TOWARDS A NEW KIND OF SOCIAL SCIENCE

Social Research in the Context of Science II and RISC-Societies

KARL H. MÜLLER · NIKO TOŠ

E - D O K U M E N T I S J M

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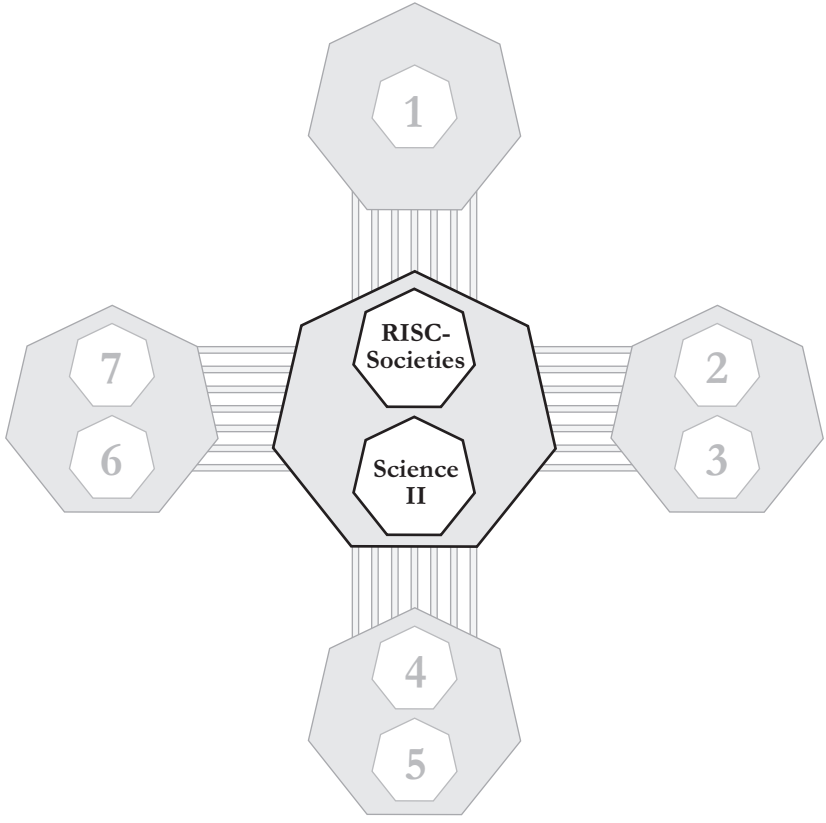
Introduction



This volume is the result of a large research project which runs under the name EECO-LAB (Eastern European Co-operation on Labour), funded by the Federal Ministry of Labour, Social Affairs and Consumer Protection of Austria. EECO-LAB has its main focus on the European Social Survey (ESS) and on generating the Austrian data for the ESS. The present volume compiles a series of jointly produced articles on ESS-data, on survey methodology and on the interpretation of survey data. Three general themes can be specified which lie at the heart of this book.

- The first major theme which provides also the necessary background focuses on an ongoing phase transition in the overall science landscapes from a traditional configuration under the name of Science I to an emergent ensemble under the heading of Science II. This transition from Science I to Science II becomes the central issue of Part I.
- The second major theme discusses the impact of the transition from Science I to Science II for empirical social research, especially for survey research. Traditional empirical survey research was built very much along the line of Science I-assumptions and conditions. The new configuration of Science II poses very serious and significant threats to survey research both with respect to the underlying survey methodology as well as to the organization of surveys and the analysis of survey data. Part II discusses the consequences of Science II for the survey methodology and Part III points to new possibilities in the area of survey constructions and of data analysis.
- The third major theme introduces the notion of RISC-societies (Rare Incidents, Strong Consequences) as a general evolutionary framework for societal analyses. The final grand theme centers on the overall organization of RISC-societies in two different aspects or dimensions. The first issue lies in the specification of basic societal structures for contemporary RISC-societies. Here, the crucial question lies in the structuration of full-time employment in contemporary RISC-societies. Does full-time employment corresponds with a stable core-periphery organization or with a strongly vertical organization where full-time employment is strongly vertically stratified and other forms of employment or even unemployment follow the distinctions within full-time employment. The second aspect or dimension focuses on societal inequality and in its impact on health conditions.

These three major issues seem even at second glance sufficiently interesting, diversified and relevant to be analyzed in a special volume.

