 2011. Networks, societies, spheres: Reflections of an actor-network theorist. *International Journal of Communication* 5.0. Available: http://ijoc.org/ojs/index.php/ijoc/article/view/1094/558

Latour, Bruno. 2010a An Attempt at Writing a 'Compositionist Manifesto'. Submitted paper. Accessed May 20, 2011: http://www.bruno-latour.fr/articles/article/120-COMPO-MANIFESTO.pdf.

Latour, Bruno. 2007. Beware, your imagination leaves digital traces. *Times Higher Literary Supplement.* April, 6th. Accessed May 20, 2011: http://www.bruno-latour.fr/sites/default/fi les/P-129-THES-GB.pdf

Latour, Bruno. 2005. Reassembling the social — An introduction to actor-network-theory. Oxford: Oxford University Press.

Latour, Bruno. no date. Bruno Latour on Mapping Controversies. Video. Assessed November 11, 2011: http://mappingcontroversies.net/Home/PlatformMappingControversiesVideoIntroduction MACOSPOL. no date. Macospol Platform. Accessed November 29 2011. http://www. mappingcontroversies.net/Home/PlatformOverview

Marres, Noortje. 2005. No issue, no public: democratic deficits after the displacement of politics. PhD thesis, University of Amsterdam.

Marres, Noortje *et al*. 2009. Sustainable Homes. Controversy-map. Accessed June 15, 2011: http://www. mappingcontroversies.net/Home/PlatformSustainableHomes.

Marres, Noortje and Richard Rogers. 2005. Recipe for tracing the fate of issues and their publics on the web. In *Making things public — Atmospheres of democracy*, edited by Bruno Latour and Peter Weibel, 922–936. Cambridge, MA: MIT Press.

Prato, Matteo and David Stark. 2011. Attention structures and valuation models: Cognitive networks among security analysts. Working Paper Series, Center on Organizational Innovation, Columbia University.

Rogers, Richard. 2004. *Information politics on the web*. Cambridge, MA: MIT Press.

Rogers, Richard. 2009. The end of the virtual: Digital methods.Vossiuspers UvA.

Schneider, S. M. and K. A. Foot. 2005. Web sphere analysis: An approach to studying online action. In *Virtual methods — Issues in social research on the internet*, edited by Christine Hine, 157–171. Oxford: Berg.

Stark, David. 2011. What's Valuable? In *The Worth of Goods: Valuation and Pricing in the Economy*, edited by Patri

Aspers and Jens Beckert. Oxford University Press

Thelwall, Mike. 2009. Introduction to webometrics: Quantitative web research for the social sciences. San Rafael, CA: Morgan & Claypool

Thelwall, Mike *et al*. 2010. Policy-relevant webometrics for individual scientific fields, *Journal of the American Society for Information Science and Technology* 61(7): 1464–1475.

Venturini, Tommaso. 2010. Building on faults: How to represent controversies with digital methods. *Public Understanding of Science*. DOI: 10.1177/0963662510387558.

Yaneva, Albena. 2012. Mapping Controversies in Architecture, Ashgate.

5.2 Reflections on Paper Two

When looking at the overall argument of Paper Two, it is clear that it is, to some extent, a repetition and re-articulation of some of the points that have already been discussed in section 4.2. The two dimensions of the typology in Figure 1, for instance, bear similarities to some of the central analytical findings in Paper One. The dimension that moves between 'objective representation' and 'social-technical modes' of seeing are roughly similar to the two epistemic legitimization-strategies of correspondence and pragmatic coherence in Paper One. The dimension that moves between 'relevance-driven' and 'filter-driven' visualizations furthermore resembles the distinction between 'training' and 'following' in the second analytical continuum of Paper One because it highlights differences in the use of expert categories and a priori knowledge as starting points from which to guide automated analytical software. These similarities are worthy of attention because they confirm the relevance of some of the ideal types discussed in Paper One and they help to re-emphasize that the difference between such ideal types should be seen as continua that specific projects will always slide between. This element of 'sliding' is important to integrate in any analytical framework that proposes to grasp the role that web-based visualizations can play as knowledge devices.

Since Chapter IV has already discussed these general divides and their relation to the concept of 'web-visions', there is, however, no point in repeating these discussions in this subsection. Whereas section 4.2 used the identification of the analytical continua to initiate a discussion between the approach of 'web-vision analysis' and the vocabularies of Anderson, Latour, and Venturini, this section will instead take a closer look at the more fine-grained differences between the framework of 'web-vision analysis' and the approaches that are positioned as being most similar to it in the typology in Paper Two. More specifically, it will provide additional details on the

choices that separate the otherwise related approaches of 'web-sphere analysis', 'cross-sphere analysis', and 'web-vision analysis'. The choice to discuss such differences between closely related approaches is at the same time to take advantage of specific strengths of the research design in Paper Two. It has already been argued in section 5.1 that it is based on a 'most similar' case-study design that is well suited for making micro-differences visible. This section will first show how such differences are useful in relation to teasing out the distinctiveness and relevance of the concept of 'web-visions', and it will end by relating this distinctiveness to the connections between the concept of 'web-visions' and the field of economic sociology.

5.2.1 Micro-Differences Between Web-Sphere Analysis, Cross-Sphere Analysis, and Web-Vision Analysis

This subsection will provide more details on the micro-differences, that Paper Two argues to exist between web-sphere analysis, cross-sphere analysis, and 'web-vision analysis'. The paper discusses these differences quite briefly, but they are worthy of more attention because they can help to bring out the distinctive characteristics of the framework of 'web-vision analysis'. Paper Two indicates that the three approaches exhibit small but important differences on the following three questions: What is a seed-site? What is a link? What is visualization? On a first reading, it seems that the answers to these questions are only of relevance to the specific type of visualization that was in focus in Paper Two—the network-visualization. However, insights into differences in the way the three approaches handle the three questions have a more general relevance in relation to the overall discussion about the characteristics of web-based visualizations in this dissertation. This general relevance is due to the fact that the micro-differences between the three approaches illustrate the relevance of proposing 'web-visions' as a concept that is not just distinct from the vocabularies of

Anderson, Latour and, Venturini (as was argued in section 4.2) but also from those of Rogers and Marres.

In order to carve out these micro-differences, we will start by revisiting the way the approach of web-sphere analysis was argued to handle the three questions in Paper Two. The paper uses Marres's construction of an issue-network that depicts the displacement of the debate about climate change as an exemplification of this approach. Marres's visualization is presented as a disclosure of a network of digital resources that are related to the specific topic of climate change. This ambition of disclosure is central to the approach of web-sphere analysis. In Schneider and Foot's original formulation of the approach, it is explicitly argued that it aims to draw the boundaries of a web-sphere by determining the number of websites that share a specific topical orientation, and it is argued that these sites are most often connected by hyperlinks (Schneider & Foot 2005: 158). Even though Marres does not use the concept of a web-sphere to describe her visualization, it seems useful to think about web-sphere analysis and issue-mapping as closely related approaches to digital methods[21]. This similarity becomes clearer when we look at the way Schneider and Foot and Marres handle the three questions raised above.

In relation to the question about seed sites, it is relevant to note that Schneider and Foot explicitly argue that it is a big advantage if a researcher can predict the types of actors that will contribute to a web-sphere in advance of its emergence (Schneider & Foot 2005: 160-161). For instance, they state that web-spheres around electoral debates are especially promising candidates for conducting web-sphere analysis because such debates tend to revolve around the websites of political parties, candidates, press organizations, and so on. The point is that this predictability makes it possible to

[21] It should be noted that the proposed connection between issue mapping and web-sphere analysis is not just something that is claimed in Paper Two. In fact, the concept of 'web-spheres' is much used in projects connected to the Digital Methods Initiative to which Marres has contributed extensively.

choose seed sites that raise the chances for the researcher to accurately disclose the web-sphere in question. This take on the question of seed sites is also implicit in Marres's choice of using organizational websites that mention the Extractive Industries Review (EIR) as the starting points from which she builds her issue-network on climate change. The EIR, and the organizations discussing it, are deemed central to the debate about climate change and this is the reason why they are used as the websites from which the visualization of the issue-network is built.

Both Schneider and Foot and Marres's arguments indicate that web-spheres and issue-networks can be more accurately disclosed if the researcher has a clear idea about the kind of websites that they will contain. However, they also agree that good starting points are not enough to ensure an accurate disclosure. This brings us to the question about the methodological status of the hyperlink, which is an equally central element in a successful disclosure in both web-sphere analysis and issue mapping. The literature on web-sphere analysis interprets hyperlinks as a cultural inscription that can be used to draw boundaries around topical web-spheres (Schneider & Foot 2005: 157). Speaking of hyperlinks in this way implicitly indicates that they function as translations of a cultural intention on the part of their producer. For instance, this intention could be to mark his or her association with a specific take on a theme of interest. This way of thinking about hyperlinks entails interpreting them as inscriptions that organize a web-sphere by translating specific associative intentions into digital traces that can then be traced by a software agent. Schneider and Foot implicitly argue that the more stable these inscriptions are, the easier it is to use them to disclose a web-sphere in a replicable manner.

When we look at the way Marres used hyperlinks to create the visualization in Figure 4, we can again see important similarities to this way of thinking about their role in digital methods. She also used them as indices of the organization of the issue of climate change on the web. The implicit assumption behind this use was once again

that issue-networks are more accurately disclosed if people use the hyperlink in a way that corresponds with the researcher's interpretation of this specific inscription. To give an example: It is explicitly argued in the documentation behind the Issue Crawler that a network based on co-links (a network that only includes websites that receive a minimum of two inlinks from the seed sites) discloses an issue-network, whereas a network based on single links discloses a social network (Govcom no date; Marres and Rogers 2008; Rogers & Marres 2000). This proposed connection between hyperlink-patterns and network-types reflects an assumption about the existence of different kinds of networks that are disclosed by different types of linking patterns that once again reflect specific associative motivations on the part of the producers leaving them. In order for an issue-network to be an accurate disclosure of a specific theme, it is important that these assumptions are correct. When used as part of a web-sphere analysis the Issue Crawler can only provide telling networks if sources in the network link intelligently—that is, if they actually use hyperlinks to identify issue-alliances (Marres 2012b).[22]

The way web-sphere analysis and issue-mapping propose to answer the questions about seed sites and hyperlinks are closely connected to the way they answer the last question concerning the status of the visualization. Proponents of web-sphere analysis speak of visualizations as more or less accurate depictions of web-spheres that are made through cultural inscriptions such as the hyperlink (Schneider & Foot 2005: 159). A web-sphere is seen as an entity that can be more or less representatively disclosed, even though proponents of web-sphere analysis emphasize that such an accurate disclosure is hard to achieve. Once again it can be can be argued that the project of

[22] This argument is also coherent with the discussion about a potential 'revenge of methods' in section 2.4 In this section it was emphasized that the Issue Crawler was originally constructed with an ambitions of remediating existing methodological critiques of citation analysis that was accused being vulnerable to authority. The Issue Crawler accordingly sought to introduce a substantive measure of relevance into hyperlink analysis that ultimately builds on reconceived relations between hyperlink-patters and network-types.

issue mapping follows the same methodological footsteps as web-sphere analysis. The visualization produced in Figure 4 is presented as disclosing the attachments and associations of organizations involved in the 'public-ization' of the climate-change debate. It retains the ambition to disclose an accurate issue-network on the web, and it is argued that the resulting visualization can be used to make conclusions about the kind of publics that are 'sparked into being' by this network (Marres 2005).

This section has until now provided more detail on the way web-sphere analysis and issue-mapping handle the questions of seed sites, links, and network-visualizations. These details provide a good basis from which to discuss how cross-sphere analysis and 'web-vision analysis' have different takes on these questions. To begin with, it is important to emphasize that there are important differences between web-sphere analysis and cross-sphere analysis even though they are often spoken of as equivalents.[23] However, the two approaches have important differences in the way they approach the questions concerning seed sites, links, and visualizations. It is these differences that justify that cross-sphere analysis is being positioned quite far away from web-sphere analysis and close to 'web-vision analysis' in the typology in Paper Two.

Looking at the horizontal axis of this typology (which is related to choices about seed sites), it is clear that cross-sphere analysis distinguishes itself from web-sphere analysis through a reliance on filter-driven modes of visualization. Whereas the ideal for web-sphere analysis is to start from pre-existing knowledge about relevant websites in relation to a specific topic, it is clear from the analysis in Paper Two that cross-sphere analysis has a more medium-specific starting point. The seed sites are not determined by pre-existing knowledge about central organizations. The pre-existing knowledge

[23] An important reason for the tendency to speak about them as similar approaches is that they are both part of the Digital Methods Initiative discussed in Chapter II, where they are both made sense of through the concepts of 'web-epistemology' and 'online groundedness'.

that lays the foundation for a visualization in cross-sphere analysis is a definition of different types of spheres and the platforms that are taken to be the leading 'ordering devices' in these spheres. Before the visualization work begins, it is agreed that there exists a blogosphere that is ordered by Technorati, a news sphere that is ordered by Google News, a tagosphere that is ordered by Del.icio.us, and so forth. It is these ordering devices and their logic of organizing that are used as the basis for shaping the visualization.

This filter-driven approach to the selection of seed sites is copied by 'web-vision analysis' in the sense that it proposes to start visualizations from different 'delineation devices', such as the national versions of Google. However, the rationale that guides the choice of relevant starting points is different in the two approaches. Whereas the choice of starting points in cross-sphere analysis is based on assumptions about distinctions between spheres and assumptions about specific ordering devices that dominate specific spheres, this is not the case in 'web-vision analysis'. Rather than having any pre-existing assumptions about spheres and the dominance of specific devices, it is simply suggested that the starting points should be chosen on the basis of their case-characteristics. Paper Two argues that this could, for instance, be achieved by looking at whether a specific filter is 'most likely' or 'least likely' to make specific information visible. This way of choosing the starting points for a visualization fits Gibson's idea that the goal is to generate a vision that can detect invariants and anomalies rather than to generate a representative vision. If one knows that the British version of Google usually returns British results, this knowledge can, for instance, be used as an invariance from which to detect anomalies in the 'web-vision' it generates.

When it comes to the question of the status of the link, it is also clear that both cross-sphere analysis and 'web-vision analysis' have different answers than that of web-sphere analysis because they give more agency to the medium and its digital traces in

the production of the visualization. Whereas proponents of web-sphere analysis see hyperlinks as cultural inscriptions, it could be said that cross-sphere analysts suggest interpreting them as natively digital objects that have their own logics and it is accepted that they do not resemble anything outside. This idea is captured in the concept of 'online groundedness' that was introduced in Chapter II as an approach to digital methods that prompts the researcher to 'follow the web'. The hyperlink is interesting because it has 'currency' on the web rather than because it functions as a cultural inscription that mediates intentions of the web-users. This distinction between web-sphere analysis and cross-sphere analysis is, however, quite minor, and both of the approaches refer to the text of Schneider and Foot as their theoretical foundation. When we look at the way 'web-vision analysis' approaches the question of the link, it is, however, clear that it is offering a take on this question that is different to both web-sphere analysis and cross-sphere analysis. It simply conceptualizes traces like the hyperlink as a variable in a quasi-experimental setup that gives agency back to the researcher in the sense that he or she has to choose between several different possible ways of 'following the web'. The last part of Paper Two provided examples of such choices and tied them to an experimental case-study logic that differs from both web-sphere analysis and cross-sphere analysis.

The differences in the way the three approaches answer the questions about seed sites and links are ultimately translated into different answers to the question about what a web-based visualization is. We have already discussed how web-sphere analysis aims at disclosing the network of websites discussing a specific theme, and from the last paragraphs, it can be concluded that the visualizations of cross-sphere analysis and 'web-vision analysis' must each have different aims. The former builds visualizations from assumptions about spheres, ordering devices, and the currency of digital traces. It is explicitly argued that the resulting visualizations are tools for conducting 'source distance analysis', which is focused on the relation between specific ordering devices

and the visibility of specific sources. By comparing the inclusion and exclusion of specific sources through specific devices, it is argued that cross-sphere analysis has the potential to provide insights into the quality of new media as bounded spaces with which to understand the world. 'Web-vision analysis' is finally a suggestion to think about visualizations as experiences of the world that are performed through an experimental setup. This setup is thought of as being geared by the researcher towards detecting specific invariances and understanding the flow of data on the basis of case studies that take their point of departure in these invariances. Paper Two illustrated this through the discussion of 'most likely' and 'least likely' case-study logics, and this aspect will be developed much more in Chapter VI. For now it is enough to conclude that there are important micro-differences between the seemingly related approaches of web-sphere analysis, cross-sphere analysis, and 'web-vision analysis'. These differences have hopefully made the distinct characteristics of the latter visible in a different way than the more general discussion in Chapter IV.

5.2.2 The Relation Between 'Web-Visions' and Economic Sociology.[24]

This subsection will end Chapter V by looking at the relation between the concept of 'web-visions' and writings within the field of economic sociology. It will be emphasized that one of the reasons why the framework of 'web-vision analysis' is positioned as distinct to other approaches to web-based visualization is that it translates specific insights from this field into the field of digital methods. Chapter III and Paper One have already argued that hw the concept of commensuration can be used as a foundation from which to understand relevant aspects of the work that goes into the construction of a web-based visualization. Also, Paper Two has just introduced

[24] I have recently published a paper focused on this relation in the journal Science, Technology & Society. I decided not to include it in the dissertation because it contains some repetitions of points made in this section and because it ended up being a strange fit in the way the dissertation is organized. It is listed as (Madsen 2013a) in the bibliography.

‘calculative spaces’ and ‘screened visions’ as concepts that have their roots in the field of economic sociology, but are nonetheless illustrative of the way ‘web-vision analysis’ suggests thinking about web-based visualizations in a different way than the other approaches mentioned in Paper Two. This makes it necessary to provide a few comments on the connection between the concept of ‘web-visions’ and ideas from the field of economic sociology.

The field of economic sociology is broad and it is naturally not all the work within it that is of relevance to the study of web-based visualizations. But a relevant insight from the field is that a market can only function if there are devices that can render things calculable (Callon & Muniesa 2005) and, as we saw in section 3.4, commensurable. Examples of devices that have been argued to have this potential are reports of security analysts, who influence the way we come to appreciate stocks as something valuable (Beunza & Garud 2007), and credit-scores (such as the FICO score) that are used to assign value to people and organisations in their role as lenders in the USA (Poon 2007). The point to take away from discussions of such devices within economic sociology is that there are lessons to be learned by comparing market devices and ‘web-visions’. The reason for this is that just as the quality of being ‘valuable’ is an outcome of the process of calculation and commensuration that market devices create, so is the quality of being ‘visible’ an outcome of calculation and commensuration related to a specific ‘web-vision’.

The claim is, accordingly, that ‘web-visions’ share important characteristics with market devices. Paper Two even mentioned that theorists within economic sociology have conceptualized stock reports as ‘screened visions’ that structure the attention of stock traders in a way that reveal some information while screening other information from their view (Prato & Stark 2011). An important point to take away from this way of conceptualizing stock reports is that it is the structure of a trader’s attention that

determines the value of a stock and that "[…] the very process of focusing on an object entails *locating* it in a field of other objects". Valuation is accordingly approached as a relational practice and another important point to take away from studies of stock reports is that the practice of locating an object in a field of other objects is to be seen as distributed across human and non-human actors such as social networks, standardized classification schemes, and computer algorithms. If we look back at the theoretical grounding for 'web-visions' that was introduced in Chapter III, it is clear that these arguments about stock reports and valuation mechanisms have close affinities with Cooley's thoughts about the creation of environments of experience and their role in processes of evaluation. One important similarity between the concept of 'web-visions', the concept of 'market devices' and Cooley´s work on 'valuation' is that they share pragmatic roots. This is why 'web-vision analysis' keeps highlighting that specific insights from the study of market devices are very relevant to the study of web-based visualizations as well.

It must also be mentioned that recent writings within the field of economic sociology have theorized about the use of market devices in a way that reflect some of Gibson's points about invariances as well (even though this link is not explicitly made by any writers within economic sociology). The way stock reports structure the attention of traders has, for instance, been argued to be valuable precisely because they allow traders to see and utilize dissonance and variance among stock analysts (Prato & Stark 2011). This point is forcefully made in a recent paper by Beunza and Stark (2012) that illustrates how traders use economic models as pragmatic tools to detect dissonance rather than as tools of representation. They show how traders deliberately use models that are based on opposite assumptions as 'checks and balances' on each other. They call this process 'reflexive modeling', and it is argued to be a way for traders to generate useful dissonance that makes them able to experience the world in a way that is different from the group they are embedded in. Even though the literature on

economic sociology uses the concept of dissonance to make this point, it is clear that the underlying logic is similar to Gibson's logic when he argued that the perceptual system is dynamic and makes sense of the world by establishing invariant structures around which change can be perceived. This is a pragmatic way of seeing that has resonance with the argument concerning 'reflexive modelling'.

This connection to the literature on economic sociology and market devices can be used as another foundation for understanding why the framework of 'web-vision analysis' differs from web-sphere analysis and cross-sphere analysis. It is simply more focused on the pragmatic aspects of both the construction and use of web-based visualizations. This distinctive characteristic of the framework was also indicated in the discussion of the crisis-monitor made by the UN's Global Pulse in section 4.2, where it was argued that the concept of 'web-visions' is better equipped to make the pragmatic balancing acts and the dynamic and distributed character of the visualization process visible than concepts derived from the works of Anderson, Latour and Venturini. From the discussion in this section, it is clear that this pragmatic focus is shared by much work within the field of economic sociology, and that the emphasis that 'web-vision analysis' places on these roots is also something that sets it apart from the frameworks of Rogers, Marres, and Schneider and Foot.

Paper Two is explicit about this connection to economic sociology, but the concepts and vocabularies that it introduces as a consequence of this connection are immature in comparison to the theoretical framework that was introduced in Chapter III. The paper was, as mentioned above, written before I had begun to inquire into the connection to Cooley, Gibson, and Espeland, and this dissertation will therefore continue to work with the insights of Paper Two on the basis of the concepts introduced in Chapter III. What is denoted as a 'delineation-device' in Paper Two is, for instance, better spoken about through Gibson's concept of a 'perceptual system' or Cooley's idea of a

'selection-system'. Contrary to the concept of a delineation-device, these concepts emphasize the distributed character that is inherent in the way attention is structured, and this makes the difference between 'web-visions' and the ordering devices of cross-sphere analysis clearer. What Paper Two refers to as 'calculative spaces' will, in a similar vein, be discussed through the vocabulary of commensuration from now on. The concepts are very similar but the latter allows for talking about different dimensions of the commensuration-process in the way it was discussed in Chapter III. Finally, it must be noted that the proposed distinction between myopic and hyperopic visions should be seen as a starting point for talking about distributed selection because it allows for studying the way some aspects of a 'web-vision' may be influenced by specific selection mechanisms that are not influential in others aspects. It begins to break the concept of 'web-visions' into analytical subunits. This focus on the distribution of the selective system will receive more focus in the discussion around Paper Three to which we will now turn.

Chapter VI: 'Web-Visions' of Synthetic Biology

This chapter is structured around the last of the three papers that make up the empirical contribution of this dissertation. It has already been mentioned that the succession of the papers is organized as a 'funnel' that started with empirical insights into general conditions for constructing web-based visualizations, and it will end here with concrete attempts at producing 'web-visions' as well as extracting insights from them. Paper Three accordingly presents a concrete 'web-vision analysis', and it can be read as an immediate successor to Paper Two, which argued for the distinctiveness of 'web-vision analysis' from other approaches to the construction of web-based visualizations within the social sciences. Paper Two ended with guidelines for the construction of 'web-visions' and Paper Three put these guidelines to work by conducting an empirical analysis of different 'web-visions' of synthetic biology that have been produced by the author from February 2011 to February 2012. In line with the guidelines in Paper Two, it has been a deliberate choice to actively construct these visions in a way that make them relevant empirical tools with which to gain insights into the selection mechanisms that influence the way attention is guided to the issue of synthetic biology on the web. As argued above, this kind of 'web-vision analysis' provides quite a different take on the practice of visualization than more representative approaches.

Accordingly, Paper Three exemplifies the potential for producing web-based visualizations that are not meant to be representative, and it provides a concrete illustration of the types of insights 'web-vision analysis' can (and cannot) provide. The meta-text around Paper Three will mirror that of the other papers. It will be preceded by a short introduction in section 6.1 and followed by a more comprehensive discussion in section 6.2, which will especially focus on two of its findings. The first is that Google's 'web-visions' of synthetic biology are proved to be the result of a

distributed chain of selection mechanisms, and the second is that the temporal extension of the research design makes it possible to pinpoint the role that events play in the process of shaping these visions. These themes of distribution and temporality will be discussed with reference to theoretical concepts introduced in Chapter II and Chapter III.

6.1 Background on Paper Three

Paper Three is entitled 'Of Spheres, Bubbles, & Visions', and it was submitted to the journal 'New Media & Society' in July 2012. In order to engage in the discussions of this journal, it is positioned within a specific literature on Internet studies that discusses the way search engines and other web-based interfaces guide the attention of their users to specific sources of information. More specifically, it discusses the increasingly popular idea that attention is guided by algorithms and that users of, for instance, Google find themselves trapped in 'filter bubbles' created by these algorithms (Pariser 2011). This mono-causal take on attention-guidance was already introduced in section 2.4 and Paper Three argues that 'web-vision analysis' is an alternative framework to make sense of the way people 'see' the world through the web, as it promotes a sensitivity to the distributed character of selection.

Paper Three proves the empirical relevance of this theoretical framework through a longitudinal and experimental study where different 'web-visions' were constructed and compared from February 2011 to February 2012. The details of these visions are explained in detail in the paper, but on a general note, it can be said that they were constructed to simulate the way the British public see the issue of synthetic biology through Google. It uses an experimental design to argue for the empirical relevance of

distinguishing between different types of 'web-visions' that are each influenced by different selection mechanisms. Even though the paper does not explicitly mention Cooley, Gibson, or Espeland, it will be argued in section 6.2 that its findings provide new arguments for the relevance of their thoughts to the field of digital methods. However, it has already been mentioned that Paper Three is quite narrowly positioned within Internet studies, and before we get to the paper, a little more background is required to shed light on why a study of Google´s 'web-visions' of synthetic biology is relevant to the more general discussion in this dissertation as well.

Section 6.2 will provide a detailed discussion of the more general lessons to be learned from the findings of Paper Three, and it will argue that insights into the 'web-visions' of Google can serve as a useful starting point from which to theorize about the characteristics of other 'web-visions' as well. The reason given to back this claim is that Google's position in the field of search is a central inspiration behind many contemporary attempts at producing web-based visualizations outside the field of search. The philosophy, on the basis of which Google's interface has become a trusted source of knowledge, as well as the way it has taken over central functions from information professionals such as librarians and journalists, has simply travelled outside the confines of search (Vaidhyanathan 2011; Halavais 2008). This makes the task of studying the distributed set of selection mechanisms involved in Google's 'web-visions' of broader relevance than that of Internet studies. Not because the influence of specific selection mechanisms on Google´s 'web-visions' can be directly translated to other types of 'web-visions', but because they provide an antidote against giving too much agency to algorithms in the process of constructing and interpreting web-based visualizations. The choice of looking at Google´s 'web-visions' and discussing the role of the algorithm furthermore positions the paper alongside recent studies within STS that are signaling a need for new vocabularies through which to

understand the role of algorithms in modern knowledge-society (see for instance Ziewitz 2011 & Gillespie forthcoming).