Acknowledgements

Working on a complex issue across national boundaries and across different languages requires a coordinated effort by a large number of persons. In our case, this co-operation was funded by a research grant under the name of EECO-LAB (Eastern European Co-operation on Labour), from the Federal Ministry of Labour, Social Affairs and Consumer Protection (BMASK). Thus, special thanks go to

- Gertrud Hafner in Vienna who was confronted with the difficult tasks of transforming published and non-published materials into a homogeneous format
- Ivi Kecman in Ljubljana who served as a vital interface between Ljubljana and Vienna
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- Christian Bischof with whom we explored the potentials inherent in new forms of secondary data analyses in article 3.2
- Michael Eigner who was mainly responsible for the design and the redesign of the diagrams, figures and graphs in the book
- Richard Fuchsbichler, formerly employed at the Federal Ministry of Labour, Social Affairs and Consumer Protection (BMASK) who provided a stable support for the co-operation between Slovenia and Austria
- Werner Korn who acted as an unmoved prime mover behind this book project and behind the WISDOM-book series
- a remarkably good spirit of stable cooperation and friendship between the editors which has overcome many obstacles and barriers and which will continue to last well-beyond the publication of this book.

It should be emphasized that the present book in its final design fits very well into the overall context of the WISDOM-book series with its emphasis on complexity research or on new research designs, new methodologies or, as an essential element, on new information designs. It is hoped that the rather unconventional ways for survey research will meet the interest of social scientists across Europe who search for novel ways and methods in survey research and analysis. It is worthwhile to contemplate an old quotation from enlightenment times, namely from Denis Diderot.

> There are things I can't force. I must adjust. There are times when the greatest change needed is a change in my viewpoint. [Denis Diderot]

We sincerely hope that the articles presented in this volume exhibit some of the changes we have taken over the last years. Moreover, we wish that the cognitive changes indicated in this volume enable researchers in their fields to widen their current tool-box significantly and to open up new ways for social research with exciting and innovative results.

Vienna and Ljubljana, October 2012
Karl H. Müller | Niko Toš

Abstracts

The Complex Drift towards Science II

The first article presents several themes which are highly relevant as background knowledge for the subsequent chapters. First, this article presents different patterns for the evolution of the science system in general, including the phase transition from Science I to Science II. In a meta-analysis strong theoretical arguments are provided why the change from Science I to Science II should be considered as the most powerful and comprehensive science drift among the currently available candidates for general science drifts. Finally, the article presents the results from an online survey which was sent out to experts in the field of science studies. Surprisingly, a large number of the assumptions for Science II could be supported empirically through this online-survey.

Keywords: Evolution of science, science drifts, Science II, leading disciplines, neuro-cognitive sciences, online surveys

Survey Research in the Age of Science II

This article will focus on the rapidly widening cognitive-science landscapes and their potential impact for fresh perspectives on survey research. More ambitiously, the article wants to explore new foundations for survey research which are based on current advances within the broad domains of the cognitive sciences. In essence, the article wants two establish four major claims. First, over the last decades survey research has reached its point of perfection and, given the quality standards of European data collections like the European Social Survey (ESS), can be improved further only marginally. Second, survey research in its current form is characterized by various forms of incompleteness which, however, cannot be re-solved within the contemporary boundaries of survey research. Third, the expanding field of the cognitive sciences should be considered as the most relevant background knowledge for survey research in all its aspects, starting from the design of questionnaires to the actual fieldwork-procedures and to the analysis of survey data. Fourth, shifting to a cognitive science background should have a highly significant aspect of re-shaping survey research and for alternative paths for survey designs which, so far, have hardly been explored.

Keywords: Long-term dynamics of science; cognitive science; survey research; genetic algorithms; over-learned and under-learned responses

The New Background Knowledge for Survey Research in the Framework of Science II

This article deals with a rapid change which is currently sweeping through the science landscapes and discusses the far-reaching implications of this structural break for the social sciences and for survey research in particular. More specifically, this article will make three central claims. First, the science system as a whole is presently undergoing a significant phase transition which can be summarized as a shift from Science I to Science II. Second, due to these large-scale changes, new cognitive environments are gradually emerging as the background knowledge of survey research which will exert a profound impact on its future practices. Third, these new cognitive environments will lead to new actor-models and to new bridges between survey research and the cognitive neuro-sciences on the one hand and bio-medical research on the other hand.

Keywords: Long-term dynamics of science; cognitive neuro-sciences; background knowledge; survey research; bio-medical research

Visual Survey Research with Pattern Formations and Pattern Recognitions

This article deals with two major issues. First, it stresses the asymmetric forms of interactions inherent in survey field work and discusses the wider implications of these asymmetric interactions especially for respondents and their life worlds. Second, this article introduces new visual forms of pattern generation and pattern recognition which are predominantly produced or controlled by respondents themselves. These visual patterns reflect a complex set or network of relationships which are usually absent both from quantitative and qualitative research. Finally, the article concludes with an outlook into the future and with the potential of visual surveys within virtual environments.