The second relevant question to ask is then why Paper Three studies 'web-visions' of synthetic biology. Synthetic biology was chosen as the issue to follow because its meaning and boundaries are undecided and controversial, and because the discussion about these meanings and boundaries engaged a range of different actors on the web when the research design was settled in February 2011. The Presidential Commission for the Study of Bioethical Issues had just delivered a report that made a favourable cost-benefit analysis of its potentials (The Presidential Commission for the Study of Bioethical Issues 2010) and environmental NGO's such as the ETC group were active in countering the conclusions of this report by emphasizing the uncertainty and potential injustice regarding who gets access to these potential benefits (The ETC Group 2007). Synthetic biology was, and still is, the most recent example of the kind of genetic engineering of biological organisms that has previously ignited wide-ranging controversy, and the broad engagement in the battle to define this technology made it an interesting issue to be used as the basis for a 'web-vision analysis'.

If we dig a little deeper into the specific characteristics of this battle, it can be said that synthetic biology is promoted by the scientific community as a way to optimize the evolutionary process in biological organisms and make them perform specifically desired functions. This has, for instance, been done by decoding the genome of an organism, translating it into digital codes on a computer, recoding it digitally, and using the resulting line of code to make synthetic DNA-structures that can be inserted into otherwise empty cells. The hope is that such modified cells will be able to produce specifically desired proteins and that they can be used as building blocks for the construction of useful living organisms such as plants with efficient photosynthesis and algae that function as biofuels (The Presidential Commission for the Study of

Bioethical Issues 2010). Around February 2011, this dream was heavily debated in the media because The J. Craig Venter Institute had just succeeded in creating the world's first synthetic and self-replicating bacterial cell. Even though its genome was minimal, it was seen as a milestone for synthetic biology by many commentators.

The fact that a microscopic cell could create such a fuss serves to indicate that synthetic biology was in its infancy at the time when the research design was settled, and it is still a flexible technology in relation to the way it is interpreted by society. There are no products made on the basis of this technology, and there are even crucial differences in the way it is defined by practitioners within the scientific community. Synthetic biology was chosen as the case to follow because the undecidedness about its meaning and boundaries made it possible for the constructed 'web-visions' to perform these meanings and boundaries in different ways. It provided an interesting case for analysing the epistemic characteristics of the web as a space where people can encounter different views about science (Weingart 1998) and where diverse actors and selection mechanisms interact in shaping the social situation around this encounter (Hjarvard 2008). Besides that synthetic biology has also recently been a topic of increasing interest within the field of STS, where the dissertation has already been argued to belong (see for instance Davies et al. forthcoming)

The choice to follow the issue of synthetic biology is an example of the way 'web-vision analysis' suggests building visualizations on the basis of known cases. Paper Three takes advantage of pre-given knowledge about the undecidedness of the issue of synthetic biology, and it uses it to generate empirical insights into the selection mechanisms that influence Google's 'web-visions' around this issue. Papee Three simply uses the flexibility of the issue to make an empirical argument for the relevance of breaking the concept of ' web-visions' into theoretical distinctions such as that between myopic and hyperopic visions discussed at the end of Paper Two. The

findings of Paper Three suggest that this distinction is important in understanding how the attention of Google's users is guided in relation to the issue of synthetic biology. It illustrates how different selection mechanisms are influential in the way the two types of visions guide attention to this specific issue.

However, the flexibility and undecidedness of the issue of synthetic biology is not the only 'variable' that the insights into the selection-mechanisms that shape Google´s web-visions are based upon. In line with the argument in section 5.2, the whole research design of Paper Three is based on pre-existing knowledge about different elements in the selection chains that are used to produce the visions. An example of this is the way changes in the choice of search terms are used as a variable to generate insights into the role that semantics play as a selection mechanism in Google´s 'web-visions'. In short, the paper showcases how 'web-vision analysis' experimentally isolates and disentangles effects from different selection mechanisms and uses this as a basis for learning. Such disentangling is, of course, always only possible to a certain extent, but the paper generates relevant findings through its experimental method that would not be generated through the other approaches discussed above. Section 6.2 will dig deeper into this argument, but before doing that, it is time to turn to the paper itself.

Paper Three:

Of Spheres, Bubbles, & Visions

Anders Koed Madsen
Department of Organization, Copenhagen Business School
Mail: akm.ioa@cbs.dk

[Currently in the second round of peer review in 'New Media & Society' where it has been quite substantially altered]

Abstract

Google's success in repurposing digital traces as indications of people's information preferences has recently inspired a diverse set of organizations to guide their attention to the social world on the basis of a similar strategy. The development of a theoretical framework that allows for understanding the selection mechanisms involved in Google's guidance of their users attention will therefore be a useful starting point for understanding the selection mechanisms involved in this development as well. The dominant literature argues that Google's algorithm provides its users with biased 'filter bubbles' in which information about the world is tailored to their preferences. This paper questions the idea of the algorithm as the decisive selection mechanism by illustrating how selection mechanisms such as national differences in semantics, the power of synonyms, and the coherence of distinctive thematic clusters of websites are influential in performing the world as well. The analytical framework of 'web-vision analysis' is proposed as a method to capture the influence of such distributed and socio-technical selection chains. This framework requires the analyst to supplement an empirical interest in Google's results pages (called myopic visions) with an interest in the information that these top-ranked URLs guide attention to (called hyperopic visions). The framework of 'web-vision analysis' is finally argued to be useful in order to understand the range of organizational visualizations that are currently modelled on the success of Google's methods.

Keywords

Filter bubble, web-vision, synthetic biology, Google, performativity

Introduction:

Web-users are constantly leaving behind behavioural traces in the form of, for instance, hyperlinks, tags, and tweets, and such traces are increasingly repurposed as empirical data by organizations interested in understanding changing social dynamics. Analysis of hyperlink networks and tag clouds are, for example, proposed as new empirical foundations for doing developmental work in the United Nations (Global Pulse 2011; 2011a; 2011b), and the use of such visualizations are argued to become central devices of empirical social analysis in the so-called 'terabyte age' (Anderson 2008). The organizational recognition of the relevance of this kind of data mining follows a decade where people have proved to be receptive to the idea that patterns in digital traces can be a trustworthy guide of their social attention. This tendency has been most clearly manifested in the broad acceptance of Google's reliance on hyperlink patterns as the empirical ground for ranking the relevance of web pages (Vaidhyanathan 2011). Google has suggested the potential in repurposing digital traces as legitimate signifiers of social preferences, and their success has made their strategy of information filtering travel to organizations that hope to transfer the power of data mining to other purposes than search. In order to understand the changes that the practice of social analysis is currently undergoing in these organizations, it is therefore productive to start by establishing a theoretical framework that enables an understanding of the selection mechanisms that influence the way Google repurposes digital traces to guide the attention of their users.

An influential approach to building such a framework has been to conceptualize Google's search engine results page (SERP) as a 'filter bubble' within which users find information that is tailored to their taste by Google's personalized algorithm (Pariser 2011). The SERP is argued to be a place where the influence of the user ends and the personalized technology begins to shape his or her attention. The SERP is seen as the

main empirical object of interest because it is argued to mark the place where the technological filter manifests itself in a bubble that restricts and directs the attention of the users. Other frameworks, however, broaden the theoretical focus beyond the algorithm when it comes to understanding the selection mechanisms that go into such attention guidance. One example is the suggestion to see Google as giving rise to 'web-visions' that perform the world on the basis of a distributed chain of socio-technical selection mechanisms (Madsen 2012). The personalized algorithm is only part of this chain, and this makes it impossible to conceptualize the SERP as *the* place where the technology takes over from the user. The argument is that the influence of the social and the technical cannot be separated in the way suggested by the concept of the 'filter bubble' and that the locus of selection needs to be conceived in a broader manner.

This paper provides a set of empirical analyses that support seeing Google as performing 'web-visions' rather than giving rise to filter bubbles. These analyses are based on an experimental design that compares the way different chains of selection mechanisms related to Google´s web-vision of synthetic biology guide the attention of their users in different ways from February 2011 to February 2012. This experimental comparison illustrates that the personalized algorithm is not the most influential selection mechanism. Mechanisms such as the semantics of search, the perceived relevance of specific publications by central websites, and the cohesion of specific thematic clusters of websites that communicate about synthetic biology in the face of big events are shown to be more important in shaping Google´s 'web-visions' of synthetic biology.

An important argument against the concept of the filter bubble is that the effects of these distributed selection mechanisms are invisible if one takes the SERP as the main empirical object of study. They are only visible if one looks at the networks of websites that become visible when following links from the SERP. This difference is

captured by talking about the SERP as the 'myopic vision' and the subsequent guidance by links as the 'hyperopic vision' of the user of Google. By highlighting differences in the way these two types of visions guide attention to the issue of synthetic biology throughout a year, the paper establishes an empirical argument for the necessity of working with a theoretical distinction between them. This involves leaving the focus on the SERP and the algorithm as the only interesting objects of analysis. The insights into the distribution of selection mechanisms involved in creating 'web-visions' is finally argued to be a useful starting point from which to conceptualize broader changes in the practice of social analysis within a broader set og organizations as well.

Repurposing the Digital – Performing the Social

Let us start by looking more closely at the proposed relation between Google's philosophy of search and recent organizational attempts at introducing new methods for understanding their social environment. Google's position as leader of the search engine market was established in the late 1990's when Sergey Brin and Larry Page proposed to repurpose hyperlinks as a foundation for organizing information on the web (Brin and Page 1998). Whereas competitors such as Yahoo relied on human editors, Google looked to the characteristics of hyperlink networks to determine the relevance of websites. By treating hyperlinks as votes for websites, Google developed a semi-automated system that assigned relevance to websites in a way that was faster and simpler than competing approaches (Battelle 2006). This unexpected success has made Google's reliance on the intelligence of digital traces trendsetting in relation to handling information on the web. In the most optimistic accounts, it has even been argued that Google's success proves that social behaviours and preferences are better understood by harnessing digital traces than through social scientific theories (Anderson 2008). This movement reflects an extreme empiricism, and the possibility

of grounding social analysis in real time empirical indicators that can scale with the data is attractive in an age where organizations deal with terabytes of information about the environment in which they operate.

This possibility has recently made a range of organizations interested in developing software tools that can help them harness digital traces and turn them into depictions of social dynamics and preferences. One example of this is the way the United Nations aims to detect moments of crisis-related stress by visualizing semantic patterns in tweets (Global Pulse 2011). The UN is experimenting with the idea of using such traces as signifiers of relevant social dynamics in a world of massive information streams. The resulting depictions perform the world of crisis-related stress in ways that are similar to the way Google performs a world of information relevance. Whereas Google repurposes patterns in hyperlinks to rank websites according to their relevance in relation to a specific query, the UN repurposes tweets to detect anomalies in the sentiment around economic reforms. A theoretical framework that allows for conceptualizing the selection mechanisms involved in Google's performance of the world is therefore a productive starting point from which to understand the selection mechanisms involved in the production of the kind of digital depictions that are currently used as analytical devices in other organizations. This paper will present an empirical study that provides arguments for grounding such a framework in the concept of 'web-visions', but it will first discuss the difference between understanding Google's guidance of social attention through this concept and understanding it on the basis of the concept of filter bubbles.

From Filter Bubbles to 'web-visions'

The suggestion to conceptualize Google's users as navigating inside a filter bubble is grounded in the recent choice of the company to give search history and search location more weight when determining the relevance of websites to the person doing the search. The concept of the filter bubble is introduced to emphasize that users of Google live in an information-rich universe where they meet information that is tailored to their personal interests, as they are interpreted by Google's algorithm (Pariser 2011). This algorithm is presented as the central selection mechanism in the creation of a filter bubble, and its effects are studied by looking at the SERP that is returned to the user on the basis of a search query. The underlying ontological assumption behind the concept of the filter bubble is accordingly that the user, the algorithm, and reality are distinct entities and that the algorithm is the mediating device between the other two. It is argued to sit between the user and reality in the same way as a camera lens sits between the photographer and his motive. Google's interface is, accordingly, seen as a filter that can represent the world in a more or less distorted way, and it is ultimately conceptualized as the place where "[…] the [users] end and the technology begins" (Pariser 2011: 13). This makes the interface and the SERP the relevant empirical objects of study if one wants to study filter bubbles.

The theory of the filter bubble is furthermore grounded in an important normative assumption. This is that the democratic value of a bubble can be accessed on the basis of whether or not it hides important parts of the web from the user. Because it is a highly personalized filter, the bubble is argued to run the risk of creating 'echo chambers' that conflict with the dream of a common civic space in which people engage with information that falls outside their comfort zone (Sunstein 2006; Pariser 2011). This way of thinking about the web as a common sphere is not foreign to Internet research (Gerhards and Schaefer 2010; Van Os et al. 2007). The concept of a

'web-sphere' has, for instance, been coined to denote the idea that there will always be a certain limited group of websites that are discussing a specific event or issue (Schneider and Foot 2005). This is the web-sphere around that specific event, and because it is limited, it can be depicted in a more or less representative way. The notion of a filter bubble works in tandem with the idea of such a sphere in the sense that it sees the bubble as providing a certain sample of such a sphere. The extent to which this sample is representative is simply the normative benchmark against which the democratic value of filter bubbles is judged.

An alternative to conceptualizing Google's performance of the world as an algorithmically produced bubble is conceptualizing it as a 'web-vision' (Madsen 2012). Grounded in the work of Actor-Network Theory (ANT), this concept emphasizes that any analytical device performs the world on the basis of a distributed socio-technical network (Latour 1991; Callon 1986). In the case of Google, this entails moving away from seeing its users as navigating bubbles created by a personalized algorithm to focusing on the distributed network of selection mechanisms that in combination guide the attention of the user (Latour 2005). Everything that affects its composition is seen as an active part of the selection chain that performs it, and the fact that this chain is distributed across different actors makes it unproductive to think about the SERP as an empirical site where the influence of the users end and the technology begins. The unit of analysis is rather the distributed socio-technical network and its effects on the attention span of the user. In the case of Google, this effect is the composition of a web-vision where some sources of information are assigned visibility in relation to a specific query.

'Web-vision analysis', accordingly, suggests seeing the algorithm as one among many selection mechanisms and the SERP as one among many empirical sites where the performance of the distributed selection chain is manifested. However, it

acknowledges that the SERP is an essential part of the web-vision of a Google-user. It is the first performance of the world that he or she meets, and it is therefore denoted as the 'myopic vision' of the device (Madsen 2012). The shape of this myopic vision is closely related to the interface of Google and its algorithm. This also means that a methodological choice to discuss the web-vision of Google based on the myopic vision runs the risk of over-emphasizing the importance of the interface and the related algorithm. One simply risks overlooking the influence of selection mechanisms that affect the attention of Google's users but are invisible if one were solely looking at the SERP. The introduction of the notion of a 'hyperopic vision' meets this methodological challenge by initiating an empirical investigation of the world that meets the user who follows hyperlinks from the pages in the SERP (Madsen 2012). Following such links is an essential element of seeing the world through Google, but the shape of this hyperopic vision is shaped by a network of distributed actors rather than just by the interface of Google and its algorithm.

Operationalizing Myopic and Hyperopic visions

The research design of the study in this paper was built to test the empirical relevance of this theoretical distinction. More specifically, it was constructed to answer the questions of whether there is indeed a difference between the myopic and hyperopic vision of Google-users, and whether it is possible to pinpoint differences in the selection mechanisms that shape these visions. In order to conduct this empirical test, it was necessary to find a way to operationalize the two distinct visions, and the first choice in doing so was to select an issue that could serve as the empirical case for comparing them. The issue chosen was the scientific practice of synthetic biology, which can be characterized as the latest attempt at utilizing human engineering to optimize evolutionary processes in biological organisms in order to make them achieve

desired functions. By inserting synthetic DNA structures into empty cells, synthetic biologists hope to build useful organisms such as plants with efficient photosynthesis (The Presidential Commission for the Study of Bioethical Issues 2010). As a scientific practice, it has been met with hopes and fears since its introduction, and the controversies surrounding it became tangible when the J. Craig Venter Institute succeeded in creating the world's first synthetic cell in 2010. Even though the genome of the cell was minimal, it fuelled discussions about the scope of the practice of synthetic biology and its goals. The fact that synthetic biology is a flexible practice that has yet to present hard scientific results makes it a good case for testing how the different types of 'web-visions' perform its boundaries and meaning.

After having settled on the issue, the second step of the analysis was to conduct a pilot study that could indicate the extent to which Google's personalization algorithm had an influence on the myopic vision of Google (the SERP). The study was carried out by getting forty-six people with different backgrounds, at different times, and in different locations to search for "synthetic biology" through the American version of Google's interface (google.com). The participants were found through calls for participation on mailing lists such as 'Association of Internet Researchers' and through the creation of a Facebook event. Each participant was asked to set their search preferences to twenty results per page and return the top-twenty URLs of their search in a word document together with information about the date, time, country, and city in which the search was carried out. This data was analysed for relationships between the search ranks and the reported contexts of the search, and the results showed only minor differences between the different searches. This suggests that the effect of personalization is not very influential when it comes to the issue of synthetic biology. Put differently, people´s filter bubbles are very much alike on this issue.

On the basis of these pilot results, the third step in the research design aimed at detecting the influence of non-personalized selection mechanisms on both the myopic visions of synthetic biology and the hyperopic visions they give rise to. The ability to detect this influence was ensured through an experimental and comparative design that analysed the way 'web-visions' based on different chains of selection mechanisms related to Google guided the attention of the web-users interested in the issues of synthetic biology every second month from February 2011 to February 2012. In order to experimentally isolate the effects of the distinct mechanisms in the different chains, it was decided to select one 'web-vision' as a baseline against which the other 'web-visions' could be compared. This baseline ended up being the web-vision that resulted from searching the British version of Google (google.co.uk) for "synthetic biology" from a computer in London and following the links that the SERP made visible. The rest of the research design consisted of the production of 'web-visions' that were then to be compared with this baseline. Each of these other visions had one element of the chain of selection mechanisms altered in comparison to the baseline. This allowed for focusing on the influence of this specific selection mechanism on both the myopic and hyperopic visions emerging from them. Figure 1 shows the details of this comparative design, and each box, triangle, circle etc. should be read as representing the construction of both a myopic and a hyperopic vision.

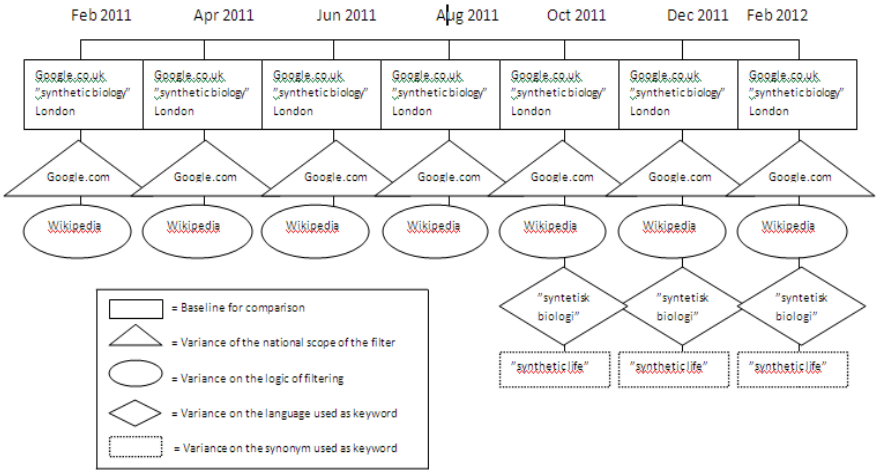

Figure 1: Details of the comparative research design.

The 'web-visions' of the baseline are marked by rectangular boxes, and the shape of the rest of the symbols indicates the selection mechanism altered in order for the comparison to show interesting differences. The triangles in the second row represent visions that are produced by searching the American version of Google (google.com) instead of the British (google.co.uk). This was done in order to detect the impact of the national scope of the filter. The circles in the third row represent 'web-visions' that are produced by browsing the issue of synthetic biology through Wikipedia rather than Google. Since Wikipedia has a different logic of selection than Google, this indicates differences between Wikipedia's bot-controlled and consensus-based filtering (Niederer & Van Dijck 2010) and Google's statistical and crowd-sourced filtering. The last two rows are focused on the semantics of search by altering the query term used. The diamonds in the fourth row represent visions that use the Danish translation of synthetic biology ("syntetisk biologi") in order to detect the influence of national semantics on the 'web-visions', and the punctuated boxes in the fifth row represent

visions that use the search term of "synthetic life", which is the most popular synonym to synthetic biology according to Google search trends. It can accordingly help to indicate the influence of synonyms on the 'web-visions'. The five rows represent an experimental research design where the influence of specific non-personalized selection mechanisms on the shape of the myopic and hyperopic visions can be studied.

Each box in Figure 1 is meant to indicate the empirical production of a myopic vision as well as a hyperopic vision. The myopic vision was operationalized as the top-twenty URLs visible in the SERP after the search results had been depersonalized by adding "&pws=0"[25] to the search URL.[26] The hyperopic visions were then operationalized through the use of the Issue Crawler[27], which is a server-side software that crawls specified sites and captures their outlinks. It was set to follow hyperlinks from all twenty URLs that were visible in the myopic visions in order to visualize the network of webpages that would become visible to a web-user browsing the web from this starting point. The crawler was set at a depth of two, which means that the webpages linked to by this second layer were included in the hyperopic vision as well. The resulting pool of websites was hereafter 'cleaned' in three ways to ensure that the pages included in the hyperopic visions were relevant in relation to the issue of synthetic biology. Items excluded were pages receiving less than two inlinks from the other sites; pages that had never mentioned synthetic biology; and irrelevant links, such as the ones that almost all websites make, that link to the licenses of Creative

[25] Thiss addition to the URL simply removed personalization issues related to, for instance, the history of the browser. It, however, does not have effects in the influence of the location. See, for instance, http://www.briangardner.com/disable-google-personal-search/

[26] Since Wikipedia does not have a SERP, the myopic vision was here operationalized as the external links in the bottom of the article. These links are not under the influence of personalization.

[27] The crawler can be found at https://www.issuecrawler.net/. For a discussion of the way it was originally produced to remediate existing methodological critiques of citation analysis turn to section 2.4 of this dissertation. From reading this section it will be clear that the crawler is here used in a different way than originally intended.

Commons and Flash-players.[28] This 'cleaning' made the hyperopic visions less likely to differ on grounds that had nothing to do with the issue of synthetic biology[29].

The visualization of the hyperopic visions were constructed by importing the remaining pages into UCI net[30]. This made it possible to draw a network that positioned sites with many shared links close to each other through the use of a spring-embedded graph (Borgatti et al. 2002). The hyperopic visions are accordingly operationalized as networks of interlinked websites, and the nodes in these networks were finally coloured, shaped, and sized on the basis of the parameters outlined in the table below. These parameters were deliberately kept simple and they are to some extent under-theorized. A distinction between websites engaged in 'public engagement, social science or ethics' and websites engaged in creating 'natural science networks' is, for instance, very crude and heuristic. However, they are chosen because they reflect the way the websites describe themselves, and they allow for colouring the networks in a way that indicates relevant differences in relation to the way the world of synthetic biology is performed by the different hyperopic visions. The parameters of 'newness', 'website type', and 'website geography' will also be used in the analysis of the myopic visions, whereas the parameters of 'SERP-relatedness' and 'network characteristics' are only relevant in relation to the hyperopic visions. The colours, shapes, and sizes that indicate the specific values of these parameters will be explained in the analysis when relevant.

[28] If the links to Creative Commons, on the other hand, had to do with the issue of e.g. "open source biology" they were kept in the visualization.
[29] The choice to clean the final visualizations in this way involves quite a heavy manipulation from the researcher and section 6.2.2 below will discuss this choice in more detail by relating it to recent discussions about the logic of experimentation within STS.
[30] www.analytictech.com/**ucinet**/

Parameter	Explanation of the parameter	Categorization as the basis for coloring, shaping and sizing
Newness	Illustrates whether a URL is new compared to the previous month in order to detect fluidity in the visions.	"New", "Re-occuring"
Website type	Illustrates the type of actor the URL represents in order to detect the kind of actors dominating the issue and the kind of actors that are connected to each other.	"News/Magazines", "Public engagement, social science or ethics", "Natural science networks", "Natural science labs", "Commercial", "Governmental", "Science Blogs", "Funding"
Website geography	Illustrates the geographical origin of the URLs in order to geo-locate the issue.	"USA", "United Kingdom", "Global", "Other Europe", "Other World"
SERP-relatedness	Illustrates whether a URL is also present in the myopic vision in order to detect the centrality of the SERP web-sites in the visions.	"Present", "non-present"
Network characteristics	Illustrates the extent to which the URLs are organized in clusters, whether these clusters have specific characteristics and whether there are URLs that serve as brokers between clusters. This is done in order to detect the polarization of the visions.	"Betweenness centrality", "Indegree centrality", "Egonetworks"

Table 1: Parameters used for comparing central characteristics of 'web-visions'.

Performing Synthetic Biology Through Distributed Selection

It has already been argued that the pilot study indicated that personalization plays a minor role in shaping the myopic vision of Google in relation to the issue of synthetic biology. The research design outlined in Figure 1 was initiated from this finding. It was specifically designed to identify non-personalized mechanisms that could potentially play a role in shaping these myopic visions as well as the hyperopic visions resulting

from them. The first subsection below contains a comparison between the myopic and hyperopic visions of the British baseline throughout the year of data collection, whereas the subsequent sections concern the differences between the 'web-visions' of the British baseline and the 'web-visions' in rows two to five in Figure 1.

The Baseline Vision and the Empirical Relevance of the Myopic/Hyperopic Distinction

The baseline of the comparative analysis is the 'web-visions' that emerge from querying the British version of Google for "synthetic biology" from a computer in London. This was done every second month from February 2011 to February 2012, and each month includes the production of both a myopic and a hyperopic vision. Each of these visions include a certain number of websites, and some of these are new compared to the 'web-vision' of the previous month. The number of websites in a web-vision is here denoted as its 'scope' and the percentage of newcomers is denoted as its 'fluidity'. The first analytical task in exploring whether myopic and hyperopic visions are productively seen as different empirical sites of analysis that are influenced by different selection mechanisms is to conduct a comparison of their scope and fluidity from February 2011 to February 2012.

Google UK	Feb 11	Apr	June	Aug	Oct	Dec	Feb 12
Scope – myopic vision	20	20	20	20	20	20	20
Fluidity – myopic vision	-	20%	15%	10%	20%	30%	35%
Scope – hyperopic vision	82	82	68	85	85	95	76
Fluidity – hyperopic vision	-	39%	34%	27%	36%	48%	42%

Table 2[31]: Scope and fluidity in the 'web-visions' of the British baseline.

Due to their operationalization as the first twenty websites in the SERP, it is not surprising that the myopic visions remain constant in scope. However, the hyperopic visions they give rise to do change in scope. The hyperopic vision of June 2011, for instance, makes sixty-eight sites visible, whereas the hyperopic vision of December 2011 makes ninety-five sites visible. We know from the operationalization that the hyperopic visions are built on the basis of the myopic visions, and their change in scope is therefore somewhat explained by the fact that each myopic vision exchanges between 10-35% of their websites every second month. When a myopic vision includes websites that were not visible in the previous months, it is clear that these new websites will also contain links to new sites that discuss the topic of synthetic biology. This will inevitably affect both the scope and fluidity of the hyperopic visions. Even though the fluidity of the hyperopic visions is larger than the fluidity of the myopic

[31] It has been decided not to analyze the data through the use of 'proper' statistical tools such as variance analyses and p-values to detect the significance of the differences between 'web-vision' in different months. The analysis in this paper will only use very simple descriptive statistics and there are two main reasons for this choice. First, the data is not a sample and the way it is generated would make it hard to interpret what measures such as a high p-value would mean for the findings. Secondly, other works within the field of digital method limit their analysis to descriptive statistics. This is, for instance, the case with all the works of the Digital Methods Initiative and the MACOSPOL project. The analysis is in that way following the standards in the field.

visions, it is quite clear from Table 2 that they are in what could be called a 'synchronized flux'. When fluidity is low in one, it is also low in the other. This synchronization could indicate that the hyperopic visions are nothing but 'enlarged mirrors' of the myopic visions. If this were the case, it would be less relevant to conceptualize them as different empirical sites of analysis because one could then infer knowledge about the characteristics of the hyperopic visions by looking at changes in the myopic visions. But Figures 2 to 5 below question this hypothesis of hyperopic visions as 'enlarged mirrors'. They do this by showing that there are more fundamental dissimilarities between the myopic and the hyperopic visions when they are analysed on the basis of the categories in Table 1.

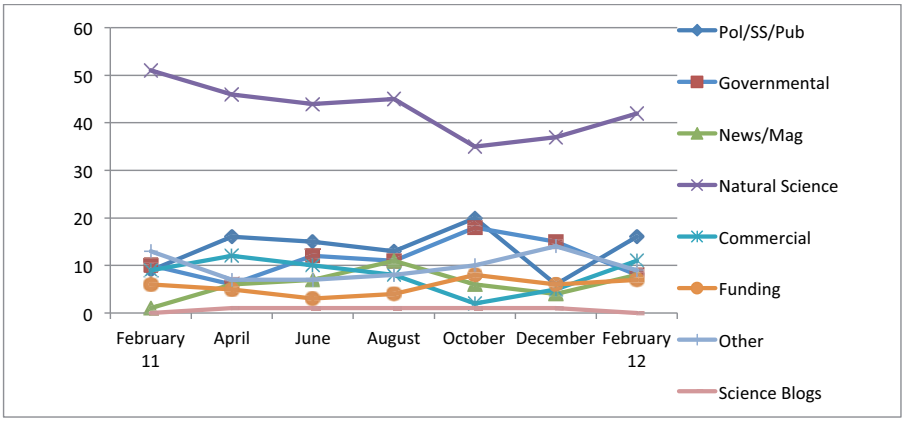

Figure 2: Percentage of website-types in relation to the total number of websites in the hyperopic visions of the British baseline.

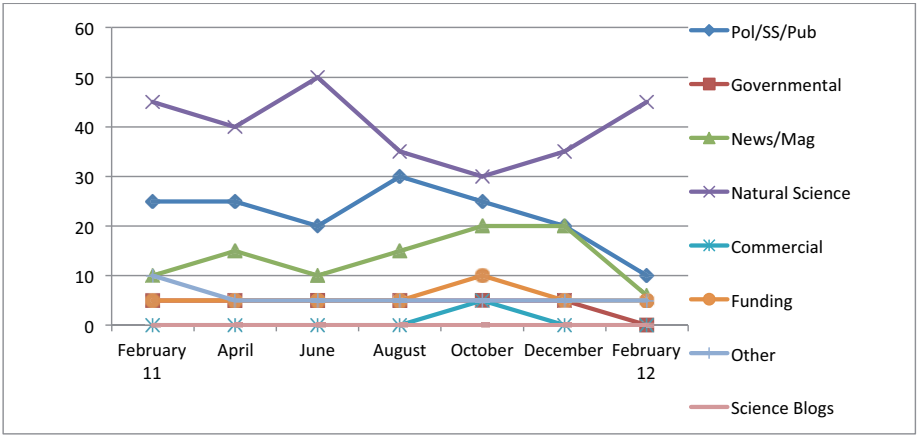

Figure 3: Percentage of website-types in relation to the total number of websites in the myopic visions of the British baseline.

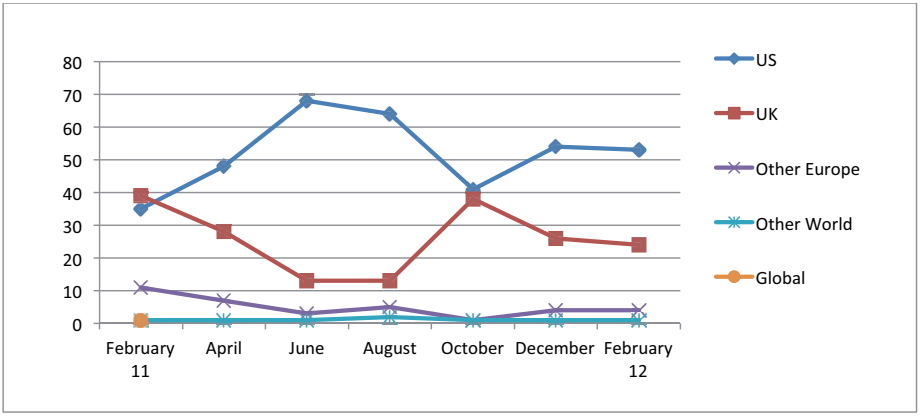

Figure 4: Percentage of website-geography in relation to the total number of websites in the hyperopic visions of the British baseline.

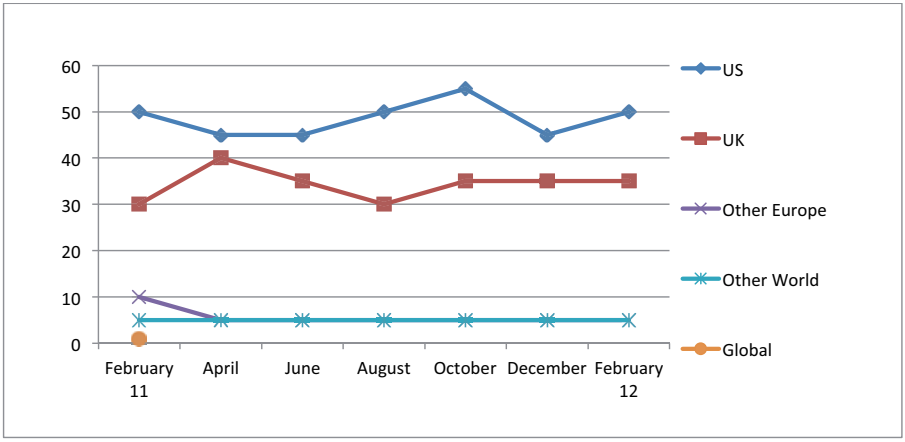

Figure 5: Percentage of website-geography in relation to the total number of websites in the myopic visions of the British baseline.

Looking at the figures above, we can see that the otherwise 'synchronized flux' hides important differences between the myopic and hyperopic visions. If we start by looking at the myopic vision of the British baseline, it is clear from Figure 3 and Figure 5 that their fluidity of does neither have a radical influence on the type of websites that the vision makes visible or on its geographical composition throughout the year. Despite the fact that the myopic vision of the baseline does contain shifting websites throughout the year, it is still dominated by American websites that provide information about natural science in all the months from February 2011 to February 2012. When we look at the hyperopic vision, it is clear from Figure 2 that it mirrors the stable dominance of natural scientists, but Figure 4 indicates that it differs from the myopic visions by having a much more fluid geographical composition. The hyperopic visions of February 2011 and October 2011 give equal visibility to American and British websites, however, this characteristic is radically altered in, for instance, June 2011 and August 2011, where American sites dominate. This difference between the myopic and hyperopic vision of the British baseline (Figures 5 and 4 respectively)

proves that the latter cannot be an 'enlarged mirror' of the former. The hyperopic vision should, accordingly, be treated as a distinct empirical entity that has its own dynamic and that is influenced by distinct selection mechanisms. This is an argument for the empirical relevance of working with a theoretical distinction between the two types of visions.

Linking Behaviour as a Selection Mechanism in the Hyperopic Vision

On the basis of Figures 2 to 5, it has just been claimed that there must exist selection mechanisms that influence the way the hyperopic vision of the British baseline performs the world of synthetic biology without influencing the myopic visions of the baseline. However, the details of these mechanisms are under-determined by the tables and figures above. These mechanisms can only be understood by analysing the specific pages and connections that make up the hyperopic visions from February 2011 to February 2012. Figures 6 to 9 below illustrate the network of British (blue) and American (red) websites that are visible in the hyperopic visions of the British baseline in February 2011, June 2011, October 2011, and February 2012. Comparing the networks of these months gives a good impression of the changes throughout the year of data collection, and they are thereby useful for detecting the details of the selection mechanisms that make the hyperopic vision different from the myopic vision in terms of its geographical composition across the period.

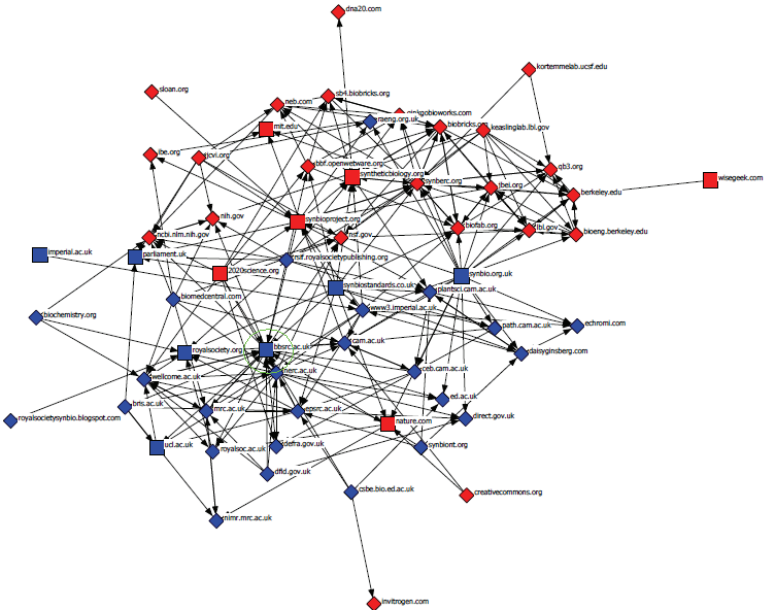

Figure 6: Hyperopic vision of the British baseline (February 2011).

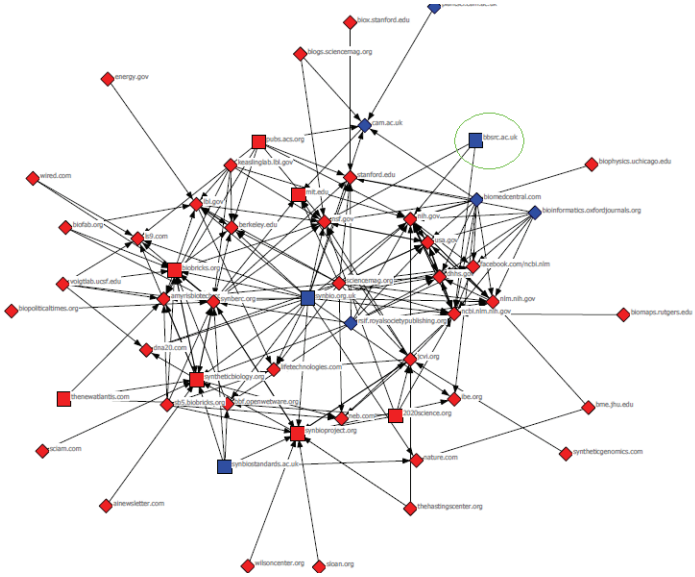

Figure 7: Hyperopic vision of the British baseline (June 2011).

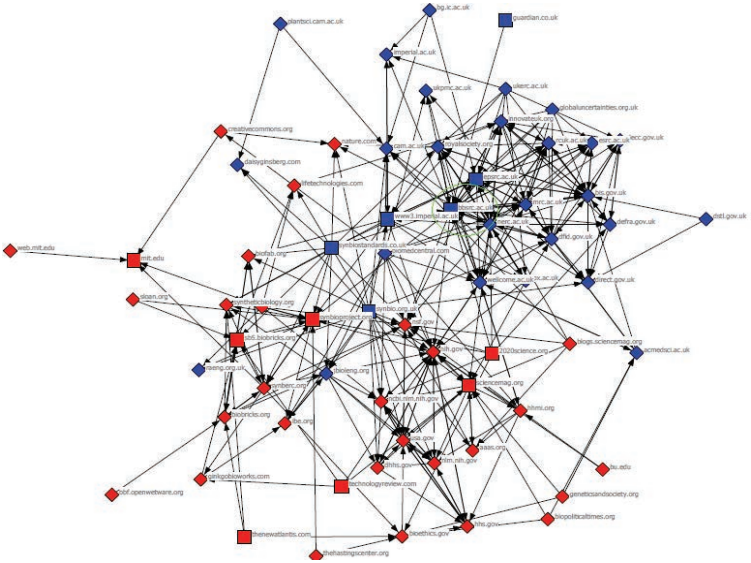

Figure 8: Hyperopic vision of the British baseline (October 2011).

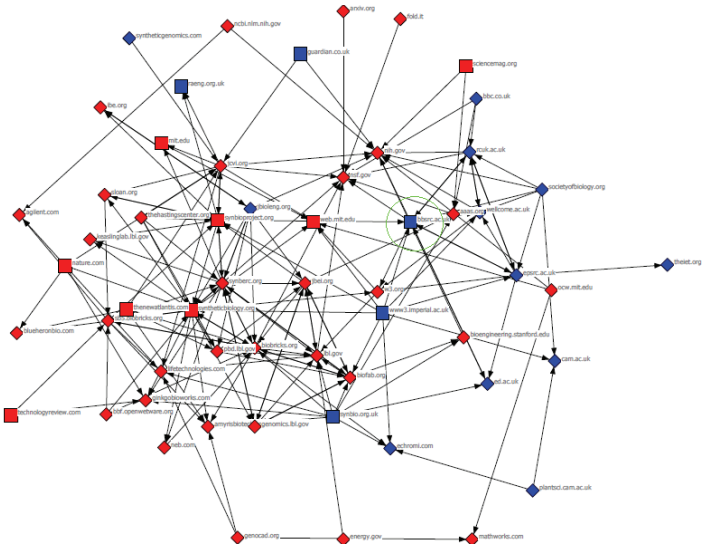

Figure 9: Hyperopic vision of the British baseline (February 2011).

The hyperopic visions of February 2011 (Figure 6) and October 2011 (Figure 8) are characterized by being dominated by two distinct geographical clusters that mainly distribute attention to other websites within their own cluster. One cluster contains American sites (marked with red), and in both months this cluster is dominated by research centres and networks of American scientists working with synthetic biology. The other cluster contains British sites (marked with blue), and in both months it is dominated by public institutions such as the BBSRC, which is a research council that funds bioscience research in the UK. The two clusters are guiding attention to radically different sources of information about synthetic biology, and the fact that they are both strong elements of the hyperopic visions in February 2011 and October 2011 is also supported by a look back at Figure 4, which shows these to be the months when British and American websites were equally visible. However, whereas the American cluster remains stable across the whole year of data collection, it is indicated by Figure 4 that the British cluster loses visibility between February 2011 and October 2011. The details of the disintegration of the British cluster are visible in more detail when one looks at the composition of the hyperopic vision in June 2011 (Figure 7) and February 2012 (Figure 9). From these figures, it is clear that there are selection mechanisms at work that make the British cluster disappear from the hyperopic vision, and it has already been established that these mechanisms cannot be traced back to geographical changes in the myopic visions where the amount of British websites remain constant.

A closer look at Figures 6 to 9 shows that the visibility of the British cluster is rather influenced by a change in linking behaviour to its central actors by the other websites included in the hyperopic vision.[32] An example of this kind of changed behaviour can be seen by comparing the patterns of links around the website of BBSRC (marked with a green circle) in Figures 6 to 9. This site is central to the hyperopic visions of

[32] The details of the linking behavior is be detected by browsing the backlog of the Issue Crawler that saves information about all the specific links made by each site in the network. This is also the way in which it is ensures that the links are relevant to the issue of synthetic biology.

February 2011 and October 2011, where it is interlinked with websites in both the British and American cluster. However, this position is lost in the hyperopic visions of June 2011 and, to some extent, February 2012.[33] A central difference between the position of the BBSRC website in Figures 6 to 9 is that it receives links from sites such as '2020 Science' and 'The Synthetic Biology Project' in February 2011 and October 2011, whereas it does not receive such links in June 2011 and February 2012. It is these links make that BBSRC central in February 2011 and October 2011, where members of both the British and the American cluster link to a specific report on the social and ethical challenges of synthetic biology that BBSRC published in 2008. In the case of '2020 Science', the interest is specifically aimed at a section of the report that takes a stance on the issue of 'garage biology', which is perceived as especially relevant to the American debate. Accordingly, there is a correlation between an American interest in this specific work of BBSRC and the overall visibility of the British cluster in the hyperopic vision of the British baseline over time.

This finding does not entail that linking behaviour around central sites in the British cluster can be isolated as *the* selection mechanism that determines the geographical composition of the hyperopic vision. However, the perceived relevance of the BBSRC report and its focus on the issue of garage biology seems to ignite the visibility of a broader British cluster. This is one reason why there are important differences between the hyperopic visions throughout the year even though the myopic visions are quite stable in the same period. The myopic visions throughout the year are all ranking the relevance of BBSRC in the same way, but this stability in the ascription of relevance to the research council is not 'mirrored' in the hyperopic visions they give rise to. The case of BBSRC is just one example of the way linking behaviour works as a selection

[33] When measuring its 'betweenness centrality' it comes in second of all the visible sites in both February 2011 and October 2011. This is very different from June 2011 where it ranks as number 43 and February 2012 where it ranks as number 15. The same patters in found when measuring its 'indegree centrality'.

mechanism that influences the stability of clusters in the hyperopic visions while not affecting the myopic visions. Another example is that the American cluster is tightly interlinked with websites that position themselves as being global voices in the debate. When searching for a global organization that has a stance on synthetic biology, one will quickly find oneself browsing websites of American organizations. The American cluster, accordingly, has a more diverse set of websites that distribute attention to it. This makes it more stable and less likely to lose visibility when specific themes or websites lose their perceived relevance.

Beyond the Baseline I: Semantics as a Selection Mechanism

The comparison between the myopic and hyperopic visions of the British baseline identified linking behaviour as a non-algorithmic selection mechanism that makes the hyperopic vision perform a different world of synthetic biology than the myopic vision that ignites them. The hyperopic vision is therefore not just an 'enlarged mirror' of the myopic vision, and it needs to be discussed as a distinct empirical phenomenon. The rest of the comparative design allows for underlining this argument as well as emphasizing that the selection mechanisms that shape the hyperopic visions are distributed beyond the kind of linking behaviour discussed above. The research design outlined in Figure 1, for instance, allows us a closer look at the role that semantics play as a selection mechanism that shapes the 'web-visions' of Google. One of the variables in the design was to compare the British baseline with 'web-visions' produced by searching for the Danish translation of synthetic biology, and the effect of changing this semantic variable is quite dramatic.

The Danish search has the effect that both the myopic and the hyperopic visions become dominated by European websites throughout the whole year (these visualizations are not shown in this paper because of limited space). The myopic vision

never contains more than one or two British or American websites in any of the months, and the European websites that are visible in the myopic vision are, to a large extent, engaged in 'public engagement, social science or ethics', which was not a dominant category of websites in the 'web-visions' of the British baseline. This tendency is reflected in the hyperopic visions resulting from the Danish search, which are also dominated by a specific European tradition of technology assessment. This tradition dominates despite the fact that the search was carried out from a computer in London, and it stands in contrast to the dominance of American natural scientists we saw in both the myopic and the hyperopic visions of the British baseline. From this finding, it is possible to conclude that national semantics is a highly influential selection mechanism in relation to both the myopic and the hyperopic vision of synthetic biology.

Another thing to emphasize on the basis of this discussion is that the composition of the 'web-visions' based on Danish semantics is more stable than the composition of the 'web-visions' of the British baseline, which shifted between being dominated by American natural scientists in some months and having a more balanced distribution in others. The Danish 'web-visions' are dominated by European actors engaged in a specific tradition of technology assessment throughout the whole year. Only the hyperopic vision of February 2012 challenges this dominance by making visible a large American cluster in which the central websites are The Kennedy Institute at Georgetown University, The Hastings Center, and The Presidential Commission for the Study of Bioethical Issues. However, all of these institutions are involved in public engagement and ethical analysis of synthetic biology, and none of them are promoting perspectives on the debate that differ radically from that of the European cluster. Their visibility also does not challenge the tightness and visibility of the European cluster. Whereas the visibility of the British cluster in the baseline was dependent on the perceived relevance of, for instance, the BBSRC report, there are no such single

important organizations in relation to stabilizing the visibility of the European websites in the visions based on Danish semantics. This also means that the importance of linking behaviour as a selection mechanism is diminished in the context of the Danish searches, where the visibility of the European tradition of technology assessment is not as prone to be overridden by American themes as the British tradition was in the baseline. This difference suggests that search language is an important selection mechanism. The fact that the British share semantics with Americans simply influences the composition of their 'web-visions' of synthetic biology. Again, this is a difference that has nothing to do with personalized search based on, for instance, browser histories.

Differences in national semantics are, however, just one example of the way semantic variance can shape 'web-visions'. The research design in Figure 1 also allows for comparing the 'web-visions' of the British baseline and the Danish search with 'web-visions' that are constructed by changing the search term to a synonym. While holding all the other variables in the baseline constant, it was decided to change the search term from "synthetic biology" to "synthetic life" in order to observe the effects of synonyms as another semantic selection mechanism. It was decided to use the term "synthetic life" because it is used by some scientists to denote the goal that they feel synthetic biology should be striving towards. The term accordingly denotes a desired product rather than a scientific practice. The first effect on composition of the 'web-visions' produced by changing the Danish search term to "synthetic life" is that it brings back the dominance of American and British websites in both the myopic and the hyperopic visions (these visualizations are also not printed because of space limits). However, this does not mean that the 'web-visions' resulting from the search for "synthetic biology" are similar to those generated from the baseline. The geographical similarity between them covers important differences in the types of websites and themes that they make visible.

When taking a closer look at the 'web-visions' produced by searching for "synthetic life", it is clear that this term gives visibility to newspapers and magazines that run stories about the issue that are strongly associated with the work of The J. Craig Venter Institute. The myopic vision resulting from this search contains no more than two posts, where Craig Venter is not mentioned no matter which month one looks at. The concept is, to a large extent, associated with Venter´s dream about the kind of products that synthetic biologists should be producing, and this makes both the myopic and hyperopic vision different than any of the previous 'web-visions' analysed. The myopic vision includes magazines like 'IO9' and 'Greeks are Sexy', which shift between covering science, technological innovation, and science fiction. The hyperopic vision includes websites such as 'NASA', which is focusing on the potential of using the methods of synthetic life to further the understanding of life in space, and 'Space.com', which quotes Venter saying that synthetic organisms could make Mars a more liveable place for humans. Despite using both the concepts of 'synthetic biology' and 'synthetic life', these websites are only visible in the 'web-visions' based on the latter as the search term. They simply fit the thematic clusters that are connected with the latter concept but not the former. This illustrates how synonyms and small semantic alterations influence the composition of 'web-visions'. Once again this is an influence that has nothing to do with personalized search.

Beyond the baseline II: Events as Catalysts of Fluidity

The analyses above have pointed to linking behaviour and semantics as important non-personalized selection mechanisms, and they have indicated how these mechanisms manifest their influence in different ways in the myopic and hyperopic visions. However, the analysis of the visions based on "synthetic life" also indicates that events, such as the proposed breakthrough of The Craig Venter Institute, play a role in

shaping the composition of 'web-visions'. This event shaped the visions based on this synonym, and if we take a detailed look back at the hyperopic vision of the British baseline, we can see that its geographical fluidity is also influenced by a major American event. This event is the launch of the report that Barack Obama requested from The Presidential Commission for the Study of Bioethical Issues in 2010 (The Presidential Commission for the Study of Bioethical Issues 2010), and its influence is illustrated by specific differences in the hyperopic vision of the British baseline in April 2011 (this visualization is also not printed because of space limits) and June 2011 (Figure 7).

One notable difference between the hyperopic visions of the baseline in these two months concerns the websites that are engaged in 'public engagement, social science or ethics'. The percentage of this type of website stays stable (see Figure 2) but this quantitative similarity covers an increasing institutionalization and Americanization in the specific websites that gain visibility within this category. Daisy Ginsberg and James King, who are both UK-based designers who work on illustrating social issues around synthetic biology, are disappearing from the hyperopic vision and their visibility in April 2011 is substituted by the visibility of North-American NGOs such as The Hastings Center and The ETC Group in June 2011. Looking at the details of the hyperopic vision of April 2011 and the hyperopic vision of June 2011, we can see that this change can be explained by the fact that central actors began linking to the report of the Presidential Commission in April 2011. Even though these links are no longer visible in June 2011, a shift has taken place where attention is guided towards institutions that are all closely involved in the making of the report. This fluidity in the hyperopic vision of the British baseline is interesting because it illustrates that its unique characteristics are fragile in the face of American events such as the launch of the Obama report. We have already seen how the interest of American actors in

BBSRC's writings on 'garage biology' influenced its composition, and this finding shows how the launch of a high profile American report has similar effects.[34]

With this result in mind, it is interesting to revisit the fact that the unique characteristics of the Danish visions are not as fragile in the face of the launch of the Obama report. This suggests that the role events play as a selection mechanism is different across 'web-visions' that are produced under different conditions. The fact that the web-vision of the British baseline shares semantics with America makes it more inclined to make central actors involved in this report visible than the Danish visions.

Theoretical, Empirical, and Practical Implications

The analysis above has shown that important differences exist between the compositions of 'web-visions' that are not the result of algorithmic personalization. Therefore, it can be argued that any theoretical framework that is used to analyse the way Google guide the attention of their users needs to focus on a more diverse set of selection mechanisms than the framework of the filter bubble and other related approaches. Such selection mechanisms include national differences in semantics, the power of synonyms, the linking patterns of specific websites, the internal tightness of distinctive thematic clusters, and the existence of big events within the issue searched for. By highlighting these selection mechanisms, the empirical study has illustrated that

[34] When comparing the hyperopic vision of the British baseline with the visions made through Wikipedia, it is evident that the institutionalization in the baseline visions from April 2011 to June 2012 makes them increasingly similar. Websites such as The Hastings Center and The ETC Group are visible in the Wikipedia visions from the outset, and the launch of the Obama report seems to drag the British baseline in the direction of Wikipedia.

selection is happening in distributed socio-technical chains that cannot be conceptualized through distinctions between humans and technologies. The framework of 'web-vision analysis' therefore suggests making the algorithm less central in analyses of the way search engines like Google perform the world, and it questions the idea that interfaces like Google´s SERP should be seen as places where the user ends and the technology begins.

The framework of 'web-vision analysis' requires a broader unit of analysis than the SERP. The SERP is the empirical operationalization of the filter bubble, and it is equivalent to the myopic vision in the web-vision framework. But these visions are only half the story in the analysis above. The fact that the hyperopic visions are different and have their own dynamics makes them a necessary unit of analysis as well. They cannot be reduced to being seen as 'enlarged mirrors' of the myopic visions. They perform the world in a distinct a way, and they are the outcome of selection chains in which different mechanisms play the central role. The framework of 'web-vision analysis' suggests an empirical approach to analysing the performance of Google, which allows for pinpointing these differences rather than collapsing them into a single bubble. This latter reduction is problematic because important details are lost and the effect of the algorithm is exaggerated.

These theoretical and empirical implications give rise to the possibility of thinking of 'web-visions' as heuristic devices that should not necessarily be evaluated on the basis of whether they provide a representative sample of a predefined web-sphere. Rather than discussing them on the basis of such a priori ideals, it is possible to ground the discussion about their value in the distributed selection chain that produces them. This allows one to evaluate them on the basis of parameters that are rooted in case-study logics rather than in the logic of representation. 'Web-visions' can, for instance, be produced in a way that allows for using them as non-representative benchmarks against

which to understand social dynamics. For example, the characteristic of the Danish visions makes them 'less likely' than the British baseline to be fluid in the face of big American events. A change in the former would therefore be an indication of unusual social dynamics without being rooted in a theory of representation. 'Web-visions' can, in that way, be evaluated as a useful pragmatic device with which to gauge anomalies rather than an attempt to represent discussions on the web at large. Knowledge of the distributed selection chains beneath them is, however, an essential condition for this kind of use.

These implications regarding the theoretical framework, the empirical unit of analysis, and the criteria of evaluation can productively be transferred to other forms of 'web-visions' as well. The kind of visualizations produced in the UN could, for instance, be approached in this way. A practical implication of doing that would be to legitimize the use of pragmatic evaluation criteria in relation to the use of such 'web-visions' as prompts for decision-making in such organizations. By manipulating the distributed selection chain that goes into producing them, crisis-monitors could be built with the aim of being 'less likely' to make a specific sentiment visible or with the purpose of tracking anomalies in the visions resulting from a specific selection chain. Evaluating crisis-monitors on such internal benchmarks is very different from evaluating them on the basis of external benchmarks connected to the idea of the web-sphere that is to be represented. Despite being different, the performances of both Google and the UN can benefit from being conceptualized as 'web-visions'. In fact, the concept is constructed to apply to such different ways of repurposing the digital.

Conclusion

The way Google performs the issue of synthetic biology is the result of a distributed set of selection mechanisms of which the algorithm is not the most decisive. This was first

established by showing important differences between the myopic vision and the hyperopic vision of the British version of Google. The driving force behind these differences was shown to be linking patterns among websites in the hyperopic visions, and this finding served as the background for highlighting two issues. The first was that Google's performance of the world of synthetic biology is the result of socio-technical chains of selection in which human and non-human influences intersect. The second was that the hyperopic vision cannot be seen as an 'enlarged mirror' of the myopic vision, and that the way Google guides the attention of their users cannot be understood through an empirical analysis of just the SERP. These findings were strengthened by comparing how the British baseline performed the world of synthetic biology with the performance of this world by 'web-visions' with altered selection mechanisms. This comparison revealed the importance of non-algorithmic selection mechanisms such as national differences in semantics, the power of synonyms, the coherence of distinctive thematic clusters, and the existence of big events related to the issue searched for. While the algorithm plays a role in Google's performance of the world of synthetic biology, its influence is at least balanced by these other selection mechanisms.

These findings suggest that it is productive to conceptualize Google's performance of the world as a web-vision that is grounded in distributed selection chains. The concept of a web-vision differs from that of a filter bubble by emphasizing the need to go beyond seeing the algorithm as the only selection mechanism and the SERP as the site in which selection is played out. 'Web-vision analysis' provides a conceptual language that captures the socio-technical character of selection rather than seeing Google's interface as the place where the user ends and the technology begins. This involves distinguishing between different forms of 'web-visions' on the basis of the way they are produced, and it suggests that their value can be evaluated on other grounds than the extent to which they represent a pre-defined notion of a web-sphere. If one gets

acquainted with the selection chain behind them, they can be approached as cases rather than samples. This way of thinking about web visions can be transferred to the kind of visualizations that are produced within organizations such as the United Nations and elsewhere. Despite being different from Google, these organizations are still engaged in performing the social world in a way that can productively be analysed on the basis of the web-vision framework.

Bibliography:

Anderson, C (2008) The end of theory: The data deluge makes the scientific method obsolete. *Wired Magazine*, 16 July.

Madsen, Anders K (2012) Web-visions as controversy-lenses. *Interdisciplinary Science Review*, 37(1): 51-68

Battelle, J (2006), *The search - How Google and its rivals rewrote the rules of business and transformed our culture*. New York: Portfolio

Borgatti, S.P, Everett, M.G. and Freeman, L.C (2002). Ucinet for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies

Brin S and Page L (1998) The anatomy of a large-scale hypertextual web search engine'. *Computer Networks and ISDN Systems*,
30(1-7): 107-117

Callon M (1986) Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay. In:

Law J (eds) *Power, action and belief: A new sociology of knowledge?* London: Routledge, 196-223

Gerhards J and Schaefer M.S (2010) Is the Internet a better public sphere? Comparing old and new media in the USA and Germany. *New Media & Society* 12(1): 143-160.

Global Pulse (2011) *Twitter and perceptions of crisis related stress*. Available online at: http://www.unglobalpulse.org/projects/twitter-and-perceptions-crisis-related-stress (January 11 2012)

Latour, B (2005) *Reassembling the social — An introduction to actor-network-theory.* Oxford: Oxford University Press.

Latour B (1991) Technology is society made durable. In: Law J (eds) *A Sociology of Monsters? Essays on Power, Technology and Domination*, London: Routledge, 103-131.

McKenzie, D (2008) *An engine, not a camera: How financial models shape markets*, Cambridge, MA, USA: MIT Press

Muniesa F, Millo Y and Callon M (2007) An introduction to market devices'. *Sociological review* 55(s2), Wiley: 1-12.

Niederer S, Van Dijck J (2010) Wisdom of the crowd or technicity of content? Wikipedia as a socio-technical system. *New Media and society 12(8), SAGE*

Pariser, E (2011) *The filter bubble – What the internet is hiding from you*. London: Penguin Press.

Schneider S.M and Foot K.A (2005) Web sphere analysis: An approach to studying online action. In: Hine C (eds) *Virtual methods - Issues in social research on the internet*. Oxford: Berg Publishers, 157-171.

Sunstein C.R (2006) *Infotopia - How many minds produce knowledge.* New York: Oxford University Press.

The Presidential Commission for the Study of Bioethical Issues (2010) *New Directions: The ethics of synthetic biology and emerging technologies.* Washington D.C.: The Presidential Commission for the Study of Bioethical Issues in the USA

Vaidhyanathan, S (2011) *The Googlization of everything (and why we should worry)*. USA: University of California Press.

Van Os R., Jankowski, N.W and Vergeer, M (2007) Political communication about Europe on the Internet during the 2004 European Parliament election campaign in nine EU member states. *European Societies* 9(5): 755-775.

6.2 Reflections on Paper Three

It has already been argued that Paper Three is positioned as a contribution to a specific discussion about search engines within the field of Internet Studies; however, the discussion at the end of the paper indicates that its findings are of broader relevance as well. When looking at the arguments provided in the paper, it is, of course, true that the specific empirical distinction between myopic and hyperopic visions is mainly relevant to discussions of search interfaces. The specific arguments regarding the influence of linking patterns in thematic clusters are, similarly, only relevant to web-based visualizations that use the hyperlink as a digital trace. However, the fact that these specific findings have limited application does not mean that there are no lessons to be learned from them in relation to the discussion that this dissertation is taking concerning the more general characteristics of web-based visualizations. This section will argue that the findings of Paper Three offer an opportunity to dig deeper into two discussions that have already been somewhat touched upon in sections 4.2 and 5.2. The first is the discussion about the distribution of selection chains and their connection to situations and events. The second is the discussion about the possibility of using case-based research designs in the construction of web-based visualizations and the role of temporality in this form of research strategy. The two subsections below will contribute to these discussions on the basis of the findings of Paper Three and highlight what these findings add to the previous discussions of these issues in this dissertation so far.

6.2.1 Distributed Selection Chains and their Connection to Situations and Events

The analysis in Paper Three provides empirical insights into the distributed chain of selection mechanisms that influence Google's 'web-visions' of synthetic biology. The

comparison between the myopic and hyperopic visions of the British baseline, for instance, identified linking behaviour as a non-algorithmic selection mechanism that makes the hyperopic visions perform a different world of synthetic biology than the myopic visions that ignite them. This is one example of a finding that illustrates that the locus of selection is distributed away from the algorithm, and the paper uses such insights to provide an argument against mono-causal and overly algorithm-oriented approaches to understand the way web-based visualizations guide the attention of their users. For instance, the empirical distinction between myopic and hyperopic visions is used to argue that an adequate understanding of Google's 'web-vision' requires a broader unit of analysis than the SERP, and it indicates a necessity to move away from thinking about interfaces as a point where the user ends and the technology begins. In Paper Three, this is specifically used to argue against the notion of a 'filter bubble' because of the way it collapses these different types of visions into a single bubble where the selective effect of the algorithm is exaggerated.

This specific argument is, naturally, closely connected to the specific topic of Paper Three. However, it can also serve as a relevant foundation from which to make a more general argument about the danger of reducing the empirical sites where 'web-visions' are studied and the need to break the analytical object of ' web-visions' into subcomponents in order to analyze it. The specific case in Paper Three was that the choice to reduce the empirical site of analysis to the SERP is, at the same time, to ignore the influence of a set of non-algorithmic selection mechanisms that are only visible if one studies the hyperopic visions as well. Hyperopic visions have distinct dynamics that are as important to study as the SERP if one wants to understand how Google turns the messy world of synthetic biology into a manageable set of information for its users. This call for non-reduction is in many ways similar to Espeland's suggestion for the need to distinguish between different dimensions of commensuration processes. Her argument was outlined in section 3.5, and it promotes

a sensitivity towards seeing commensuration processes as having distinct dimensions that are influenced by different selection mechanisms. Espeland's distinction illustrates why the process of turning qualitative phenomena into quantitative measures should not be seen as something that happens in one spot at one point in time. It is a process that is distributed in time and space and this makes it necessary to work with distributed empirical sites of analysis in order to understand it. The suggestion made in Paper Three to work with a distinction between myopic and hyperopic visions can be seen as one example of the way this general argument can be operationalized. They are distinct dimenisons of the work that goes into producing Google´s 'web-vision'.

The empirical argument for the necessity of distinguishing between a myopic and a hyperopic vision takes up the first part of Paper Three; however, the rest of the paper supplements this finding with examples of other non-algorithmic selection mechanisms that influence the visions. These mechanisms are national differences in semantics, the power of synonyms, the linking patterns of specific websites, the internal tightness of distinctive thematic clusters, and the existence of big events within the issue searched for. The findings provide a thorough empirical foundation for the argument against seeing the 'web-vision' of Google as an algorithmically driven bubble, and they illustrate that the power of selection is distributed across socio-technical chains that cut across distinctions between humans and technologies. This finding can once again be given a suitable theoretical foundation in the ontological thoughts of Cooley and Gibson. We have already seen how these writers have been useful in relation to interpreting the findings of Paper One; however, they will also be invoked here to make sense of the findings of Paper Three.

The first thing to note about this reoccurring relevance across two quite different papers is that the ontological thoughts of Cooley and Gibson are not just of limited relevance to specific visualizations. They seem to have the potential to be used as a

more general ontological foundation from which to make sense of a broad range of web-based visualizations and the argument for the way their thoughts can be used to make sense of the findings in Paper Three will in many ways resemble the arguments about environments of experience and ecological objects that were brought up in section 4.2. These arguments concern the ontological in-betweenness of experience and perception and they will not be repeated in this section. However, the fact that Paper Three has a different object of analysis and relies on different methods than Paper One also makes it a useful basis for discussing aspects of the writings of Cooley and Gibson, which were not touched upon in section 4.2. More specifically, it can be used to revisit their thoughts about the role that 'situations' and 'events' are to play in the way we understand the production of experience and perception.

When Cooley and Gibson's ontologies were introduced in Chapter III, it was emphasized that both of them suggest that experience and perception are influenced by situations and events. This suggestion was taken up in the discussion of Paper One in section 4.2. This paper was based on documents and interviews, and its findings were used to show how project leaders engaged in the construction of web-based visualizations must align distributed socio-technical influences into choices that are both technologically feasible and legitimate in the situation in which they are to be used. It was argued that these findings of Paper One were productively understood through Gibson's ontological idea that all perceptions are the product of aligning technological affordances with the characteristics of the perceiving agent and the dynamic situation he or she finds him- or herself in. This was illustrated by digging deeper into the situation in which the crisis-monitor of the UN's Global Pulse was produced. Moreover, the discussion of this situation was also used to argue for the relevance of Cooley's focus on environments of experience as the result of situated human choices.

If we take a look back at the way Cooley's ontology is outlined in section 3.2, it is, however, explicitly emphasized that he slides between a focus on human choices in conscious situations and a focus on subconscious and technological elements when he writes about the selection mechanisms that shape environments of experience. Whereas the findings of Paper One allow for highlighting the former aspect of Cooley's ontology, it can be argued that the findings of Paper Three allow for highlighting the latter. Paper Three does not provide any insights into the conscious situation that the user of Google´s 'web-visions' finds him- or herself in; however, it serves to make selective principles visible that are not necessarily conscious to those who use Google to see the world of synthetic biology. An example is the way Paper Three illustrates how remote 'events' function as such selective principles. These events are different from the situations discussed in Paper One because they are less conscious to the user of the 'web-vision'. For instance, it is argued that the 'web-vision' of British users of Google is shaped by American events such as the launch of the report from The Presidential Commission for the Study of Bioethical Issues because the two countries share semantics. This is just one example of the way Paper Three illustrates that events that are remote from a person using a web-based visualization can influence the shape of his or her 'web-vision'.

The discussion of events and national semantics is, of course, tied to the specific 'web-visions' studied in Paper Three, but the point about the role of remote events has a more general relevance for the conceptualization of web-based visualizations as well. Just as section 4.2 used the specific findings of Paper One to make a general call for an increased analytical sensitivity towards the 'situation' in which the visualizations are produced, so can the specific findings of Paper Three be used as an empirical indication of the necessity of an increased analytical sensitivity towards 'events' that are external to the perceiving agent. Such events are, for example, also relevant in relation to 'web-visions' produced through Twitter, where the centrality of the hash tag

(#) has made the visualizations sensitive to the way events are defined and demarcated from each other by the user-community (Bruns 2012). Compared to the events discussed in Paper Three, the types of events that are influential in Twitter´s 'web-visions' are perhaps less determined by their semantic content and more determined by the extent to which they are happening in situations where people have mobile phones with functioning Twitter apps. But the findings of Paper Three can nonetheless be used to illustrate the importance of distinguishing between the role played by 'situations' in which the visualizations are built and 'events' that influence the visualizations in potentially subconscious ways. They make a case for the necessity of accepting Cooley's argument for the need to supplement the focus on human choices in the construction of experience with a focus on the history of communication technologies and the way such technologies draw boundaries around events.

This section has until now forged links between the findings of Paper Three and the theoretical grounding of 'web-vision analysis' introduced in Chapter III. Furthermore, it has argued for the relevance of building an analytical framework for the study of 'web-visions' on the basis of general thoughts from Cooley, Gibson, and Espeland. In addition, it has used this as an argument against approaches that are mono-causal, overly focused on technology, and that reduce the empirical site of analysis in ways that make users of these approaches blind to the distribution of selection mechanisms. The next question is whether these points have already been made by some of the writers in the review of digital methods presented in Chapter II. The remaining part of this subsection will answer this question by returning to the discussion of how the distribution of selection has been handled by writers associated with economic sociology as well as the way Marres and Weltevrede have recently presented takes on this question that are similar to the take suggested by 'web-vision analysis'.

Let us start by restating that the arguments above are clearly inspired by writings within economic sociology. This was already indicated by linking the argument for the distinction between myopic and hyperopic visions to Espeland's suggestion to break commensuration-processes up into distinct dimensions that are influenced by different actors. It has already been mentioned that her argument reflects a broader tendency within economic sociology to look at valuation, calculation, and cognition as distributed processes. Section 5.2 showed how the concept of 'web-visions' is inspired by the way theorists within this field have conceptualized phenomena, such as the report of stock analysts, financial charts, pricing theories, stock market analysis software, and debt obligations as distributed 'market devices' that generate 'screened visions' on the part of their users. What was not as explicitly discussed in this section was that this list of different market devices illustrates that such different market devices are fulfilling quite distinct roles in the process of market construction. For instance, it has been shown that the report of a stock analyst is a managerial device that is likely to rely on, and incorporate, other types of market devices such as classification schemes or analysis software. Market devices are 'nested' together when they produce markets.

The theoretical consequence to draw from such insights is that market devices rarely stand alone but are likely to be chained together. The structure of attention that a stock report provides its user with is distributed across a chain of market devices, and this insight from economic sociology is an obvious inspiration to the way Paper Three talks about 'web-visions' as the product of distributed selection chains. However, even though theorists of market devices have pointed to the existence of such chains, they have yet to provide a granular theoretical vocabulary to make this point. This is one of the reasons why the theoretical work of Cooley, Gibson, and Espeland has been drawn upon as the main theoretical foundation from which to conceptualize 'web-visions'. Their vocabulary allows for a more explicit focus on such chains than writings within economic sociology. The discussion about myopic and hyperopic visions in Paper

Three is an example of the way in which Cooley´s argument about selection and experience and Gibson´s arguments about the ontological inbetweenness of visions can be used as a theoretical foundation to make sense of a research design that takes the existence of distributed selection chains to the heart of the analytical strategy.

The issue of distribution has also been touched upon by other writers within the field of digital sociology. If we turn our attention back to the review of digital sociology in Chapter II, it is specifically in section 2.5 that this issue is dealt with. This is done with reference to the discussion about the reconfiguration of the profession of the social scientist. The papers of Savage and Burrows, for instance, highlight the way the authority to produce and validate data concerning the social world has been displaced from academia to proponents of commercial sociology. They argue that actors outside academic institutions are providing alternatives to the methods of knowledge production that have traditionally been associated with the professional skills of academics. This means that the data that is relevant for the social sciences is being produced by a more distributed set of actors than ever before. It is argued that whereas academic social scientists occupied the apex of the social research apparatus in the mid 20th century, they are now enmeshed in an area of 'knowing capitalism' where they are occupying a marginal position in a distributed research infrastructure.

The empirical findings from Paper One and Paper Three can be read as providing a foundation for the somewhat similar argument that 'web-visions' are also the product of a distributed set of actors. However, in comparison to the arguments just mentioned, it can be argued that especially the findings in Paper Three suggest the existence of a mode of distribution that is different from an outright displacement of research capacities from professional academics to private companies in the information industry. In the context of Paper Three, such a focus would amount to looking at the displacement of the authority of information filtering from professional journalists and

librarians to data-crunchers at Google. This is, however, not the kind of distribution that the paper provides insight into. One of its central points is, in fact, to suggest that we stop thinking about 'Google's web-visions' as produced by Google and instead start thinking about them as outcomes of broader selection chains. Such chains are distributed across actors such as the infrastructure of HTML technologies; the characteristics of digital traces and software packages; the occurring of events related to the subject queried for; and the existence of specific semantic cultures that are prone to be affected by specific events. The point is that the work that goes into shaping Google´s 'web-visions' is distributed across all these actors and that acknowledgement of this fact is an important starting point for any theoretical framework that attempts to make sense of them as an object of analysis.

If we look at the literature reviewed in section 3.5, it is clear that this approach to distribution is in many ways similar to Marres's arguments about the 'redistribution' of methods in the digital environment. She agrees that the important elements in the production of data and information filtering are happening outside the scope of traditional professions, but she emphasizes that it is necessary to stop talking about this as a displacement of knowledge capacities and start talking about it as a redistribution of the division of labour involved in the collection, analysis, and visualization of data. Marres's point is that this division of labour has always been distributed, and that the rise of digital methods is to be seen as igniting further redistributions. This means that contemporary knowledge creation will include different actors actors such as online platforms, web users, databases, design agencies, algorithms, editors, social movements, and many others. The findings of Paper Three provide new empirical reasons for continuing this talk about 'redistribution' of methods, but it has already been indicated that the concept of 'web-visions' suggests a slightly different way of understanding and taking advantage of this change than Marres. The foundation in Cooley and Gibson simply enables a different take on this issue. A central example of

such a difference is the way 'web-vision analysis' emphasize the potential of experimental methods in the production of web-based visualizations and the next subsection will briefly discuss how Paper Three provides further insights into the role that experimental methods can potentially play in the analysis of 'web-visions'.

6.2.2 Experimental Designs and the Role of Temporality

The subsection above has just argued that 'web-vision analysis' builds on a similar diagnosis of the conditions that the rise of digital data sets for the empirical social inquiry as the one Marres offers in her discussion of redistribution. It is therefore interesting to look at the extent to which it also follows the methodological prescriptions she has drawn from this diagnosis. Marres's methodological prescriptions were outlined in section 3.5, and it was emphasized that she uses her description of the digital environment to argue for a 'revenge of methods' that consists of translating already existing methodology critiques into the digital environment. The examples she gives of the kind of revenge she imagines digital data to enable, concern methods like co-citation analysis and co-word analysis. These methods were originally pioneered in the 1970's and 1980's as critiques of methods like inlink citation analysis and frequency analysis that were both argued to be overly focused on reputational dynamics. The argument Marres makes is that the critiques inherent in these methods were sound, but that the state of the technology back then made it impossible for them to materialize in actual methodological alternatives.

It is clear from section 3.5 that Marres sees the contemporary digital environment as enabling a 'revenge' of these methods in a way that opens for the possibility for criticizing the way popular approaches to digital methods conflate the authoritative, the popular, and the relevant. An example of the way she envisions such a critique to

function was already outlined in section 4.2, with her argument that a substitution of 'live' methods with 'lively' methods is a way to re-assert the difference between the popular and the relevant. Rather than following the suggestions of 'web-epistemology' to follow the web and repurpose the existing devices, she promotes a more active engagement that consists of remediating existing methodological critiques into the digital environment. One of her main points is that the redistribution of knowledge production makes for a situation where already existing methodological critiques can be invigorated in new ways. According to Marres, this needs to be done by actively incorporating the contribution of distributed agents in a way that steer practices of classification, visual design, and automated analysis towards a remediation of already formulated critiques.

Even though it was argued above that the framework of 'web-vision analysis' takes many of Marres's points about redistribution to heart, it is clear from the analysis in Paper Three that it draws slightly different methodological consequences from the way the digital environment affords new modes of empirical social analysis. First of all, it is not engaged in remediating any existing methodological critiques. It is rather engaged in experimenting with new ways of visualizing the effects of selection chains and thereby gain a better understanding of the 'web-visions' that these chains generate. The aim is to generate a theoretical vocabulary that can enable a new understanding of what it means to 'see' the world through the web. The critical potential in introducing the concept of 'web-visions' is that it can serve to counter some of the existing vocabularies concerning web-based visualizations and their role in the production of knowledge about the social world. It can perhaps be argued to provide a remediation of already existing epistemic battles, but these battles are different from the battles that Marres is engaged in. The remediation that Marres aims at with the notion of a 'revenge of methods' is not a suggestion to move towards experimental methods in the same way as the framework of 'web-vision analysis' moves towards. This difference

between the framework of 'web-vision analysis' and related approaches has already been discussed in sections 4.2 and 5.2, and the concrete findings produced through the 'web-vision analysis' in Paper Three have hopefully served as an exemplification of the way these differences lead to a different way of conceptualizing and producing web-based visualizations.

It should, however, also be emphasized that the research design in Paper Three provides an illustration of a claim made in section 4.2. This claim is that the temporality of data is treated in quite similar ways in 'web-vision analysis' and in the kind of 'lively' research that Marres and Weltevrede have recently called for. The theoretical details about this resemblance and the way the treatment of temporality can be rooted in the writings of Gibson was already discussed in detail in section 4.2. However, it is worth mentioning that the analysis in Paper Three illustrates the way 'web-vision analysis' echoes the call for 'lively' research by attending to the dynamic elements of data in the discussion about the stability and instability of different 'web-visions' over time. Furthermore, it illustrates how it uses these dynamic aspects to draw conclusions about the role that, for instance, American events and national semantics play in shaping 'web-visions' over time. The visualizations in Paper Three do not depict fresh and 'live' data. They are rather constructed with the aim of detecting invariances and changing compositions in already captured data streams. It thereby shows how some of the more theoretical discussions in section 4.2 can be translated into actual empirical research designs.

The last thing to notice in this subsection is that some of the characteristics that have just been emphasized as central to 'web-vision analysis' reflect arguments that have recently made by pragmatically oriented researchers interested in experiments. An example is the way Lezaun, Muniesa, and Vikkelsø (2012) have reviewed examples of socio-psychological experiments conducted around the 1930's, and used this review to argue that many contemporary criticisms of the artificiality of such experiments have

misread this mode of conducting research. Rather than evaluating experiments as representations of reality, they suggest understanding experimental techniques as providing what they call a 'provoked containment of reality'. The relevance of this suggestion to the discussion of 'web-vision analysis' is best understood by explicating what is meant by the words 'provocative' and 'containment'.

When Lezaun, Muniesa, and Vikkelsø argue that experiments are 'provocative' they point to a characteristic of the experimental research design that has also been central to the analysis in Paper Three. They argue that an experiment is constructed with the intention of triggering an effect of the object studied and thereby revealing something that is not already available. The rationale behind experiments is not to represent the world but to manipulate and provoke it in order to make it perform specific realities for specific purposes. This is also the case in Paper Three, where 'web-visions' are provoked by altering specific variables while holding others constant. The 'web-visions' are rooted in case-study logics such as the attempt to make specific 'web-visions' 'least likely' to exhibit certain properties. This is both ensured through the selection of variables and through the way the visions are cleaned by the researcher. This is an example of the way 'web-vision analysis' is working towards making otherwise invisible selection mechanisms visible. What is made visible is different from web-vision to web-vision, but the general point to take away is that they are to be interpreted as empirical sites that are intentionally rendering social phenomena visible and manageable. If we take a look back at section 1.2, it is clear that this way of producing knowledge has roots in pragmatic methodology that ultimately entails understanding objects and notions by considering their practical effects. It is also similar to the way Gibson suggests that we learn through a process of moving around the world and testing which things remain stable and which do not when we alter, for instance, our position or the illumination.

The way Lezaun, Muniesa, and Vikkelsø argue that experiments are involved in a 'containment' of the world highlights another central aspect of the analysis in Paper Three. They argue that a central element of the experimental design is to establish a clearly demarcated space within which reality can be managed without overflowing. In the socio-psychological experiments, this space can for instance take the form of a theatre or a fake prison, and in Paper Three it can be argued that this space is the chain of software tools that end with the visualization module in UCI-net. This is where the effects of selection mechanisms are rendered visible. This makes it relevant to focus on a second point that Lezaun, Muniesa, and Vikkelsø make about containment, which is that it is tightly connected to the authorship of the scientist that is responsible for its outcome. When looking at the use of UCI-net in Paper Three, this connection is, for instance, visible in the choice to constantly clean the 'web-visions' to keep them focused on the issue of synthetic biology. Webpages with less than two inlinks and webpages that do not mention synthetic biology were left out in order to make it less likely that the various 'web-visions' differed from each other. This way of manipulating the visualizations is different from the other approaches to web-based visualization discussed above, and it can productively be analysed as an act of containment.

After having discussed the meaning of the words 'provocative' and 'containment', Lezaun, Muniesa, and Vikkelsø end their paper by listing five traits of provocative containment of which three are of immediate interest to the concept of 'web-visions'. The first is that the socio-psychological experiments they review were deliberately designed to provoke authentic self-expressions on the part of the participants. Rather than capturing an objective reality, the experimental setups were constructed to elicit subjective responses to events. This trait is interesting because it resembles the way some approaches to web-based visualizations have promoted digital traces as honest signals that can also be seen to elicit subjective responses to events. From the

discussions above, it is clear that the framework of 'web-vision analysis' does not translate this trait of early socio-psychology into its construction of 'web-visions'. To the contrary, it emphasizes that the interfaces on which people leave traces are part of the provocation of the world.

But Lezaun, Muniesa, and Vikkelsø mention two other traits of provocative containment that are somewhat reflected in the framework of 'web-vision analysis'. One trait is that the experiments of the 1930´s were designed with the ambition of giving inputs to specific political situations such as the threats to liberal democracy. This ambition also meant that the choices taken in their design were shaped by how these situations were perceived and discussed at the time. An example of this kind of shaping is the way one of the socio-psychological experiments was based on distinctions between 'democracies' and 'autocracies'. This is very similar to the way some of the visualizations discussed in Paper One were argued to be produced in a specific situation that constrained the extent to which it was possible to follow the algorithm and end up with visualizations that were alien to the language in which the situation was already discussed. It was explicitly argued that the returned visualization needed to be coherent with the language of the organizations in which they were to be used. The same is true with the categories that serve as the basis of the way the 'web-visions' in Paper Three are colored, and 'web-visions' can in that sense be conceptualized as responses to situations.

Another trait of provocative containment that is reflected in the framework of 'web-vision analysis' is that the outcomes of the research designs are a result of a process of distillation that is tightly connected to the technological devices used in the experimental setup. The concept of 'distillation' indicates that researchers conducting experiments are engaged in an attempt to purify the experimental situation. The fact that this is done through technologies makes it evident that the goal of the experiment is not to produce an unmediated version of a specific social phenomenon, but rather to

perform the social world and affect it through transformations, experimental separations, and artificial conjunctions. Technologies are accordingly not to be seen as instruments for recording and reproducing evidence but rather as tools for provoking specific forms of outcomes. This active role of technologies in the research design is reflected in 'web-vision analysis' where the web is both the subject matter and the medium of the experiment. This is also a different take on this theme than the one provided by most of the approaches discussed in Chapter II.

In summary, it can therefore be said that 'web-visions' share quite a few characteristics with the experimental designs discussed by Lezaun, Muniesa, and Vikkelsø. Their setups are contrived, their starting points are manipulated, they are technologically mediated, and the role of the researcher and the situation she finds herself within is highly influential. This makes 'web-visions' ontologically dubious if they are evaluated as representations of reality. However, the arguments that Lezaun, Muniesa, and Vikkelsø make about the experiments of the 1930´s reflect the argument made about 'web-visions' throughout this dissertation—criteria of representation are not the right form of evaluation for these types of devices. As instances of provocative containment, it is unfair to measure their value against the yardstick of representational sciences. They should not be treated as imperfect representations but rather judged on the extent to which they render something previously unavailable visible. This is not far from the pragmatic ethos that to see and know the world involves 'doing it'.

Chapter VII: Implications & Future Studies

The chapters of this dissertation can roughly be said to have fallen into one of two categories. Chapters I-III provided the theoretical and methodological background for talking about ' web-based visualizations', 'digital methods' and 'web-visions' whereas Chapters IV-VI presented empirical papers concerning the actual production of web-based visualizations in different contexts. Furthermore, these latter chapters included discussion sections that related the arguments and findings of the papers to the theoretical and methodological foundations developed in the first few chapters. More specifically these sections argued for the relevance of approaching web-based visualizations as 'web-visions' that structure the experience of their users and they pondered the ways in which the framework of 'web-vision analysis' can be said to be different to other concepts with the field of digital methods. The details of the points made in sections 4.2, 5.2, and 6.2 will not be repeated here. Rather, this chapter will summarize the theoretical and practical implications of the discussions in these three sections and suggest ways in which these implications carry both descriptive and prescriptive guidelines for future studies of web-based visualizations.

7.1 Theoretical and Practical Implications Following from 'Web-Vision Analysis'

This subsection will explicate the most important theoretical and practical implications of the arguments in this dissertation and thereby lay the groundwork for suggesting future studies that are motivated by the framework of 'web-vision analysis'. Each implication will be given a short formulation in *italics*, and it will be followed by a brief explanation containing references to the parts of the dissertation where the reader can trace the arguments that warrant the formulation of the implication concerned. The

first theoretical implication to draw from the discussion in this dissertation so far is the following:

The affordances of 'web-visions' cannot be properly understood by attending to the characteristics of the digital technologies used to produce them. The 'visions' of the social that they provide their users with are to be interpreted as 'ecological objects' that exist in-between situated construction practices, remote events, human intentions, and material infrastructures. Each of these elements sets conditions that need to be understood in order to understand the shape of 'web-visions' and their function as devices that guide social attention.

This claim has its theoretical grounding in Cooley and Gibson's thoughts about the ontology of experience and perception introduced in section 3.2. This section emphasized how their writings highlight the 'in-betweenness' of experience and perception, and it was suggested that web-based visualizations can be approached from a similar perspective if they are thought about as 'visions'. An empirical argument for the relevance of drawing on Cooley and Gibson's ontology in the study of web-based visualizations was given in Paper One. This paper illustrates how the necessity to distribute the practice of data formatting, as well as to accept a certain amount of automatization in the analysis of the formatted data, gives rise to trade-offs on the part of the project-leaders involved in the construction of web-based visualizations. Paper One conceptualized different trade-offs and used them to illustrate that the affordances of web-based visualizations exist in-between situated practices, human intentions, and material infrastructures in the way suggested by Cooley and Gibson.

The link between the findings of Paper One and the concept of 'web-visions' was motivated in section 4.2. Here, it was argued that the latter concept suggests a way of thinking about web-based visualizations that is different from both the 'rise of empiricism' suggested by Anderson as well as the way Latour and Venturini suggested seeing such visualizations as 'monads' that can ensure 'second-degree objectivity'. A central claim in section 4.2 was that these concepts fail to make the researcher

sufficiently sensitive towards the 'in-betweenness' of web-based visualizations and the trade-offs that this 'in-betweenness' comes with. On the contrary, they seem to suggest that the affordances of web-based visualizations should be understood by analysing the possibilities that digital traces and software programs provide the analyst with 'in principle', rather than by attending to the trade-offs involved in their practical construction. The suggestion to conceptualize web-based visualizations as 'web-visions' differs by suggesting that one should approach the world as being full of digital traces with specific affordances, while at the same time emphasizing that these affordances need to be seen in relation to the capacities of the perceiving agent who engages with specific technologies in a specific situation. The arguments in section 4.2 served to highlight the relevance of focusing analytical attention on the diverse actors at work in the situation in which 'web-visions' are produced.

Section 6.2 added to this argument by emphasizing how the empirical findings of Paper Three suggest a need to acknowledge the role that external events play in the process of shaping web-based visualizations as well. This section adds empirical detail to the implication formulated above by illustrating the importance of drawing a distinction between 'situations' and 'events' when trying to understand and analyse the affordances of 'web-visions'. Whereas Paper One shows how producers of web-based visualizations must make conscious choices about their mode of construction in 'situations' where different influences need to be aligned, Paper Three is focused on the influence of selection mechanisms that are unrelated the conscious situation that the user of Google's 'web-visions' finds him- or herself in. For instance, it shows how the 'web-vision' of British users of Google is shaped by 'events' that originate outside this situation and that are not not necessarily conscious to those who use Google to get information about the issue of synthetic biology. Examples are the influence of American events, such as the launch of the report from The Presidential Commission

for the Study of Bioethical Issues as well as discoveries and media events related to the J. Craig Venter Institute.

The need to focus on such events when trying to understand the shape of web-based visualizations was given a theoretical foundation by returning to Cooley. Section 3.2 argued that one of the central arguments that can be derived from his writings is that there is a need to supplement a theoretical focus on conscious human choices in the construction of experience with a focus on the history of communication technologies as well as the way such technologies draw subconscious associations between ideas and events. This argument was outlined in section 3.2.1, and it was illustrated that Cooley saw the power of selection as something that existed in-between communication technologies and human intentionality, or in the distributed environment and its events. It has been emphasized throughout the dissertation that this theoretical sensitivity is transferred to the framework of 'web-vision analysis'.

The claim that web-based visualizations should be seen as ' visions' that exist in-between the influence of technologies, intentions, situations and events, however, leads to a second theoretical implication that can be formulated as follows:

The extent to which 'web-visions' are built on theoretical assumptions cannot be reduced to a question about the extent to which theories concerning the topic of the visualization are encoded into a software system by the people who are formally responsible for the visualizations. The question must be broadened to include, for instance, general theories about semantics and network structures that are distributed across the chain of selection mechanisms that shape the visualization. 'Web-visions' should be thought of as normative devices, because they inevitably assign values to entities in the world on the basis of theories with controversial assumptions.

The theoretical foundation of this point can be traced back to the writings of Espeland and other scholars within the field of economic sociology who have insisted upon

seeing calculative devices as evaluative tools that are shaped by a distributed set of human and non-human actors. Espeland's distinction between three different dimensions of commensuration were outlined to make this point in section 3.4, and her arguments are a useful basis on which to ground the second theoretical implication. The distinction that Espeland draws between technical commensuration, value commensuration, and cognitive commensuration illustrates that the process of turning qualitative phenomena into quantitative measures cannot be seen as something that happens in one location at one point in time. It is distributed across a range of actors that have an interest in the commensuration process, and even though aspects of the work of commensuration may seem like a neutral bureaucratic exercise, there are inevitably normative choices being made in various dimensions of the process. This point about the inevitable normativity in calculation and commensuration was also highlighted by the studies of 'valuation' outlined in section 5.2 and it was also argued to be a central aspect of Cooley´s writings on the issue of 'valuation' in section 3.4.

The empirical argument for the relevance of enrolling these theoretical sources into a framework for understanding web-based visualizations can primarily be derived from the work done in Paper Two and Paper Three. The conclusions in these papers are, to a large extent, based on an attempt by the author to construct 'web-visions' and to reflect on the extent to which the choices of selection—and the theoretical assumptions about how to understand the social world—are distributed across a range of different actors in such a construction process. Paper Two was based upon the lessons learned in an attempt to construct visualizations through state-of-the-art software tools. It used these lessons to formulate 'web-vision analysis' as a distinct analytical framework that takes the performativity of distributed selection mechanisms to the heart of the strategy of construction. Paper Three gave further empirical details as to how 'web-visions' should be seen as performative and distributed. It did this by using the controversial

issue of synthetic biology as a case for locating selection mechanisms that are influential in guiding the attention of Google's users.

The empirical findings in these two papers warrant the formulation of the second theoretical implication above, which clearly runs contrary to the claim of the rise of a 'theory-free empiricism' that has been made by many writers on digital methods in previous years. The empirical insights drawn from Paper Two and Paper Three indicate that it does not make sense to talk about theory-free visualizations - not even when one is talking about completely inductive visualizations that 'follow' the structures emerging from the digital data in the sense suggested in Paper One. In that case, the visualization should just be seen as shaped by non-topical theories such as abstract assumptions about the mathematical properties of, for instance, semantic and social networks. An example of the influence of such non-topical theories could be seen in the operationalization of the hyperopic visions in Paper Two and Paper Three, where the assumptions about network compositions that are built into UCInet (for instance, in the form of spring-based graphs and indegree centrality) end up shaping the 'web-visions'. When theories become non-topical, they may be distributed away from topical experts, but that does not mean that web-based visualizations are 'theory-free'. They are rather the product of a distributed theorizing that can, however, be more or less explicit.

Since acts of theorizing are never disinterested, this also means that the visualizations should be approached as normative. This connection between distributed selection and normativity is given empirical support in Paper Two and Paper Three, and it has already been argued that it has its theoretical roots in the discussions of 'valuation' in section 3.4. This section suggests using Cooley and Espeland as a basis from which to argue that processes of 'variegation' and 'commensuration' are necessary interventions if one is to experience or act in the world. Both of them argue that such processes

should be seen as processes of valuation because they end up locating objects in the vicinity of other objects in a way that enables people to evaluate their worth. This is a common claim in economic sociology where it has also recently been emphasized that valuation may also be taken to include, for instance, judgments of relevance. It is through their inevitable reliance on a distributed set of such judgments that 'web-visions' become normative. It is this argument about theory and normativity that lies beneath the formulation of the second implication above, and it gives rise to a third implication that has to do with the epistemic criteria on which web-based visualizations can be evaluated. This third implication can be formulated as follows:

'Web-visions' are not to be evaluated as representations of the world but rather as experimental detections of invariant structures. Such invariants should be seen as the product of a system of 'information pick-up' that actively engages with available objects and mediums in order to establish fixed points with reference to which the changing environment can be organized.

The formulation of this theoretical implication builds on the previous implications, but it has a distinct theoretical foundation in Gibson's thoughts on the epistemology of perception as they were outlined in section 3.3. The main theoretical claim drawn from this section was that the key competency one needs in order to perceive the world skillfully, is the competency to detect invariant structures in a changing environment. Gibson emphasizes that this competency should not be seen as a passive representative skill but rather as something that can be gradually learned through active and experimental interactions with the world. He claims that people learn to perceive the world through, for instance, changing the illumination of objects and moving them around with the aim to detect invariant structures that remain the same despite such activities. His point is that it is only through such interactions with the world that it is possible to obtain fixed points with reference to which the chaotic environment of ever-changing objects can be organized. It is therefore also with reference to the

characteristics of this organizing activity—and not with reference to an external world with which perceptions are supposed to correspond—that the epistemic merit of perceptual systems should be evaluated according to Gibson. It is discriminatory, selective, and organizing skills rather than representational skills that are crucial when one perceives the world.

The empirical relevance of transferring this take on epistemology to the topic of web-based visualizations was proved in all of the three empirical papers and it was discussed in sections 4.2, 5.2, and 6.2. For instance, it was argued in section 4.2 that the crisis-monitor of the UN Global Pulse illustrates how the condition of working with distributed selection mechanisms and theoretical assumptions makes it hard to translate methodological criteria of transparency, reliability, validity, and representation into meaningful guidelines for the construction of web-based visualizations. An empirical finding of Paper One was that it simply does not make sense to evaluate the UN's crisis monitor on the basis of whether or not it provides a representative sample of a specific crisis-prone population, whether or not the tweets can be traced back to their sources, or whether or not they are honest signals. However, it is sensible to evaluate it on the basis of whether or not it is capable of spotting interesting anomalies in data streams. This mode of evaluation is based on benchmarks that are internal to the data streams and especially section 4.2 emphasized how this epistemological strategy bears important similarities to Gibson's theory of invariance in the practice of perception.
The discussion of Paper Two in section 5.2 were also focused on the issue of representation, and it was argued that it is precisely in its attempt to formulate an alternative to criteria of epistemic evaluation that the framework of 'web-vision analysis' can be said to be distinct from related approaches such as 'web-sphere analysis' and 'cross-sphere analysis'. Even though none of these adhere to traditional formulations of representative science, it was shown how the former emphasizes the need to choose seed sites that enable a representative disclosure of a web-sphere,

whereas the latter emphasizes the need to locate the filters and information gatekeepers that can be used to represent the 'logic' of specific pre-defined spheres. Paper Two illustrates the empirical relevance of translating Gibson's vocabulary into the study of web-based visualizations, as it shows that the epistemic prescriptions derived from related approaches are not meaningful as evaluative criteria for the 'web-visions' that Paper Two presents on the issue of synthetic biology.

This argument is strengthened by the arguments in Paper Three as well as by the discussion of its findings in section 6.2. An important aspect of this discussion was the argument against approaching the temporal order of a 'web-vision' as something that is external to the interactions between the distributed set of actors that co-produces it. So-called real time visualizations do not just respond to current developments and they cannot be thought of as representing a flow of time that takes place outside the visualization. On the contrary, it was argued that 'web-visions' function by establishing invariant structures as the fixed points through which the temporality of digital data is structured. This means that 'web-visions' will necessarily come to rely on historical patterns in previous data flows and the perception of real time is then inevitably based on historical knowledge. The first part of this dissertation to make this point was the discussion of the UN's crisis monitor in section 4.2, as it illustrated how the 'hotness' of a topic was modelled on the basis of insights into people's previous tweet behavior. The empirical work carried out in Paper Three motivated a restatement of this point and it illustrated how different chains of selection mechanisms produce different temporalities in the sense that some chains generate 'visions' that are more apt to change in the face of big events than others. Their temporal characteristics are shaped by the history of the chains they are built from.

The theoretical foundations of these claims can, at the most general level, be given by a return to Cooley's thoughts about the relation between the characteristic information-

technologies and the temporal characteristics of the environment of experience they enable. These thoughts were outlined in section 3.1.1 and 3.2.1, and it was argued that Cooley saw electrified communication technology as having an influence on the pace of experience. Gibson's epistemology is, however, a stronger theoretical source to use as a basis for this discussion about temporality because it supports the idea that temporal orders are produced through active engagement with the world. Time is not mirrored but rather produced in the sense that was also suggested by Uprichard in section 2.3. This is a further argument for the sensibility in turning from discussions of representation of real time data flows to discussions of the extent to which visualizations are capable of detecting invariants in the way data streams fluctuate over a specific period. What distinguishes the concept of 'web-visions' from the related frameworks discussed is precisely that it follows Gibson's argument that any detection of variance must be preceded by an attempt to derive invariants from the stream of data. It is only through the specification of invariant structures that it becomes possible to talk about variance.

A relevant question to ask is then how to construct 'web-visions' that can actually detect interesting variances. This question, finally, leads to a practical implication of the arguments made in this dissertation. This implication concerns the choices made in the construction of web-based visualizations and it can be formulated as follows:

'Web-visions' can productively be designed on the basis of case-study logics rather than logics of sampling. This can, for instance, be done by integrating known invariants into the selection mechanisms that shape the visualizations and make them 'most likely' or 'least likely' to depict specific phenomena.

The formulation of this practical implication follows from the other implications formulated above, and it ultimately has the same theoretical foundation. The suggestion to build 'web-visions' on the basis of case-study logics follows from the claim that people 'see' the world through experimental interactions with it. We have

just seen how this claim is grounded in the work of Gibson, and the implication formulated above illustrates how the framework of 'web-vision analysis' draws practical guidelines from it in relation to the choices taken in the actual construction of 'web-visions'. One such guideline is the suggestion to interpret such construction choices as a manipulation of variables that can make the 'web-vision' exhibit specific case characteristics. This is an alternative to approaching the construction of web-based visualizations through the kind of sampling logics that constitute the foundation for representative social sciences.

Both Paper Two and Paper Three provided empirical examples of the way case-study logics can guide the construction of 'web-visions'. Paper Two introduced the suggestion to construct visualizations with an ambition of making them 'most likely' or 'least likely' to exhibit specific characteristics. An example given of the way this consideration can guide practical construction choices was given by showing how the networks that depict the 'hyperopic visions' were cleaned for 'irrelevant' nodes before they were compared. It was a deliberate choice to manipulate these networks to keep them focused on the issue of synthetic biology. Webpages with less than two inlinks and webpages that did not mention synthetic biology were left out of the visualizations in order to ensure that the 'web-visions' produced were 'less likely' to differ from each other than they would have otherwise been. This manipulation was not done to make the 'web-visions' representative of the issue of synthetic biology, but rather to make the remaining differences between them more more interesting in relation to detecting the selection mechanisms that were influenctial in guiding attention to this issue.

Paper Three provided even more empirical detail as to how this case-based research strategy can be translated into practical choices in the construction of 'web-visions'. For instance, it suggested the possibility of manipulating visualizations to be 'less likely' to change in the face of American events concerning the issue of synthetic

biology. For instance, it was argued that this could be done by 'seeing' the issue through Danish 'web-visions' that proved more stable than the British 'web-visions' in the face of such events. The logic of this research strategy is once again to take advantage of the fact that if one can dectect changes in a visualization that is manipulated to be unlikely to change, then it is possible to interpret it as a strong signal of change. This logic is also similar to the way the producers of the UN's crisis-monitor suggest looking for anomalies rather than representative samples when identifying early crisis signals in crisis-prone populations. Ultimately, it can be said that the suggestion to produce 'web-visions' on the basis of case-study logics involves choosing known invariants (such as stability in Danish 'web-visions' or extended tweets about the economy at the beginning of the month) as the reference against which flows of data are interpreted.

It has already been argued that this approach to the construction of 'web-visions' is in line with the theoretical foundations outlined in Chapter III as well as with the three implications outlined in this section so far. But section 6.2 gave further theoretical grounding to the approach by emphasizing its similarities to the technique of 'provoked containment' of reality, which was the backbone of many experiments in the first half of the 20th century and which has been taken up in recent methodological discussions inspired by pragmatist philosophy. When visualizations are constructed on the basis of 'web-vision analysis', it can be argued that they are 'provoked' in the sense that they are constructed with the intention of triggering an effect of the object studied and thereby revealing something that is not already available. This is done by altering specific variables while holding others constant. Furthermore, it can be argued that they are 'contained' because a central element of the experimental design is to establish a clearly demarcated space within which reality can be managed without overflowing.

This means that the concept of a 'web-vision' can be seen as part of a reinvigoration of experimental logics that accept the need for containments or demarcations in order for focused attention to be possible. This is an argument that can once again be traced back to both Cooley's concept of 'variegation' and Gibson's thoughts about perception as the result of active experimentation. The discussion about 'provoked containment', however, shows that it can also be found in recent writings on methods. This suggestion to 'bring back demarcation' is also a central part of what makes the framework of 'web-vision analysis' distinct from the other takes on digital methods outlined in Chapter II. This is especially the case if one discusses 'web-vision analysis' up against an approach such as 'second-degree obejctivity', but it is also true if one speaks of related approaches such as that of Marres. Even though the framework of 'web-vision analysis' takes many of Marres's points about redistribution to heart, it is clear that it draws slightly different methodological consequences from the way the digital environment affords new modes of empirical social analysis. The remediation of existing methodological critiques that Marres aims at with the notion of a 'revenge of methods', for instance, does not come with a suggestion to move towards experimental methods in the same way as the framework of 'web-vision analysis' does.

The formulation and discussion of the fourth implication above has hopefully also illustrated why 'web-vision analysis' is different from a research strategy that aims at representing reality through samples. 'Web-visions' are the results of processes of distillation of reality that are tightly connected to the technological devices used in the experimental setups. They can be seen as outcomes of attempts to purify an experimental situation, and the fact that this is done through technologies makes it evident that the goal of the experiment is not to produce an unmediated version of a specific social phenomenon. It is rather to perform the social world and affect it through transformations, experimental separations, and artificial conjunctions. This is what makes 'web-visions' share characteristics with the experiments of the early 20th

century. The technologies used to produce such 'visions' are therefore not to be seen as instruments for recording and reproducing evidence, but rather as tools for provoking specific forms of outcomes and containing these outcomes in manageable visualizations.

This section has outlined four implications of the arguments and findings in this dissertation so far and together they illustrate what is meant by the suggestion to approach web-based visualizations as 'web-visions'. If one chooses to approach such visualizations on the basis of the framework of 'web-vision analysis' one must adhere to the implications listed above no matter whether one's aim is to discuss these emerging devices analytically or whether one's aim is to engage in an actual construction process. When looking at the four implications, it should be emphasized that they provide a basis for engaging in the discussion of all the four themes that were argued to be central to contemporary theorizing on digital methods in Chapter II. In combination they provide inputs to the discussion about the role that theory plays in the construction of web-based visualizations (section 2.1); the extent to which such visualizations can be said to be representative (section 2.2); the way temporality is organized in longitudinal visualization projects (section 2.3); and the consequences that the distribution of data raises for proponents of digital methods (section 2.4). In line with the tenets of pragmatism introduced in section 1.2 it is clear from the arguments so far that the framework of 'web-vision analysis' carries both descriptive and prescriptive points in relation to these themes.

This dissertation will end with some brief concluding remarks that relate the four implications formulated in this subsection to the research questions that were formulated in the introduction. Before reaching these concluding remarks, the next section will make an attempt to translate the four implications above into suggestions for future studies that take the concept of 'web-visions' as the theoretical foundation

from which to ask questions about web-based visualizations. More specifically, it will suggest how the theoretical arguments of this dissertation can be used to guide research projects within the field of organization analysis.

7.2 Suggestions for Future Studies within the Field of Organizational Analysis

The section above distilled the main points of this dissertation into four implications that illustrate how web-based visualizations should be approached if they are thought of as 'web-visions'. One of the motivations of coining the concept of 'web-visions', as well as deriving implications from the concept, has been to offer a theoretical framework that can motivate a different way of thinking about and producing web-based visualizations than the ones suggested in Chapter II. Because the framework of 'web-vision analysis' highlights the practical dilemmas involved in the construction of web-based visualizations, it can be argued to be an especially suitable theoretical foundation from which to analyse the use of web-based visualizations in organizational contexts. This section will therefore provide a brief indication of ways in which the implications outlined in section 7.1 can be used as a foundation for conducting future analyses of web-based visualizations within the field of organizational analysis.

This will be done by relating the framework of 'web-vision analysis' to a theme that has been central to organizational analysis for a long time. This theme concerns the way technologies structure the relation between organizations and their environment. It is perhaps not the most common question in contemporary organizational theory, but it was at the centre of the field in the 1950's, when the so-called contingency theorists (see for instance Harvey 1968) argued for the need to focus scholarly attention on it. The theorists who wrote under this heading saw technology as a 'contingency factor' that has an impact on the level of control an organization can have over its production,

the extent to which authority can be centralized in an organization, the extent to which rules can be formalized, and so on. This led the contingency theorists to argue that any decision taken within an organization that favors a specific mode of organizing must take into account the development of state-of-the-art technologies. The contingency theorists, accordingly, gave the concept of 'technology' an equally thorough treatment as the concepts 'power' and 'meaning' are given in current organizational theory.

A point to take away from this brief description of contingency theory is that organizations formulate their functions and tasks in ways that are shaped by the technologies that organize their encounters with the environment. This idea has also been important in subsequent studies of bureaucracy, which is a mode of organization that relies heavily on technical devices to structure such encounters. An especially interesting paper in this regard illustrates how the modes of organization that dominated the rising American bureaucracy in the late 19th century were to a large extent shaped by the kind of technologies that were used to manage the increasing amount of information about American citizens (Stephens & Lubar 1986). Whereas private companies enrolled technologies such as the typewriter, the Dictaphone, the telephone, and the vertical filing cabinet—and built their organizational design around their affordances—this was not the case with the bureaucratic administration. It responded to the new 'information overload' by expanding existing systems for filing information rather than adopting new labour-saving technologies. The fact that private companies and the government differed in the technologies they adopted also meant that they established different relations to their environment.

A third example of the way technology shapes the relation between organizations and their environment can be found in recent studies published under the heading of economic sociology. It has already been mentioned earlier in this dissertation how these studies have suggested a need to look at the way 'market devices' organize

people's evaluations of entities in their surroundings. In an organizational context, this theme is especially well studied in the case of financial analysts, and it has been shown that stocks (taken as entities in the economic environment) are valued in a way that is shaped by state-of-the-art classification schemes (Zuckerman 2004) and software programs (Prato & Stark 2011). It has similarly been shown how 'market devices' with different assumptions have deliberately been used as a cure against the kind of conservative group-think that can come to shape the way organizations relate to their environment. Traders simply use technical models as social cues to reveal the interpretations of other traders in a process of 'reflexive modeling' that challenges their assumptions about the environment in which they act (Beunza & Stark 2012).

This brief description of studies conducted by contingency theorists, bureaucracy scholars, and economic sociologist serves to show that the question about the way new technologies organize the relation between an organization and its environment has been of continuous relevance to the field of organization studies. This question is not far from asking how technologies structure attention to the environment and the point that this section endeavours to make is that the rise of 'Big Data' and web-based visualizations are empirical developments that suggest a need to reinvigorate an academic focus on this theme. Just as technological developments in the late 19th century led to new types of information that challenged the established relation between the public bureaucracy and the American citizens, so does the spread of digital methods challenge similar boundaries. The overall theme of 'information overload' is recurring across these historical contexts, and it is clear from the arguments in this dissertation that new digital data flows are reflecting some well-known challenges. Comparing the analysis of the UN Global Pulse in Chapter IV with that of 19th century American bureaucracy, it is, for instance, clear that questions about centralization and decentralization of information processing, control over the

structures of metadata, and transparency in data processing are as relevant now as they were in the 19th century.

The framework of 'web-vision analysis' is well suited for bringing these questions of organizational analysis into the digital realm. The four implications outlined above make it clear that 'web-vision analysis' offers a theoretical framework that equips the researcher to pose different questions about the relation between web-based visualization techniques and the perception of the organizational environment than the other frameworks introduced in Chapter II. By grounding a study of the organizational use of Big Data in Cooley's work on the telegraph, one is first of all not tempted to interpret the rise of big chunks of digital traces as so revolutionary that it finally does away with epistemological and normative challenges. One becomes aware that information technology and new forms of data have always ignited dreams about a smooth relation between the organization and the environment as well as dilemmas regarding this dream. Instead of treating the development of digital methods as something that enable organizations to pick up honest and unmediated signals from their environment, 'web-vision analysis' would entail seeing it as evoking some classic questions about the organization of perception and knowledge in new ways. Rather than theorizing about the modes of knowledge organization that are in principal possible with the introduction of this new data, it suggests looking at sociological dynamics in the distributed network of human and non-human actors involved in the production of 'web-visions'. The affordances of such 'visions', and the way they can potentially re-organize the relation between an organization like the UN and its environment, is seen as settled in-between situated construction practices, influential events, human intentions, and material infrastructures.

This is a descriptive claim that can be used as a foundation for participating in discussions about the epistemological status of the visualizations produced in

organizations, like the UN, for debating normative issues such as the legitimacy of the knowledge produced through these methods and for analysing the extent to which they re-organize the relation between organizations and their environments. Three general questions that can be asked on the basis of the framework of 'web-vision analysis' could, for instance, be: How do new technological possibilities and existing organizational norms become aligned in the creation of new modes of attention to the environment in organizations like the UN? What is the procedure through which new modes of seeing become accepted and legitimized? And what new professional skills come into demand when organizational 'vision' is re-organized? Technologies and methods are often important mediators of the divisions of labour within knowledge intensive organizations, and in relation to the case of the UN, two further relevant questions could be: What kind of knowledge cultures are clashing in the movement from household surveys to web-based visualizations? And to what extent is the established understanding of data-legitimacy affected when data is produced through socio-technical networks that do not live up to traditional criteria of data validity and transprency?

Being grounded in a pragmatic tradition that makes no hard distinction between description and prescription, it should also be emphasized that the framework of 'web-vision analysis' suggests using empirical findings as a basis from which to raise normative dilemmas. In relation to the UN, one such dilemma could concern the role that traditional methodological criteria such as validity and reliability *should* play in the practice of crisis management and crisis monitoring. If such practices are to live up to classic criteria of good bureaucratic management, it would, for instance, mean that they would have to prioritize unambiguous accountability of the data processing (Jacques 1991). Looking at the kind of metrics that the UN is producing on the basis of streams of Big Data, it is, however, interesting that they are conditioned upon the need to give authority to groups that cannot be held accountable for the information they

provide. The people tweeting and the persons employed by Twitter are not internal to the organization of the UN, but they are nonetheless given authority in the process of constructing the monitor depicted in Paper One.

Central tenets of bureaucracy accordingly seem to be at odds with developments in digital methods in interesting ways on this issue. Where to place the accountability of data validity in such an order is namely a tricky issue, and the problems of accountability that have lately emerged around Google is a telling example of the way the ideal of accountability is challenged with the rise of digital traces. Google's way of sorting Big Data is based upon a distribution of authority to 'crowds' of internet-users, and this design of information-filtering has, for instance, led to a situation where searches for 'Jews' have brought back anti-Semitic information to Google's users. However, courts have had huge difficulties in ascribing accountability for this kind of information because Google pushes the accountability to the 'crowd'. Similar normative questions about the role that accountability should play in organizational designs could be relevant to focus upon when studying the way organizations like the UN integrate Big Data and web-based visualizations into their decision-making.

The framework of 'web-vision analysis' suggests taking such normative discussions from a pragmatic foundation that looks at the situation in which the visualizations are produced, rather than taking them on the basis of pre-established principles for good organizational practices. This approach is also reflected in the implication formulated above concerning the potential of using case-study logics as a basis from which to construct visualizations. This implication is derived from a practical experience with the construction of visualizations that illustrated why pre-established guidelines for quantitative social science were hard to translate into the production of web-based visualizations. Future studies on the introduction of Big Data and web-based visualizations into organizational contexts that use the framework of 'web-vision

analysis' as their basis should therefore ask questions about the way their descriptive findings challenge established prescriptions regarding knowledge production in the organizational contexts of interest.

Concluding Remarks

Chapter VII was written as a summarizing and concluding chapter, and the concluding remarks in this section will therefore be very brief. The main purpose of these final remarks is to illustrate how the arguments in this dissertation have served to answer the two general research questions that were formulated in the introduction. Since this dissertation has been filled with summarizing and concluding sections, this section will not restate what has already been formulated. It will rather point to the sections in this dissertation where the answers to the two questions can be found, since this has not been explicated in the discussion sections so far. The first of the two research questions in the introduction was formulated as follows:

Which actors are involved in the construction of web-based visualizations that create manageable depictions of social reality, and what are the central challenges and trade-offs facing producers of such visualizations?

All three of the empirical papers have provided inputs to answering this question. Paper One was especially focused on the latter part of the question in that it outlined the trade-offs that producers of visualizations inevitably face concerning the distribution of data formatting and the role that automatization plays in the construction process. The details of these challenges can be found by returning to section 4.2, where it was also argued that they are a consequence of the distributed chain of actors involved in the processes of turning vast amounts of digital traces into manageable depictions of the social world. This leads us back to the first part of the question above, which was also touched upon in all three empirical papers. It was especially discussed in section 6.2, which used the findings of Paper Three to reflect on the distributed chain of actors that are necessarily enrolled in the production of web-based visualizations.

The arguments in these sections were ultimately synthesized into the first theoretical implication formulated in section 7.1, which can also be read as an answer to the fist research question. This implication claimed the need to see 'web-visions' as objects existing 'in-between' a range of human and non-human actors. Some of these actors are tied to the situation in which the visualization is produced. Examples of such actors given in Paper One were the available technological infrastructures and data formats; the assumptions about legitimate knowledge production in the contexts in which the visualizations are to be used; and the perception that the producer of the visualization has of the situation. Other actors influence the shape of the visualization from a further distance, and it was especially emphasized in Paper Three how events such as the launch of a report by Barrack Obama had the potential to influence the shape of visualizations about synthetic biology. The details of the answers to the first research question can accordingly be found in the summarizing sections throughout this dissertation, but it should be noted that a central outcome of these answers was the argument that it is a promising move to draw on Cooley, Gibson and Espeland to argue that web-based visualizations should be thought of as 'visions' that are produced by an active chain of human and non-human actors.

The suggestion to introduce the concept of 'web-visions' as distinct from other concepts in the field of digital methods is therefore also an implicit answer to the second research question in the introduction. This question was formulated as follows:

To what extent do existing methodological vocabularies capture the epistemological and normative characteristics of the realities that digital methods and web-based visualizations produce?

This question has also been discussed and answered in various sections throughout this dissertation. The foundation for this discussion was laid in Chapter II, where state-of-the-art approaches to digital methods and web-based visualizations were reviewed. It

was argued that the themes of theory, representation, temporality, and distribution were at the core of contemporary discussions within the field. This dissertation has continuously focused on the ways in which the concept of 'web-visions' can be said to guide a different understanding of the epistemological and normative characteristics of the realities that digital methods and web-based visualizations produce than the approaches outlined in Chapter II. The attempt to answer the second research question dominated sections 4,2 5.2, and 6.2, that each used findings in the empirical papers to point out the distinctiveness of conceptualizing web-based visualizations as 'web-visions'.

The details of the arguments can be found in these three sections and they will not be repeated here. However, it can briefly be stated that section 4.2 showed how the concept of 'web-visions' leads to a different take on the themes of theory and representation than approaches suggested by Anderson, Latour, and Venturini. Section 5.2 focused on micro-differences between the approach to representation suggested by 'web-vision analysis' and those suggested by related theorists such as Rogers and Marres. Section 6.2 focused on the themes of temporality and distribution, and it was especially focused on the extent to which 'web-vision analysis' provides an alternative to mono-causal theories of visualizations, such as the ones promoted by Pariser. It furthermore touched upon the extent to which it offers a different way of approaching the construction and function of web-based visualizations than related approaches such as that of Marres and Weltevrede. The main points of these discussions were finally summarized in the formulation of the second, third, and fourth implications in section 7.1. Each of these implications indicated aspects where the framework of 'web-vision analysis' has a distinct way of interpreting the epistemological and normative aspects of the realities that digital methods and web-based visualizations can and should produce.

The second implication emphasized that a 'web-vision' is inevitably a theoretical entity even though the theoretical assumptions on which it is built are not necessarily related to the topic of the visualization. The framework of 'web-vision analysis' therefore suggests looking closer at the role played by non-topological theories in the production of web-based visualizations and to accept that they can never be neutral devices. The third and fourth implications suggested possible responses to the distributed and non-transparent character of the selection chains that function as the backbone of 'web-visions'. The third implication illustrated how the choice to conceptualize web-based visualizations as 'visions' involves a move away from evaluating them as representations of the world towards thinking about them as experimental detections of invariances. This epistemological argument was linked back to Gibson's theory of perception, and it was finally translated into the fourth implication, which argued for the potential of designing web-based visualizations on the basis of case-study logics rather than logics of sampling.

The detailed argument for the way these implications are derived from the empirical findings of this dissertation can be found by returning to sections 4.2, 5.2, 6.2 and 7.1. These concluding remarks has just summarized some of the main arguments of this dissertation and linked them to the formulation of the two research questions in the introduction. Since the questions were formulated in a very general fashion they have also been given very general answers. It has primarily been argued that the dissertation has shown how the choice of thinking about web-based visualizations as 'web-visions' leads to new questions about the actors involved in the production of these visualizations and ignites new questions about their epistemological and normative aspects. The introduction of the framwork of 'web-vision analysis' has been the main ambition of the dissertation and it has been highlighted where the concept of 'web-visions' has its theoretical roots, and where it is argued to be distinct from even closely related approaches within the field of digital methods. Whether or not 'web-visions' is

a concept that allows for taking the first steps down a new theoretical road in the analysis and construction of web-based visualizations cannot be decided here. Only time will tell whether it can serve as a useful heuristic for scholars within the field of digital methods, or whether it is a doctoral attempt at entering this field that will soon be forgotten.

Bibliography

(Includes both the references in the three papers and the references in the meta-text around them)

A

Ackland, Robert, Gibson R., Lusoli, W, and Ward, S. (2010). Engaging with the Public? Assessing the Online Presence and Communication Practices of the Nanotechnology Industry. *Social Science Computer Review,* 28(4), 443–65.

Adamic, L. A., & Glance, N. (2005). The Political Blogosphere and the 2004 U.S. Election: Divided They Blog. *Proceedings of the 3rd International Workshop on Link Discovery in Chicago, Illinois*, 36-43.

Adkins, L. & Lury, C. (2011). Introduction: Special Measures. *The Sociological Review*, 59, 5–23.

Adkins, L & Lury, C. (2009). Introduction: What Is the Empirical? *European Journal of Social Theory*, 12(1), 5-20.

Anderson, C. (2008). The End of Theory: The Data Deluge Makes the Scientific Method Obsolete. *Wired Magazine,* 16.07.

Andjelic, A. (2010-2012). *I [love] Marketing*. Blogroll. Retrieved February 24, 2012 from the blog http://anaandjelic.typepad.com/.

B

Battelle, J. (2006), *The Search - How Google and its Rivals Rewrote the Rules of Business and Transformed our Culture*. New York: Portfolio

Beunza, D., & Garud, R. (2007). Calculators, Lemmings or Frame-makers? The Intermediary Role of Securities Analysts. *The sociological review*, 55(s2), 13-39.

Beunza, D., & Stark, D. (2012). From Dissonance to Resonance: Cognitive Interdependence in Quantitative Finance. *Economy and Society*, 41(3), 383-417.

Blair, A. (2003). Reading Strategies for Coping with Information Overload ca. 1550-1700. *Journal of the History of Ideas*, 64(1), 11-28.

Borgatti, S.P, Everett, M.G. and Freeman, L.C. (2002). *Ucinet for Windows: Software for Social Network Analysis*. Harvard, MA: Analytic Technologies

boyd, D., & Crawford, K. (2011). Six Provocations for Big Data. Paper presented at *A Decade in Internet Time: Symposium on the Dynamics of the Internet and Society*, Oxford University, September 21. Retrieved March 8th, 2013 from the website: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1926431.

Braund, M. J. (2008). The Structures of Perception: An Ecological Perspective. *Kritike*, 2, 123-144.

Brin, S. & Page, L. (1998). The Anatomy of a Large-Scale Hypertextual Web Search Engine. *Computer Networks and ISDN Systems*, 30 (1-7), 107-117.

Bruns, A. (2012). Twitter, Big Data, and the Search for Meaning – Methodology in Progress. Presentation at *Digital data – lost, found, and made,* Copenhagen University, October 16th.

Bryman, A. (2004). *Social Research Methods*, (2nd ed), Oxford University Press.

C

Callon M. (1986). Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay. In J. Law (Eds.), *Power, Action and Belief: A New Sociology of Knowledge?* (pp. 196-223). London: Routledge.

Callon, M. and Muniesa, F. (2005). Peripheral Vision — Economic Markets as Calculative Collective Devises. *Organization Studies,* 26(8), 1229–1250.

Carey, J. W. (1989). *Communication as Culture - Essays on Media and Society*. Winchester, MA, USA:
Unwin Hyman.

Carusi, A. (2009). Philosophy Engines: Technology and Reading/Writing/Thinking Philosophy, *Discourse*, 8(3), Retrieved March 8th, 2013 from the website: http://ssrn.com/abstract=1505970

Carusi, A., Novakovic, G. and Webmoor, T. (2010). Are Digital Picturings
Representations?, *EVA2010 Conference Proceedings*. Retrieved March 8th, 2013 from the website: http://ssrn.com/
abstract=1929438

Chemero, A. (2003). Radical Empiricism Through the Ages, *Contemporary Psychology: APA Review of Books*, 48(1), 18-21.

Cooley, C.H. (1912), Valuation as a Social Process, *The Psychological Bulletin*, ix(12).

Cooley, C.H. (1909), *Social Organization – A Study of the Larger Mind*. Cornell University Library

Cooley, C.H. (1897), The Process of Social Change. In J. D. Peters, & P. Simonson (Eds.), *Mass Communication and American Social Thought Key Texts 1919-1968* (pp. 21-25). Rowman & Littlefield.

Cormode, G., & Krishnamurthy, B. (2008). Key Differences Between Web 1.0 and Web 2.0. *First Monday*, 13(6), 2.

D

Davies, S. R., Glerup, C. & Horst, M. (Forthcoming). On Being Responsible: Multiplicity in Responsible Development. In A. Ferrar et al. (Eds.)*Nanotechnology and Responsibility*. London: Springer.

Dewey, J. (1938). *The Theory of Inquiry*. New York: Holt, Rinehart & Wiston, USA.

Dewey, J. (1927). *The Public and its Problems*. Ohio University Press, USA.

du Gay, P. & Madsen, A.K. (2013), Introduction to the Second Edition. In du Gay et al., *Doing Cultural Studies – The Story of the Sony Walkman*, (2nd Eds.). Retrieved March 8th, 2013 from the website: http://www.uk.sagepub.com/upm-data/54534_du_gay_intro_to_2nd_ed.pdf

E

Emirbayer, M. (1997). Manifesto for a Relational Sociology, *The American Journal of Sociology* ,103(2), 281–317.

Emirbayer, M. & Mische, A. (1998). What Is Agency?, *American journal of sociology*, 103(4), 962-1023.

Espeland, W. (1998). *The Struggle for Water: Politics, Rationality, and Identity in the American Southwest*. University of Chicago Press.

Espeland, W. N. & Sauder, M. (2007). Rankings and Reactivity: How Public Measures Recreate Social Worlds, *American Journal of Sociology*, 113(1), 1-40.

F

Febvre, L. & Martin, H.-J. (1976). *The Coming of the Book - The Impact of Printing 1450-1800*. Verso

Flyvbjerg, Bent. (2004). Five Misunderstandings about Case-Study Research, *Sosiologisk Tidsskrift*, 12(2), 117-42.

G

Gane, N. (2011). Measure, Value and the Current Crises of Sociology, *The Sociological Review*, 59, 151–173.

Gerhards J. & Schaefer M.S. (2010). Is the Internet a Better Public Sphere? Comparing Old and New Media in the USA and Germany, *New Media & Society,*12(1), 143-160.

Gibson, J. J. (1986). *The Ecological Approach to Visual Perception*. Psychology Press.

Gillespie, T. (forthcoming). The Relevance of Algorithms. In T.Gillespie, P. Boczkowski & K. Foot (Eds.), *Media Technologies*, MIT Press, Cambrige. Retrieved April 2nd from the website: http://6.asset.soup.io/asset/3911/8870_2ed3.pdf.

Global Pulse. (2011). *Twitter and Perceptions of Crisis Related Stress*. Retrieved January 11th, 2013 from the website:
http://www.unglobalpulse.org/projects/twitter-and-perceptions-crisis-related-stress.

Global Pulse. (2011a). *Streams of Media Issues - Monitoring World Food Security*. Retrieved January 11th, 2013 from the website:
http://www.unglobalpulse.org/projects/news-awareness-and-emergent-information-monitoring-system-food-security.

Global Pulse. (2011b). *Using Social Media and Online Conversations to add Depth to Unemployment Statistics*. Retrieved January 11th, 2013 from the website:.http://www.unglobalpulse.org/projects/can-social-media-mining-add-depth-unemployment-statistics.

Glynn, C. et al. (2004). *Public Opinion*, (2nd Eds.), Westview Press, USA

Govcom.org. (no date). *Issuecrawler.net - Scenarios of Use for NGOs and Other Researchers*. Retrieved November 29th 2011 from the website: http://www.govcom.org/scenarios_use.htm

Granovetter, M. (1973). The Strength of Weak Ties, *American Journal of Sociology*, 78(6), 1360-1380.

H

Hacking, I. (1990). *The Taming of Chance*. Cambridge University Press.

Halavais, A. (2008). *Search Engine Society*. Polity Press.

Harvey, E. (1968). Technology and the Structure of Organizations. *American Sociological Review*, 247-259.

Hjarvard, S. (2008). The Mediatization of Society - A Theory of the Media as Agents of Social and Cultural Change, *Nordicom Review,* 29(2), 105-134

Hutchby, I. (2001). Technologies, Texts and Affordances, *Sociology,* 35, 441–56.

J

Jaques, E. (1991). In Praise of Hierarchy. *Markets, Hierarchies and Networks: The Coordination of Social Life*, 48-52.

James, W. (1907), What Pragmatism Means. In L. Manand (Eds.) *Pragmatism – A Reader*, (pp. 93-112), Vintage Publishing

James, W. (1907a), Pragmatism´s Conception of Truth. In L. Manand (Eds.) *Pragmatism – A Reader,* (pp. 112-132), Vintage Publishing

K

Kelly, J. et al. (2009). *Mapping the Arabic Blogosphere: Politics, Culture, and Dissent*, Berkman Center Research Publication. Retrieved November 13th 2011 from the website: http://cyber.law.harvard.edu/publications/2009/Mapping_the_Arabic_Blogosphere.

Kelly, J. and Bruce E. (2008). *Mapping Iran´s Online Public: Politics and Culture in the Persian Blogosphere*, Berkman Center Research Publication. Retrieved November 13th 2011 from the website: http://cyber.law.harvard.edu/publications/2008/Mapping_Irans_Online_Public/.

Kelly, J. (2008). *Pride of Place: Mainstream Media and the Networked Public Sphere*, Berkman Center Research Publication. Retrieved November 13th 2011 from the website: http://cyber.law.harvard.edu/sites/cyber.law.harvard.edu/files/Pride%20of%20Place_MR.pdf.

Ki-Moon, B. (2011). Secretary-General's Remarks at General Assembly Briefing on the Global Pulse Initiative. Retrieved January 11th 2012 from the website: http://www.un.org/sg/statements/?nid=5668.

L

Latour, Bruno. (no date). Bruno Latour on Mapping Controversies. Video. Retrieved November 11th 2011 from the website: http://mappingcontroversies.net/Home/PlatformMappingControversiesVideoIntroduction

Latour, B. (2011). Networks, Societies, Spheres: Reflections of an Actor-Network Theorist. *International Journal of Communication*, *5*(2011), 796-810.

Latour, B. (2010). Tarde's Idea of Quantification. In M. Candea (Eds.) *The Social After Gabriel Tarde: Debates and Assessments,* (pp. 145-163), Routledge.

Latour, B. (2010a). An Attempt at a "Compositionist Manifesto". *New Literary History*, 41(3), 471-490.

Latour, B. (2007). Beware, Your Imagination Leaves Digital Traces. *Times Higher Literary Supplement*, *6*(4).

Latour, B. (2005). *Reassembling the Social — An Introduction to Actor-Network Theory.* Oxford: Oxford University Press.

Latour B. (1991). Technology is Society Made Durable. In J. Law (Eds.) *A Sociology of Monsters? Essays on Power, Technology and Domination*, (pp. 103-131), Routledge, London.

Latour, B. (1990). Visualisation and Cognition: Drawing Things Together. In M. Lynch and S. Woolgar (Eds.) *Representation in Scientific Practice,* MIT Press, Cambridge. Retrieved December 10th 2012 from the website: http://www.bruno-latour.fr/sites/default/files/21-DRAWING-THINGS-TOGETHER-GB.pdf.

Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers through Society*. Harvard University Press.

Latour, B., Jensen, P., Venturini, T., Grauwin, S., & Boullier, D. (2012). *The Whole is Always Smaller than its Parts – A Digital Test of Gabriel Tardes' Monads*. Retrieved December 10th 2012 from the website: http://www.bruno-latour.fr/sites/default/files/123-WHOLE-PART-FINAL.pdf.

Latour, B., & Lépinay, V. A. (2009). *The Science of Passionate Interests- An Introduction to Gabriel Tarde's Economic Anthropology*. University of Chicago Press.

Latour, B. & Woolgar, S. (1986). *Laboratory Life: The Construction of Scientific Facts.* (2nd Eds). Princeton University Press, USA

Law, J., Ruppert, E., & Savage, M. (2010). The Double Social Life of Method. Presentation at the *6th Annual CRESC conference on the Social Life of Method,* St Hugh's College, 31st August–3rd September.

Lazer, D. et. al. (2009). Computational Social Science. *Science Magazine*. Vol. 323: 721-723.30(1-7): 107-117

Levin, P., & Espeland, W. N. (2002). Pollution Futures: Commensuration Commodification and the Market for Air. In A. J. Hoffman & M. J. Ventresca (Eds.) *Organizations, Policy, and the Natural Environment: Institutional and Strategic Perspectives,* Stanford: Stanford University Press.

Lezaun, J. (2007). A Market of Opinions: The Political Epistemology of Focus Groups. *The Sociological Review*, *55*(s2), 130-151.

Lezaun, J., Muniesa, F., & Vikkelsø, S. (2012). Provocative Containment and the Drift of Social-Scientific Realism. *Journal of Cultural Economy*, Retrieved February 22nd 2013 from the website: http://www.tandfonline.com/doi/full/10.1080/17530350.2012.739972

M

MACOSPOL. (no date). Macospol Platform. Retrieved November 29th 2011from the website: http://www. mappingcontroversies.net/Home/PlatformOverview

Madsen, A. K. (2012). Web-Visions as Controversy-Lenses. *Interdisciplinary Science Reviews*, 37(1), 51-68.

Madsen, A.K (2013). Virtual Acts of Balance! Virtual Technologies of Knowledge-Management as Co-Produced by Social Intentions and Technical Limitations, *Electronic Journal of E-Governance.*

Madsen, A. K. (2013a). Steps Towards a Conceptualisation of Digital Institutions of Knowledge. *Science Technology & Society*, 18(1), 63-74.

Manovich, L. (2008). *Software Takes Command*, Retrieved January 20th 2012 from the website: http://lab.softwarestudies.com/2008/11/softbook.html

Marres, N. (2012). *Material Participation: Technology, the Environment and Everyday Publics*. Palgrave Macmillan.

Marres, N. (2012a). The Experiment in Living. In C. Lury and N. Wakeford (Eds.), *Inventive Methods: The Happening of the Social*, Routledge, London.

Marres, N. (2012b). The Redistribution of Methods: On Intervention in Digital Social Research, Broadly Conceived. *The Sociological Review*, *60*(S1), 139-165.

Marres, N. (2009). *Sustainable Homes*. Controversy-Map. Retrieved June 15th 2011from the website: http://www.mappingcontroversies.net/Home/PlatformSustainableHomes

Marres, N. (2005). *No Issue, No Public: Democratic Deficits after the Displacement of Politics*. PhD thesis. University of Amsterdam.

Marres, N. & Weltevrede, E. (2012). Scraping the Social? Issues in Real-Time Social Research. *Journal of Cultural Economy (subm)*, pp. 1-52. Retrieved October 19th 2012 from the website: http://eprints.gold.ac.uk/6768/.

Marres, N., & Rogers, R. (2008). Subsuming the Ground: How Local Realities of the Fergana Valley, the Narmada Dams and the BTC pipeline are Put to Use on the Web. *Economy and Society*, 37(2), 251-281.

Marres, N. and Richard R. (2005). Recipe for Tracing the Fate of Issues and their Publics on the Web. In B. Latour & P. Weibel (Eds.) *Making things public — Atmospheres of Democracy*, (pp. 922–936). MIT Press, Cambridge, MA.

Marvin, C. (1988). *When Old Technologies were New*. New York: Oxford University Press.

McKenzie, D. (2008). *An Engine, Not a Camera: How Financial Models Shape Markets*, MIT Press, Cambridge, MA.

McKinsey Global Institute. (2011). Big Data: The Next Frontier for Innovation, Competition, and

Productivity. Retrieved August 1st 2012 from the website: http://www.mckinsey.com/insights/mgi/research/technology_and_innovation/big_data_the_next_frontier_for_innovation.

Menand, L. (1997). An Introduction to Pragmatism. In L. Manand (Eds.) *Pragmatism – A Reader,* (pp. xi-xxxv), Vintage Publishing

Muniesa F, Millo Y and Callon M. (2007). An Introduction to Market Devices. *Sociological review* 55(s2), Wiley: 1-12.

N

Newman, M., Barabasi, A. L., & Watts, D. J. (2011). *The Structure and Dynamics of Networks*. Princeton University Press.

Niederer, S., & van Dijck, J. (2010). Wisdom of the Crowd or Technicity of Content? Wikipedia as a Sociotechnical System. *New Media & Society*, 12(8), 1368-1387.

Norman, D. A. (2002). *The Design of Everyday Things*. Basic Books.

O

O´Reilly, T. (2007). What is Web 2.0: Design Patterns and Business Models for the Next Generation of Software. *Communications & Strategies*, (1), 17.

P

Pallaris, C. (2009). *OSINT as Knowledge, Activity and Organization - Trends, Challenges and Recommendations*. Retrieved February 27th 2012 from the website: http://www.eurosint.eu/system/files/docs/osint-knowledge-activity-organization.pdf.

Pallaris, C. (2011). The Four Architectures of Competitive Intelligence. Presentation. *360 Degree Indian CI Conference*

Pariser, E. (2011). *The Filter Bubble – What the Internet is Hiding From You*. London: Penguin Press.

Pentland, A. S., & Pentland, S. (2008). *Honest Signals: How They Shape our World*. MIT press.

Pentland, A. (2012). *Reinventing Society in the Wake of Big Data*. Video. Retrieved October 1st 2012 from the website: http://www.edge.org/conversation/reinventing-society-in-the-wake-of-big-data

Pierce, C. S. (1878). How to Make Our Ideas Clear. In Talisse & Aikin (Eds.) *The Pragmatism Reader – From Pierce to the Present*, Princeton University Press.

Poon, M. (2007). Scorecards as Devices for Consumer Credit: The Case of Fair, Isaac & Company Incorporated. *The Sociological Review*, 55(s2), 284-306.

Porter, A. and Stephen C. (2011). A Forward Diversity Index. *Scientometrics,* 90(2): 407-427

Porter, A. et al. (Forthcoming). Forecasting Innovation Pathways:
The Case of Nano-Enhanced Solar Cells, *Technological Forecasting & Social Change*

Porter, A. and John G. (2011). Assessing the Human and Social Dynamics Program. Paper presentation. *Conference on Science and Innovation Policy*, Atlanta.

Plesner, U & Horst, M. (2012). Before Stabilization: Communication and non-standardization of 3D digital models in the building industry, *Information, Communication & Society.* 1-24

Prato, M. and David S. (2011). Attention Structures and Valuation Models: Cognitive Networks Among Security Analysts. Working Paper Series, Center on Organizational Innovation, Columbia University.

Press, G. (2012). Big Data News Flash: First Ever U.S. Census Bureau API. Blogpost. Retrieved February 15th 2013 from the website: http://whatsthebigdata.com/2012/06/29/big-data-news-flash-first-ever-u-s-census-bureau-api/

R

Rogers, R. (2004). *Information Politics on the Web*. Cambridge, MA: MIT Press.

Rogers, R. (2009). *The End of the Virtual: Digital Methods*.Vossiuspers UvA.

Rogers, R., & Marres, N. (2000). Landscaping Climate Change: A Mapping Technique for Understanding Science and Technology Debates on the World Wide Web. *Public Understanding of Science*, 9(2), 141-163.

Ruppert, E. (2011). Population objects: Interpassive subjects. *Sociology*, *45*(2), 218-233.

Ruppert, E., & Savage, M. (2011). Transactional politics. *The Sociological Review*, *59*(s2), 73-92

S

Savage, M., & Burrows, R. (2007). The Coming Crisis of Empirical Sociology. *Sociology*, 41(5), 885-899.

Savage, M. & Burrows, R. (2009). Some Further Reflections on the Coming Crisis of Empirical

Sociology. *Sociology*, 43(4): 765–775.

Schneider, S. M. and K. A. Foot. (2005). Web Sphere Analysis: An Approach to Studying Online Action. In C. Hine (Eds.) *Virtual Methods — Issues in Social Research on the Internet*, (pp. 157–171), Oxford: Berg.

Stark, D. (2008). Searching Questions: The Center on Organizational Innovation at Columbia University. *European Management Review,* 5(4), 275-280.

Stark, D. (2011). What's Valuable? In P. Aspers & J. Beckert (Eds.) *The Worth of Goods: Valuation and Pricing in the Economy*, (pp. 319-339), Oxford University Press

Stephens, C. and Steven L. (1986). A Place for Public Business: The Material Culture of the Nineteenth-Century Federal Office, *Business and Economic History,* 2nd series, Vol. 15.

Strawson, P. (2008). *Freedom and Resentment and Other Essays*, Routledge.

Sunstein C.R (2006). *Infotopia - How Many Minds Produce Knowledge.* New York: Oxford University Press.

T

The ETC Group. (2007). *Extreme Genetic Engineering – An Introduction to Synthetic Biology,* The ETC Group, Montreal.

The Presidential Commission for the Study of Bioethical Issues. (2010). *New Directions: The Ethics of Synthetic Biology and Emerging Technologies.* The Presidential Commission for the Study of Bioethical Issues in the USA, Washington D.C.

Thelwall, M. (2009). *Introduction to Webometrics: Quantitative Web Research for the Social Sciences*. San Rafael, CA: Morgan & Claypool.

Thelwall, M. et al. (2010). Policy-Relevant Webometrics for Individual Scientific Fields, *Journal of the American Society for Information Science and Technology*, 61(7): 1464–1475.

Thrift, N. (2005). *Knowing Capitalism*. SAGE Publications.

U

Uprichard, E. (2011), Dirty Data: Longitudinal Classification Systems". *The Sociological Review*, 59: 93–112.

Uprichard, E. (2012). Being Stuck in (Live) Time: The Sticky Sociological Imagination. *The Sociological Review*, 60(S1), 124-138.

V

Vaidhyanathan, S. (2011). *The Googlization of Everything (and why we should worry)*. University of California Press.

Van Os R., Jankowski, N.W and Vergeer, M. (2007). Political Communication About Europe on the Internet During the 2004 European Parliament Election Campaign in Nine EU Member States. *European Societies,* 9(5): 755-775.

Venturini, T. (2010). Building on Faults: How to Represent Controversies with Digital Methods. *Public Understanding of Science*. Retrieved October 25th 2012 from the website: http://www.tommasoventurini.it/web/uploads/tommaso_venturini/BuildingOnFaults.pdf.

Vinciarelli, A., Pantic, M., Bourlard, H., & Pentland, A. (2008). Social Signals, Their Function, and Automatic Analysis: A Survey. *Proceedings of the 10th International Conference on Multimodal Interfaces* (pp. 61-68). ACM.

W

Wang, H. et al. (2012). A System for Real-time Twitter Sentiment Analysis of 2012 U.S. Presidential Election Cycle. *Proceedings of the 50th Annual Meeting of the Association for Computational Linguistics*. Retrieved February 15th 2013 from the website: http://www.aclweb.org/anthology-new/P/P12/P12-3020.pdf

Weingart, P. (1998). Science and the Media. *Research Policy*, 27(8), 869-879.

World Economic Forum. (2012). Big Data, Big Impact: New Possibilities for International Development. Retrieved August 1st 2012 from the website: http://www3.weforum.org/docs/WEF_TC_MFS_BigDataBigImpact_Briefing_2012.pdf.

Wouters, P., Hellsten, I., & Leydesdorff, L. (2004). Internet Time and the Reliability of Search Engines. *First Monday*, 9(10-4).

Wu, L., & Brynjolfsson, E. (2009). *The Future of Prediction: How Google Searches Foreshadow Housing Prices and Sales*. Retrieved August 1st 2012 from the website: http://pages.stern.nyu.edu/~bakos/wise/papers/wise2009-3b3_paper.pdf

Y

Yaneva, A. (2012). *Mapping Controversies in Architecture*, Ashgate.

Z

Ziewitz, M. (2011). How to Think about an Algorithm? Notes From a not Quite Random Walk. Paper preseted, *Knowledge Machines between Freedom and Control*, Retrieved April 2nd from the website: http://ziewitz.org/papers/ziewitz_algorithm.pdf

Zuckerman, E. W. (2004). Structural Incoherence and Stock Market Activity. *American Sociological Review*, 69(3):405-432

Danish Summary

I slutningen af 1990erne blev Google pioneere indenfor internet søgning på baggrund af en simple idé. De fik success med at 'scrape' internettet for digitale spor som f.eks hyperlinks og 'genbruge' disse spor som en form for data der gjorde det muligt at forstå menneskers preferencer og adfærd på en ny måde. Denne nye metode til at generere empirisk indsigt i social dynamikker kan betegnes 'digital metode' og i løbet af de sidste fem år har digitale metoder vundet indpas på andre områder end internet søgning. Forskellige typer organisationer er begyndt at tale om nødvendigheden af at indsamle digitale spor og udnytte den intelligens der ligger i store digitale datasæt. Denne udvikling er også blevet beskrevet som en udvikling henimod 'Big Data' og selv indenfor samfundsvidenskaben er man begyndt at se på mulighederne for at bevæge sig væk fra etablerede metoder som spørgeskemaer og fokusgrupper. Alternativet til disse metoder er at tage ved lære af den måde Google og andre virksomheder har haft success med at oversætte digital spor til brugbar viden om sociale dynamikker. I og med digitale metoder tilbyder nye måder at søge, samle og forbinde empiriske datasæt på, er det ikke utænkeligt at spredningen af sådanne metoder vil ændre den måde både organisationer, samfundsvidenskaben og borgere opfatter den verden de lever og interagerer i.

Denne afhandling tilbyder en analyse af de epistemologiske of sociologiske problematikker denne udviling rejser. Afhandlingens studieobjekt er den type 'web-baserede visualiseringer' der ofte er produktet af forsøget på at omdanne digital spor til billeder der kan guide deres brugeres opmærksomhed på en brugbar måde. Afhandlingens empiriske bidrag består af tre videnskabelige artikler der hver især indeholder en analyse af konstruktionen og brugen af web-baserede visualiseringer i en bestent sfære af samfundet. Den første artikel fokuserer på den måde hvorpå forskellige organisationer bruger sådanne visualiseringer som et empirisk værktøj til at

'scanne' deres omgivelser. Den anden artikel fokuserer på hvordan samfundsvidenskaben har brugt dem til at forstå udviklingen af kontroversielle nye teknologier. Den tredje artikel fokuserer på hvordan Britiske brugere af Google får styret deres opmærksomhed af web-baserede visualiseringer når de søger efter information om syntetisk biologi. De tre artikler er forenet af en fælles ambition om at identificere de aktører og selektionsmekanismer der er involveret i konstruktionen af de visualiseringer de undersøger, samt en ambition om at klargøre de udfordinger og dilemmaer der følger med, når man forsøger at få de forskellige aktører og mekanismer til at blive til en brugbar og legitim visualisering.

Afhandlingens teoretiske bidrag er at bruge disse empiriske indsigter til at udvikle begrebet 'web-visions' og argumenterer for dets relevans som et teoretisk vokabular forskere kan trække på når de analyserer web-baserede visualiseringer og diskuterer de valg der tages i konstruktionen af dem. Begrebet har rødder den måde hvorpå pragmatismen har diskuteret erfaring, perception og værdisættelse siden slutningen af 1800-tallet og afhandlingen trækker på disse teoretiske ressourcer i en diskussion af fire temaer der allerede bliver behandlet indenfor digital metode. Det første tema handler om den rolle teori og a priori distinktioner spiller i konstruktionen af web-baserede visualiseringer, det andet tema handler om hvorvidt sådanne visualiseringer kan siges at være representative, det tredje tema handler om den måde temporalitet er konstrueret i sådanne visualiseringer og det fjerde tema handler om i hvilken grad deres distribuerede karakter medfører ændringer i de måder hvorpå vi hidtil har ordnet vores viden om verden. Afhanlingen argumenterer for at begrebet, 'web-visions', er et nyttigt supplement til den måde disser temaer hidtil har været diskuteret af akademikere intereseret i de performative aspekter af digitale metoder. Hele vejen igennem afhandlingen gøres det klart på hvilken måde begrebet tilbyder noget nyt i forhold til den eksisterende litteratur på området.

TITLER I PH.D.SERIEN:

2004

1. Martin Grieger
Internet-based Electronic Marketplaces and Supply Chain Management

2. Thomas Basbøll
LIKENESS
A Philosophical Investigation

3. Morten Knudsen
Beslutningens vaklen
En systemteoretisk analyse of moderniseringen af et amtskommunalt sundhedsvæsen 1980-2000

4. Lars Bo Jeppesen
Organizing Consumer Innovation
A product development strategy that is based on online communities and allows some firms to benefit from a distributed process of innovation by consumers

5. Barbara Dragsted
SEGMENTATION IN TRANSLATION AND TRANSLATION MEMORY SYSTEMS
An empirical investigation of cognitive segmentation and effects of integrating a TM system into the translation process

6. Jeanet Hardis
Sociale partnerskaber
Et socialkonstruktivistisk casestudie af partnerskabsaktørers virkelighedsopfattelse mellem identitet og legitimitet

7. Henriette Hallberg Thygesen
System Dynamics in Action

8. Carsten Mejer Plath
Strategisk Økonomistyring

9. Annemette Kjærgaard
Knowledge Management as Internal Corporate Venturing
– a Field Study of the Rise and Fall of a Bottom-Up Process

10. Knut Arne Hovdal
De profesjonelle i endring
Norsk ph.d., ej til salg gennem Samfundslitteratur

11. Søren Jeppesen
Environmental Practices and Greening Strategies in Small Manufacturing Enterprises in South Africa
– A Critical Realist Approach

12. Lars Frode Frederiksen
Industriel forskningsledelse
– på sporet af mønstre og samarbejde i danske forskningsintensive virksomheder

13. Martin Jes Iversen
The Governance of GN Great Nordic
– in an age of strategic and structural transitions 1939-1988

14. Lars Pynt Andersen
The Rhetorical Strategies of Danish TV Advertising
A study of the first fifteen years with special emphasis on genre and irony

15. Jakob Rasmussen
Business Perspectives on E-learning

16. Sof Thrane
The Social and Economic Dynamics of Networks
– a Weberian Analysis of Three Formalised Horizontal Networks

17. Lene Nielsen
Engaging Personas and Narrative Scenarios – a study on how a user-centered approach influenced the perception of the design process in the e-business group at AstraZeneca

18. S.J Valstad
Organisationsidentitet
Norsk ph.d., ej til salg gennem Samfundslitteratur

19. Thomas Lyse Hansen
Six Essays on Pricing and Weather risk in Energy Markets

20. Sabine Madsen
Emerging Methods – An Interpretive Study of ISD Methods in Practice

21. Evis Sinani
The Impact of Foreign Direct Investment on Efficiency, Productivity Growth and Trade: An Empirical Investigation

22. Bent Meier Sørensen
Making Events Work Or, How to Multiply Your Crisis

23. Pernille Schnoor
Brand Ethos
Om troværdige brand- og virksomhedsidentiteter i et retorisk og diskursteoretisk perspektiv

24. Sidsel Fabech
Von welchem Österreich ist hier die Rede?
Diskursive forhandlinger og magtkampe mellem rivaliserende nationale identitetskonstruktioner i østrigske pressediskurser

25. Klavs Odgaard Christensen
Sprogpolitik og identitetsdannelse i flersprogede forbundsstater
Et komparativt studie af Schweiz og Canada

26. Dana B. Minbaeva
Human Resource Practices and Knowledge Transfer in Multinational Corporations

27. Holger Højlund
Markedets politiske fornuft
Et studie af velfærdens organisering i perioden 1990-2003

28. Christine Mølgaard Frandsen
A.s erfaring
Om mellemværendets praktik i en transformation af mennesket og subjektiviteten

29. Sine Nørholm Just
The Constitution of Meaning – A Meaningful Constitution?
Legitimacy, identity, and public opinion in the debate on the future of Europe

2005

1. Claus J. Varnes
Managing product innovation through rules – The role of formal and structured methods in product development

2. Helle Hedegaard Hein
Mellem konflikt og konsensus – Dialogudvikling på hospitalsklinikker

3. Axel Rosenø
Customer Value Driven Product Innovation – A Study of Market Learning in New Product Development

4. Søren Buhl Pedersen
Making space
An outline of place branding

5. Camilla Funck Ellehave
Differences that Matter
An analysis of practices of gender and organizing in contemporary workplaces

6. Rigmor Madeleine Lond
Styring af kommunale forvaltninger

7. Mette Aagaard Andreassen
Supply Chain versus Supply Chain Benchmarking as a Means to Managing Supply Chains

8. Caroline Aggestam-Pontoppidan
From an idea to a standard
The UN and the global governance of accountants' competence

9. Norsk ph.d.

10. Vivienne Heng Ker-ni
An Experimental Field Study on the

Effectiveness of Grocer Media Advertising
Measuring Ad Recall and Recognition, Purchase Intentions and Short-Term Sales

11. Allan Mortensen
Essays on the Pricing of Corporate Bonds and Credit Derivatives

12. Remo Stefano Chiari
Figure che fanno conoscere
Itinerario sull'idea del valore cognitivo e espressivo della metafora e di altri tropi da Aristotele e da Vico fino al cognitivismo contemporaneo

13. Anders Mcllquham-Schmidt
Strategic Planning and Corporate Performance
An integrative research review and a meta-analysis of the strategic planning and corporate performance literature from 1956 to 2003

14. Jens Geersbro
The TDF – PMI Case
Making Sense of the Dynamics of Business Relationships and Networks

15 Mette Andersen
Corporate Social Responsibility in Global Supply Chains
Understanding the uniqueness of firm behaviour

16. Eva Boxenbaum
Institutional Genesis: Micro – Dynamic Foundations of Institutional Change

17. Peter Lund-Thomsen
Capacity Development, Environmental Justice NGOs, and Governance: The Case of South Africa

18. Signe Jarlov
Konstruktioner af offentlig ledelse

19. Lars Stæhr Jensen
Vocabulary Knowledge and Listening Comprehension in English as a Foreign Language
An empirical study employing data elicited from Danish EFL learners

20. Christian Nielsen
Essays on Business Reporting
Production and consumption of strategic information in the market for information

21. Marianne Thejls Fischer
Egos and Ethics of Management Consultants

22. Annie Bekke Kjær
Performance management i Proces-innovation
– belyst i et social-konstruktivistisk perspektiv

23. Suzanne Dee Pedersen
GENTAGELSENS METAMORFOSE
Om organisering af den kreative gøren i den kunstneriske arbejdspraksis

24. Benedikte Dorte Rosenbrink
Revenue Management
Økonomiske, konkurrencemæssige & organisatoriske konsekvenser

25. Thomas Riise Johansen
Written Accounts and Verbal Accounts
The Danish Case of Accounting and Accountability to Employees

26. Ann Fogelgren-Pedersen
The Mobile Internet: Pioneering Users' Adoption Decisions

27. Birgitte Rasmussen
Ledelse i fællesskab – de tillidsvalgtes fornyende rolle

28. Gitte Thit Nielsen
Remerger
– skabende ledelseskræfter i fusion og opkøb

29. Carmine Gioia
A MICROECONOMETRIC ANALYSIS OF MERGERS AND ACQUISITIONS

30. Ole Hinz
Den effektive forandringsleder: pilot, pædagog eller politiker?
Et studie i arbejdslederes meningstilskrivninger i forbindelse med vellykket gennemførelse af ledelsesinitierede forandringsprojekter

31. Kjell-Åge Gotvassli
Et praksisbasert perspektiv på dynamiske læringsnettverk i toppidretten
Norsk ph.d., ej til salg gennem Samfundslitteratur

32. Henriette Langstrup Nielsen
Linking Healthcare
An inquiry into the changing performances of web-based technology for asthma monitoring

33. Karin Tweddell Levinsen
Virtuel Uddannelsespraksis
Master i IKT og Læring – et casestudie i hvordan proaktiv proceshåndtering kan forbedre praksis i virtuelle læringsmiljøer

34. Anika Liversage
Finding a Path
Labour Market Life Stories of Immigrant Professionals

35. Kasper Elmquist Jørgensen
Studier i samspillet mellem stat og erhvervsliv i Danmark under 1. verdenskrig

36. Finn Janning
A DIFFERENT STORY
Seduction, Conquest and Discovery

37. Patricia Ann Plackett
Strategic Management of the Radical Innovation Process
Leveraging Social Capital for Market Uncertainty Management

2006

1. Christian Vintergaard
Early Phases of Corporate Venturing

2. Niels Rom-Poulsen
Essays in Computational Finance

3. Tina Brandt Husman
Organisational Capabilities, Competitive Advantage & Project-Based Organisations
The Case of Advertising and Creative Good Production

4. Mette Rosenkrands Johansen
Practice at the top
– how top managers mobilise and use non-financial performance measures

5. Eva Parum
Corporate governance som strategisk kommunikations- og ledelsesværktøj

6. Susan Aagaard Petersen
Culture's Influence on Performance Management: The Case of a Danish Company in China

7. Thomas Nicolai Pedersen
The Discursive Constitution of Organizational Governance – Between unity and differentiation
The Case of the governance of environmental risks by World Bank environmental staff

8. Cynthia Selin
Volatile Visions: Transactons in Anticipatory Knowledge

9. Jesper Banghøj
Financial Accounting Information and Compensation in Danish Companies

10. Mikkel Lucas Overby
Strategic Alliances in Emerging High-Tech Markets: What's the Difference and does it Matter?

11. Tine Aage
External Information Acquisition of Industrial Districts and the Impact of Different Knowledge Creation Dimensions

A case study of the Fashion and Design Branch of the Industrial District of Montebelluna, NE Italy

12. Mikkel Flyverbom
Making the Global Information Society Governable
On the Governmentality of Multi-Stakeholder Networks

13. Anette Grønning
Personen bag
Tilstedeværelse i e-mail som interaktionsform mellem kunde og medarbejder i dansk forsikringskontekst

14. Jørn Helder
One Company – One Language?
The NN-case

15. Lars Bjerregaard Mikkelsen
Differing perceptions of customer value
Development and application of a tool for mapping perceptions of customer value at both ends of customer-supplier dyads in industrial markets

16. Lise Granerud
Exploring Learning
Technological learning within small manufacturers in South Africa

17. Esben Rahbek Pedersen
Between Hopes and Realities: Reflections on the Promises and Practices of Corporate Social Responsibility (CSR)

18. Ramona Samson
The Cultural Integration Model and European Transformation.
The Case of Romania

2007

1. Jakob Vestergaard
Discipline in The Global Economy
Panopticism and the Post-Washington Consensus

2. Heidi Lund Hansen
Spaces for learning and working
A qualitative study of change of work, management, vehicles of power and social practices in open offices

3. Sudhanshu Rai
Exploring the internal dynamics of software development teams during user analysis
A tension enabled Institutionalization Model; "Where process becomes the objective"

4. Norsk ph.d.
Ej til salg gennem Samfundslitteratur

5. Serden Ozcan
EXPLORING HETEROGENEITY IN ORGANIZATIONAL ACTIONS AND OUTCOMES
A Behavioural Perspective

6. Kim Sundtoft Hald
Inter-organizational Performance Measurement and Management in Action
– An Ethnography on the Construction of Management, Identity and Relationships

7. Tobias Lindeberg
Evaluative Technologies
Quality and the Multiplicity of Performance

8. Merete Wedell-Wedellsborg
Den globale soldat
Identitetsdannelse og identitetsledelse i multinationale militære organisationer

9. Lars Frederiksen
Open Innovation Business Models
Innovation in firm-hosted online user communities and inter-firm project ventures in the music industry
– A collection of essays

10. Jonas Gabrielsen
Retorisk toposlære – fra statisk 'sted' til persuasiv aktivitet

11. Christian Moldt-Jørgensen
Fra meningsløs til meningsfuld evaluering.
Anvendelsen af studentertilfredshedsmålinger på de korte og mellemlange videregående uddannelser set fra et psykodynamisk systemperspektiv

12. Ping Gao
Extending the application of actor-network theory
Cases of innovation in the telecommunications industry

13. Peter Mejlby
Frihed og fængsel, en del af den samme drøm?
Et phronetisk baseret casestudie af frigørelsens og kontrollens sameksistens i værdibaseret ledelse!

14. Kristina Birch
Statistical Modelling in Marketing

15. Signe Poulsen
Sense and sensibility:
The language of emotional appeals in insurance marketing

16. Anders Bjerre Trolle
Essays on derivatives pricing and dynamic asset allocation

17. Peter Feldhütter
Empirical Studies of Bond and Credit Markets

18. Jens Henrik Eggert Christensen
Default and Recovery Risk Modeling and Estimation

19. Maria Theresa Larsen
Academic Enterprise: A New Mission for Universities or a Contradiction in Terms?
Four papers on the long-term implications of increasing industry involvement and commercialization in academia

20. Morten Wellendorf
Postimplementering af teknologi i den offentlige forvaltning
Analyser af en organisations kontinuerlige arbejde med informationsteknologi

21. Ekaterina Mhaanna
Concept Relations for Terminological Process Analysis

22. Stefan Ring Thorbjørnsen
Forsvaret i forandring
Et studie i officerers kapabiliteter under påvirkning af omverdenens forandringspres mod øget styring og læring

23. Christa Breum Amhøj
Det selvskabte medlemskab om managementstaten, dens styringsteknologier og indbyggere

24. Karoline Bromose
Between Technological Turbulence and Operational Stability
– An empirical case study of corporate venturing in TDC

25. Susanne Justesen
Navigating the Paradoxes of Diversity in Innovation Practice
– A Longitudinal study of six very different innovation processes – in practice

26. Luise Noring Henler
Conceptualising successful supply chain partnerships
– Viewing supply chain partnerships from an organisational culture perspective

27. Mark Mau
Kampen om telefonen
Det danske telefonvæsen under den tyske besættelse 1940-45

28. Jakob Halskov
The semiautomatic expansion of existing terminological ontologies using knowledge patterns discovered

on the WWW – an implementation and evaluation

29. Gergana Koleva
European Policy Instruments Beyond Networks and Structure: The Innovative Medicines Initiative

30. Christian Geisler Asmussen
Global Strategy and International Diversity: A Double-Edged Sword?

31. Christina Holm-Petersen
Stolthed og fordom
Kultur- og identitetsarbejde ved skabelsen af en ny sengeafdeling gennem fusion

32. Hans Peter Olsen
Hybrid Governance of Standardized States
Causes and Contours of the Global Regulation of Government Auditing

33. Lars Bøge Sørensen
Risk Management in the Supply Chain

34. Peter Aagaard
Det unikkes dynamikker
De institutionelle mulighedsbetingelser bag den individuelle udforskning i professionelt og frivilligt arbejde

35. Yun Mi Antorini
Brand Community Innovation
An Intrinsic Case Study of the Adult Fans of LEGO Community

36. Joachim Lynggaard Boll
Labor Related Corporate Social Performance in Denmark
Organizational and Institutional Perspectives

2008

1. Frederik Christian Vinten
Essays on Private Equity

2. Jesper Clement
Visual Influence of Packaging Design on In-Store Buying Decisions

3. Marius Brostrøm Kousgaard
Tid til kvalitetsmåling?
– Studier af indrulleringsprocesser i forbindelse med introduktionen af kliniske kvalitetsdatabaser i speciallægepraksissektoren

4. Irene Skovgaard Smith
Management Consulting in Action
Value creation and ambiguity in client-consultant relations

5. Anders Rom
Management accounting and integrated information systems
How to exploit the potential for management accounting of information technology

6. Marina Candi
Aesthetic Design as an Element of Service Innovation in New Technology-based Firms

7. Morten Schnack
Teknologi og tværfaglighed
– en analyse af diskussionen omkring indførelse af EPJ på en hospitalsafdeling

8. Helene Balslev Clausen
Juntos pero no revueltos – un estudio sobre emigrantes norteamericanos en un pueblo mexicano

9. Lise Justesen
Kunsten at skrive revisionsrapporter. En beretning om forvaltningsrevisionens beretninger

10. Michael E. Hansen
The politics of corporate responsibility: CSR and the governance of child labor and core labor rights in the 1990s

11. Anne Roepstorff
Holdning for handling – en etnologisk undersøgelse af Virksomheders Sociale Ansvar/CSR

12. Claus Bajlum
Essays on Credit Risk and Credit Derivatives

13. Anders Bojesen
The Performative Power of Competence – an Inquiry into Subjectivity and Social Technologies at Work

14. Satu Reijonen
Green and Fragile
A Study on Markets and the Natural Environment

15. Ilduara Busta
Corporate Governance in Banking
A European Study

16. Kristian Anders Hvass
A Boolean Analysis Predicting Industry Change: Innovation, Imitation & Business Models
The Winning Hybrid: A case study of isomorphism in the airline industry

17. Trine Paludan
De uvidende og de udviklingsparate
Identitet som mulighed og restriktion blandt fabriksarbejdere på det aftayloriserede fabriksgulv

18. Kristian Jakobsen
Foreign market entry in transition economies: Entry timing and mode choice

19. Jakob Elming
Syntactic reordering in statistical machine translation

20. Lars Brømsøe Termansen
Regional Computable General Equilibrium Models for Denmark
Three papers laying the foundation for regional CGE models with agglomeration characteristics

21. Mia Reinholt
The Motivational Foundations of Knowledge Sharing

22. Frederikke Krogh-Meibom
The Co-Evolution of Institutions and Technology
– A Neo-Institutional Understanding of Change Processes within the Business Press – the Case Study of Financial Times

23. Peter D. Ørberg Jensen
OFFSHORING OF ADVANCED AND HIGH-VALUE TECHNICAL SERVICES: ANTECEDENTS, PROCESS DYNAMICS AND FIRMLEVEL IMPACTS

24. Pham Thi Song Hanh
Functional Upgrading, Relational Capability and Export Performance of Vietnamese Wood Furniture Producers

25. Mads Vangkilde
Why wait?
An Exploration of first-mover advantages among Danish e-grocers through a resource perspective

26. Hubert Buch-Hansen
Rethinking the History of European Level Merger Control
A Critical Political Economy Perspective

2009

1. Vivian Lindhardsen
From Independent Ratings to Communal Ratings: A Study of CWA Raters' Decision-Making Behaviours

2. Guðrið Weihe
Public-Private Partnerships: Meaning and Practice

3. Chris Nøkkentved
Enabling Supply Networks with Collaborative Information Infrastructures
An Empirical Investigation of Business Model Innovation in Supplier Relationship Management

4. Sara Louise Muhr
Wound, Interrupted – On the Vulnerability of Diversity Management

5. Christine Sestoft
Forbrugeradfærd i et Stats- og Livsformsteoretisk perspektiv

6. Michael Pedersen
Tune in, Breakdown, and Reboot: On the production of the stress-fit self-managing employee

7. Salla Lutz
Position and Reposition in Networks – Exemplified by the Transformation of the Danish Pine Furniture Manufacturers

8. Jens Forssbæck
Essays on market discipline in commercial and central banking

9. Tine Murphy
Sense from Silence – A Basis for Organised Action
How do Sensemaking Processes with Minimal Sharing Relate to the Reproduction of Organised Action?

10. Sara Malou Strandvad
Inspirations for a new sociology of art: A sociomaterial study of development processes in the Danish film industry

11. Nicolaas Mouton
On the evolution of social scientific metaphors:
A cognitive-historical enquiry into the divergent trajectories of the idea that collective entities – states and societies, cities and corporations – are biological organisms.

12. Lars Andreas Knutsen
Mobile Data Services:
Shaping of user engagements

13. Nikolaos Theodoros Korfiatis
Information Exchange and Behavior
A Multi-method Inquiry on Online Communities

14. Jens Albæk
Forestillinger om kvalitet og tværfaglighed på sygehuse
– skabelse af forestillinger i læge- og plejegrupperne angående relevans af nye idéer om kvalitetsudvikling gennem tolkningsprocesser

15. Maja Lotz
The Business of Co-Creation – and the Co-Creation of Business

16. Gitte P. Jakobsen
Narrative Construction of Leader Identity in a Leader Development Program Context

17. Dorte Hermansen
"Living the brand" som en brandorienteret dialogisk praxis:
Om udvikling af medarbejdernes brandorienterede dømmekraft

18. Aseem Kinra
Supply Chain (logistics) Environmental Complexity

19. Michael Nørager
How to manage SMEs through the transformation from non innovative to innovative?

20. Kristin Wallevik
Corporate Governance in Family Firms
The Norwegian Maritime Sector

21. Bo Hansen Hansen
Beyond the Process
Enriching Software Process Improvement with Knowledge Management

22. Annemette Skot-Hansen
Franske adjektivisk afledte adverbier, der tager præpositionssyntagmer indledt med præpositionen à som argumenter
En valensgrammatisk undersøgelse

23. Line Gry Knudsen
Collaborative R&D Capabilities
In Search of Micro-Foundations

24. Christian Scheuer
Employers meet employees
Essays on sorting and globalization

25. Rasmus Johnsen
The Great Health of Melancholy
A Study of the Pathologies of Performativity

26. Ha Thi Van Pham
Internationalization, Competitiveness Enhancement and Export Performance of Emerging Market Firms:
Evidence from Vietnam

27. Henriette Balieu
Kontrolbegrebets betydning for kausativalternationen i spansk
En kognitiv-typologisk analyse

2010

1. Yen Tran
Organizing Innovationin Turbulent Fashion Market
Four papers on how fashion firms create and appropriate innovation value

2. Anders Raastrup Kristensen
Metaphysical Labour
Flexibility, Performance and Commitment in Work-Life Management

3. Margrét Sigrún Sigurdardottir
Dependently independent
Co-existence of institutional logics in the recorded music industry

4. Ásta Dis Óladóttir
Internationalization from a small domestic base:
An empirical analysis of Economics and Management

5. Christine Secher
E-deltagelse i praksis – politikernes og forvaltningens medkonstruktion og konsekvenserne heraf

6. Marianne Stang Våland
What we talk about when we talk about space:
End User Participation between Processes of Organizational and Architectural Design

7. Rex Degnegaard
Strategic Change Management
Change Management Challenges in the Danish Police Reform

8. Ulrik Schultz Brix
Værdi i rekruttering – den sikre beslutning
En pragmatisk analyse af perception og synliggørelse af værdi i rekrutterings- og udvælgelsesarbejdet

9. Jan Ole Similä
Kontraktsledelse
Relasjonen mellom virksomhetsledelse og kontraktshåndtering, belyst via fire norske virksomheter

10. Susanne Boch Waldorff
Emerging Organizations: In between local translation, institutional logics and discourse

11. Brian Kane
Performance Talk
Next Generation Management of Organizational Performance

12. Lars Ohnemus
Brand Thrust: Strategic Branding and Shareholder Value
An Empirical Reconciliation of two Critical Concepts

13. Jesper Schlamovitz
Håndtering af usikkerhed i film- og byggeprojekter

14. Tommy Moesby-Jensen
Det faktiske livs forbindtlighed
Førsokratisk informeret, ny-aristotelisk ἦθος-tænkning hos Martin Heidegger

15. Christian Fich
Two Nations Divided by Common Values
French National Habitus and the Rejection of American Power

16. Peter Beyer
Processer, sammenhængskraft og fleksibilitet
Et empirisk casestudie af omstillingsforløb i fire virksomheder

17. Adam Buchhorn
Markets of Good Intentions
Constructing and Organizing Biogas Markets Amid Fragility and Controversy

18. Cecilie K. Moesby-Jensen
Social læring og fælles praksis
Et mixed method studie, der belyser læringskonsekvenser af et lederkursus for et praksisfællesskab af offentlige mellemledere

19. Heidi Boye
Fødevarer og sundhed i senmodernismen
– En indsigt i hyggefænomenet og de relaterede fødevarepraksisser

20. Kristine Munkgård Pedersen
Flygtige forbindelser og midlertidige mobiliseringer
Om kulturel produktion på Roskilde Festival

21. Oliver Jacob Weber
Causes of Intercompany Harmony in Business Markets – An Empirical Investigation from a Dyad Perspective

22. Susanne Ekman
Authority and Autonomy
Paradoxes of Modern Knowledge Work

23. Anette Frey Larsen
Kvalitetsledelse på danske hospitaler
– Ledelsernes indflydelse på introduktion og vedligeholdelse af kvalitetsstrategier i det danske sundhedsvæsen

24. Toyoko Sato
Performativity and Discourse: Japanese Advertisements on the Aesthetic Education of Desire

25. Kenneth Brinch Jensen
Identifying the Last Planner System
Lean management in the construction industry

26. Javier Busquets
Orchestrating Network Behavior for Innovation

27. Luke Patey
The Power of Resistance: India's National Oil Company and International Activism in Sudan

28. Mette Vedel
Value Creation in Triadic Business Relationships. Interaction, Interconnection and Position

29. Kristian Tørning
Knowledge Management Systems in Practice – A Work Place Study

30. Qingxin Shi
An Empirical Study of Thinking Aloud Usability Testing from a Cultural Perspective

31. Tanja Juul Christiansen
Corporate blogging: Medarbejderes kommunikative handlekraft

32. Malgorzata Ciesielska
Hybrid Organisations.
A study of the Open Source – business setting

33. Jens Dick-Nielsen
Three Essays on Corporate Bond Market Liquidity

34. Sabrina Speiermann
Modstandens Politik
Kampagnestyring i Velfærdsstaten.
En diskussion af trafikkampagners styringspotentiale

35. Julie Uldam
Fickle Commitment. Fostering political engagement in 'the flighty world of online activism'

36. Annegrete Juul Nielsen
Traveling technologies and transformations in health care

37. Athur Mühlen-Schulte
Organising Development
Power and Organisational Reform in the United Nations Development Programme

38. Louise Rygaard Jonas
Branding på butiksgulvet
Et case-studie af kultur- og identitetsarbejdet i Kvickly

2011

1. Stefan Fraenkel
Key Success Factors for Sales Force Readiness during New Product Launch
A Study of Product Launches in the Swedish Pharmaceutical Industry

2. Christian Plesner Rossing
International Transfer Pricing in Theory and Practice

3. Tobias Dam Hede
Samtalekunst og ledelsesdisciplin
– en analyse af coachingsdiskursens genealogi og governmentality

4. Kim Pettersson
Essays on Audit Quality, Auditor Choice, and Equity Valuation

5. Henrik Merkelsen
The expert-lay controversy in risk research and management. Effects of institutional distances. Studies of risk definitions, perceptions, management and communication

6. Simon S. Torp
Employee Stock Ownership:
Effect on Strategic Management and Performance

7. Mie Harder
Internal Antecedents of Management Innovation

8. Ole Helby Petersen
Public-Private Partnerships: Policy and Regulation – With Comparative and Multi-level Case Studies from Denmark and Ireland

9. Morten Krogh Petersen
'Good' Outcomes. Handling Multiplicity in Government Communication

10. Kristian Tangsgaard Hvelplund
Allocation of cognitive resources in translation - an eye-tracking and key-logging study

11. Moshe Yonatany
The Internationalization Process of Digital Service Providers

12. Anne Vestergaard
Distance and Suffering
Humanitarian Discourse in the age of Mediatization

13. Thorsten Mikkelsen
Personligsheds indflydelse på forretningsrelationer

14. Jane Thostrup Jagd
Hvorfor fortsætter fusionsbølgen udover "the tipping point"?
– en empirisk analyse af information og kognitioner om fusioner

15. Gregory Gimpel
Value-driven Adoption and Consumption of Technology: Understanding Technology Decision Making

16. Thomas Stengade Sønderskov
Den nye mulighed
Social innovation i en forretningsmæssig kontekst

17. Jeppe Christoffersen
Donor supported strategic alliances in developing countries

18. Vibeke Vad Baunsgaard
Dominant Ideological Modes of Rationality: Cross functional

integration in the process of product innovation

19. Throstur Olaf Sigurjonsson
Governance Failure and Icelands's Financial Collapse

20. Allan Sall Tang Andersen
Essays on the modeling of risks in interest-rate and inflation markets

21. Heidi Tscherning
Mobile Devices in Social Contexts

22. Birgitte Gorm Hansen
Adapting in the Knowledge Economy Lateral Strategies for Scientists and Those Who Study Them

23. Kristina Vaarst Andersen
Optimal Levels of Embeddedness The Contingent Value of Networked Collaboration

24. Justine Grønbæk Pors
Noisy Management A History of Danish School Governing from 1970-2010

25. Stefan Linder
Micro-foundations of Strategic Entrepreneurship Essays on Autonomous Strategic Action

26. Xin Li
Toward an Integrative Framework of National Competitiveness An application to China

27. Rune Thorbjørn Clausen
Værdifuld arkitektur Et eksplorativt studie af bygningers rolle i virksomheders værdiskabelse

28. Monica Viken
Markedsundersøkelser som bevis i varemerke- og markedsføringsrett

29. Christian Wymann
Tattooing The Economic and Artistic Constitution of a Social Phenomenon

30. Sanne Frandsen
Productive Incoherence A Case Study of Branding and Identity Struggles in a Low-Prestige Organization

31. Mads Stenbo Nielsen
Essays on Correlation Modelling

32. Ivan Häuser
Følelse og sprog Etablering af en ekspressiv kategori, eksemplificeret på russisk

33. Sebastian Schwenen
Security of Supply in Electricity Markets

2012

1. Peter Holm Andreasen
The Dynamics of Procurement Management - A Complexity Approach

2. Martin Haulrich
Data-Driven Bitext Dependency Parsing and Alignment

3. Line Kirkegaard
Konsulenten i den anden nat En undersøgelse af det intense arbejdsliv

4. Tonny Stenheim
Decision usefulness of goodwill under IFRS

5. Morten Lind Larsen
Produktivitet, vækst og velfærd Industrirådet og efterkrigstidens Danmark 1945 - 1958

6. Petter Berg
Cartel Damages and Cost Asymmetries

7. Lynn Kahle
Experiential Discourse in Marketing A methodical inquiry into practice and theory

8. Anne Roelsgaard Obling
Management of Emotions in Accelerated Medical Relationships

9. Thomas Frandsen
Managing Modularity of Service Processes Architecture

10. Carina Christine Skovmøller
CSR som noget særligt
Et casestudie om styring og menings-skabelse i relation til CSR ud fra en intern optik

11. Michael Tell
Fradragsbeskæring af selskabers finansieringsudgifter
En skatteretlig analyse af SEL §§ 11, 11B og 11C

12. Morten Holm
Customer Profitability Measurement Models
Their Merits and Sophistication across Contexts

13. Katja Joo Dyppel
Beskatning af derivater
En analyse af dansk skatteret

14. Esben Anton Schultz
Essays in Labor Economics
Evidence from Danish Micro Data

15. Carina Risvig Hansen
"Contracts not covered, or not fully covered, by the Public Sector Directive"

16. Anja Svejgaard Pors
Iværksættelse af kommunikation
- patientfigurer i hospitalets strategiske kommunikation

17. Frans Bévort
Making sense of management with logics
An ethnographic study of accountants who become managers

18. René Kallestrup
The Dynamics of Bank and Sovereign Credit Risk

19. Brett Crawford
Revisiting the Phenomenon of Interests in Organizational Institutionalism
The Case of U.S. Chambers of Commerce

20. Mario Daniele Amore
Essays on Empirical Corporate Finance

21. Arne Stjernholm Madsen
The evolution of innovation strategy
Studied in the context of medical device activities at the pharmaceutical company Novo Nordisk A/S in the period 1980-2008

22. Jacob Holm Hansen
Is Social Integration Necessary for Corporate Branding?
A study of corporate branding strategies at Novo Nordisk

23. Stuart Webber
Corporate Profit Shifting and the Multinational Enterprise

24. Helene Ratner
Promises of Reflexivity
Managing and Researching Inclusive Schools

25. Therese Strand
The Owners and the Power: Insights from Annual General Meetings

26. Robert Gavin Strand
In Praise of Corporate Social Responsibility Bureaucracy

27. Nina Sormunen
Auditor's going-concern reporting
Reporting decision and content of the report

28. John Bang Mathiasen
Learning within a product development working practice:
- an understanding anchored in pragmatism

29. Philip Holst Riis
Understanding Role-Oriented Enterprise Systems: From Vendors to Customers

30. Marie Lisa Dacanay
Social Enterprises and the Poor
Enhancing Social Entrepreneurship and Stakeholder Theory

31. Fumiko Kano Glückstad
Bridging Remote Cultures: Cross-lingual concept mapping based on the information receiver's prior-knowledge

32. Henrik Barslund Fosse
Empirical Essays in International Trade

33. Peter Alexander Albrecht
Foundational hybridity and its reproduction
Security sector reform in Sierra Leone

34. Maja Rosenstock
CSR - hvor svært kan det være? Kulturanalytisk casestudie om udfordringer og dilemmaer med at forankre Coops CSR-strategi

35. Jeanette Rasmussen
Tweens, medier og forbrug
Et studie af 10-12 årige danske børns brug af internettet, opfattelse og forståelse af markedsføring og forbrug

36. Ib Tunby Gulbrandsen
'This page is not intended for a US Audience'
A five-act spectacle on online communication, collaboration & organization.

37. Kasper Aalling Teilmann
Interactive Approaches to Rural Development

38. Mette Mogensen
The Organization(s) of Well-being and Productivity
(Re)assembling work in the Danish Post

39. Søren Friis Møller
From Disinterestedness to Engagement
Towards Relational Leadership In the Cultural Sector

40. Nico Peter Berhausen
Management Control, Innovation and Strategic Objectives – Interactions and Convergence in Product Development Networks

41. Balder Onarheim
Creativity under Constraints
Creativity as Balancing 'Constrainedness'

42. Haoyong Zhou
Essays on Family Firms

43. Elisabeth Naima Mikkelsen
Making sense of organisational conflict
An empirical study of enacted sensemaking in everyday conflict at work

2013

1. Jacob Lyngsie
Entrepreneurship in an Organizational Context

2. Signe Groth-Brodersen
Fra ledelse til selvet
En socialpsykologisk analyse af forholdet imellem selvledelse, ledelse og stress i det moderne arbejdsliv

3. Nis Høyrup Christensen
Shaping Markets: A Neoinstitutional Analysis of the Emerging Organizational Field of Renewable Energy in China

4. Christian Edelvold Berg
As a matter of size
THE IMPORTANCE OF CRITICAL MASS AND THE CONSEQUENCES OF SCARCITY FOR TELEVISION MARKETS

5. Christine D. Isakson
Coworker Influence and Labor Mobility
Essays on Turnover, Entrepreneurship and Location Choice in the Danish Maritime Industry

6. Niels Joseph Jerne Lennon
Accounting Qualities in Practice
Rhizomatic stories of representational faithfulness, decision making and control

7. Shannon O'Donnell
Making Ensemble Possible
How special groups organize for collaborative creativity in conditions of spatial variability and distance

8. Robert W. D. Veitch
Access Decisions in a Partly-Digital World
Comparing Digital Piracy and Legal Modes for Film and Music

9. Marie Mathiesen
Making Strategy Work
An Organizational Ethnography

10. Arisa Shollo
The role of business intelligence in organizational decision-making

11. Mia Kaspersen
The construction of social and environmental reporting

12. Marcus Møller Larsen
The organizational design of offshoring

13. Mette Ohm Rørdam
EU Law on Food Naming
The prohibition against misleading names in an internal market context

14. Hans Peter Rasmussen
GIV EN GED!
Kan giver-idealtyper forklare støtte til velgørenhed og understøtte relationsopbygning?

15. Ruben Schachtenhaufen
Fonetisk reduktion i dansk

16. Peter Koerver Schmidt
Dansk CFC-beskatning
I et internationalt og komparativt perspektiv

17. Morten Froholdt
Strategi i den offentlige sektor
En kortlægning af styringsmæssig kontekst, strategisk tilgang, samt anvendte redskaber og teknologier for udvalgte danske statslige styrelser

18. Annette Camilla Sjørup
Cognitive effort in metaphor translation
An eye-tracking and key-logging study

19. Tamara Stucchi
The Internationalization of Emerging Market Firms:
A Context-Specific Study

20. Thomas Lopdrup-Hjorth
"Let's Go Outside":
The Value of Co-Creation

21. Ana Alačovska
Genre and Autonomy in Cultural Production
The case of travel guidebook production

22. Marius Gudmand-Høyer
Stemningssindssygdommenes historie i det 19. århundrede
Omtydningen af melankolien og manien som bipolære stemningslidelser i dansk sammenhæng under hensyn til dannelsen af det moderne følelseslivs relative autonomi.
En problematiserings- og erfarings-analytisk undersøgelse

23. Lichen Alex Yu
Fabricating an S&OP Process
Circulating References and Matters of Concern

24. Esben Alfort
The Expression of a Need
Understanding search

25. Trine Pallesen
Assembling Markets for Wind Power
An Inquiry into the Making of Market Devices

26. Anders Koed Madsen
Web-Visions
Repurposing digital traces to organize social attention

TITLER I ATV PH.D.-SERIEN

1992

1. Niels Kornum
Servicesamkørsel – organisation, økonomi og planlægningsmetode

1995

2. Verner Worm
Nordiske virksomheder i Kina
Kulturspecifikke interaktionsrelationer ved nordiske virksomhedsetableringer i Kina

1999

3. Mogens Bjerre
Key Account Management of Complex Strategic Relationships
An Empirical Study of the Fast Moving Consumer Goods Industry

2000

4. Lotte Darsø
Innovation in the Making
Interaction Research with heterogeneous Groups of Knowledge Workers creating new Knowledge and new Leads

2001

5. Peter Hobolt Jensen
Managing Strategic Design Identities
The case of the Lego Developer Network

2002

6. Peter Lohmann
The Deleuzian Other of Organizational Change – Moving Perspectives of the Human

7. Anne Marie Jess Hansen
To lead from a distance: The dynamic interplay between strategy and strategizing – A case study of the strategic management process

2003

8. Lotte Henriksen
Videndeling
– om organisatoriske og ledelsesmæssige udfordringer ved videndeling i praksis

9. Niels Christian Nickelsen
Arrangements of Knowing: Coordinating Procedures Tools and Bodies in Industrial Production – a case study of the collective making of new products

2005

10. Carsten Ørts Hansen
Konstruktion af ledelsesteknologier og effektivitet

TITLER I DBA PH.D.-SERIEN

2007

1. Peter Kastrup-Misir
Endeavoring to Understand Market Orientation – and the concomitant co-mutation of the researched, the re searcher, the research itself and the truth

2009

1. Torkild Leo Thellefsen
Fundamental Signs and Significance effects
A Semeiotic outline of Fundamental Signs, Significance-effects, Knowledge Profiling and their use in Knowledge Organization and Branding

2. Daniel Ronzani
When Bits Learn to Walk Don't Make Them Trip. Technological Innovation and the Role of Regulation by Law in Information Systems Research: the Case of Radio Frequency Identification (RFID)

2010

1. Alexander Carnera
Magten over livet og livet som magt
Studier i den biopolitiske ambivalens