Keywords: Long-term dynamics of science; survey research and survey design; universal laws; patterns; pattern recognition; pattern formation

New Forms of Secondary Analyses

This article focuses on the rapidly increasing piles of survey data which are lost for comparative research because they were developed and generated within a specific regional or national context and were not replicated in other regions or nations. Due to the absence of functionally identical datasets in other regions or countries these datasets fell out of the scope of comparative research. In view of the very large quantities of survey data which are currently lost for comparative analyses the present article presents the outlines of a new road for comparative research which

should become of special relevance for these large quantities of unused survey ort panel data. More specifically, the article offers a test with data from the European Social Survey in order to demonstrate the viability and the empirical soundness of the proposed new trajectory for comparative analysis on the basis of data sets which are conventionally.

Keywords: Comparative social research; secondary data analysis; morphology; morphological forms; data formation and data aggregation

Modern Contemporary RISC-Societies and their Basic Organization: Core-Periphery or Vertically Stratified?

The short article attempts to shed new light on the basic organization of contemporary societies. Initially, two models of societal organization are introduced which are classified as core-periphery model and as a homogeneous vertical stratification model. The second section points to a notorious weakness in currently available stratification schemes which are hardly capable to account for the multi-dimensionality of contemporary living conditions. The third part of this article introduces a complex stratification scheme with a multiplicity of different domains and dimensions. As a next step, the two societal stratification models are combined with the complex stratification scheme so that both societal models can be expressed in terms of different stratification patterns. The fifth section produces the results from two parallel surveys in Slovenia and in Austria which were implemented with two groups of 400 fully employed and 400 unemployed persons. The outcomes of the surveys clearly support the homogeneous vertical model and reject, by and large, the center-periphery model. In a final section one of the empirical findings, namely the strong relations between the lower segment of unemployed persons on the one hand and their health conditions on the other hand are further discussed in theoretical terms and new theoretical links are suggested between social inequality research and medical research.

Keywords: Social inequality, comparative research, health research, living conditions

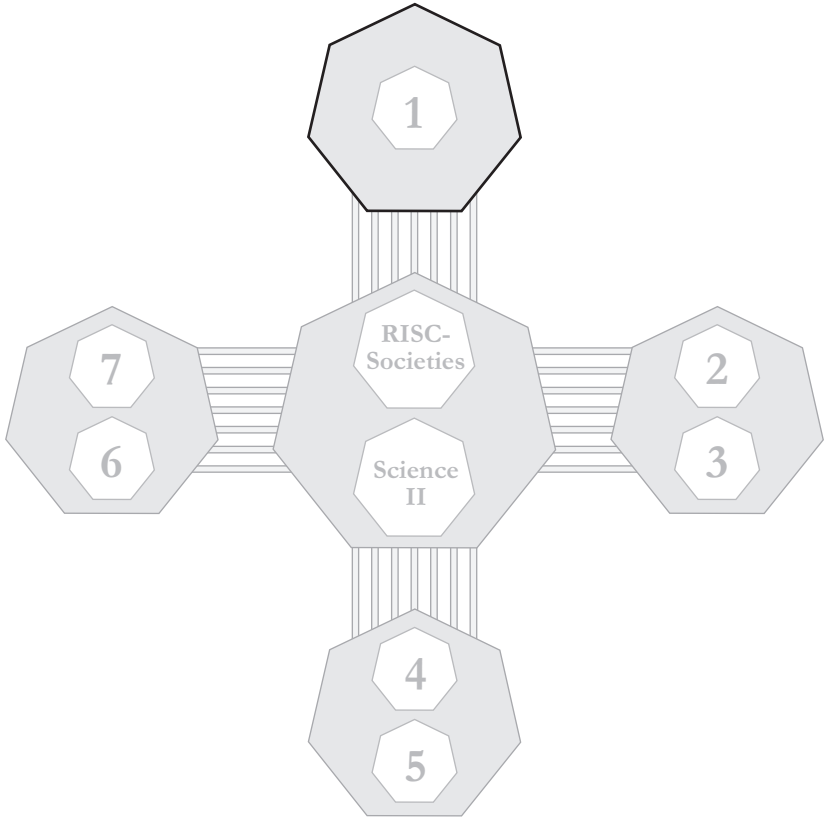
Inequality and Health Conditions in Modern RISC-Societies

The final article attempts to shed new light on the deep relations between stratification, social inequality and health-relevant dimensions. For this purpose a new relational metric will be introduced which transforms a multiplicity of living conditions into a [-1, 0, +1] metric of socio-economic risks and life chances and, subsequently, into a social inequality scale and a vertical stratification scheme with groups of multiple life chances at the upper end and multiple risk groups at the lower

end. With two international survey data sets it can be shown that the new relational metric leads to significantly deeper relations between stratification, inequality and health than in the traditional accounts.

Keywords: Social inequality, comparative research, health research, living conditions

Part I
From Science I to Science II



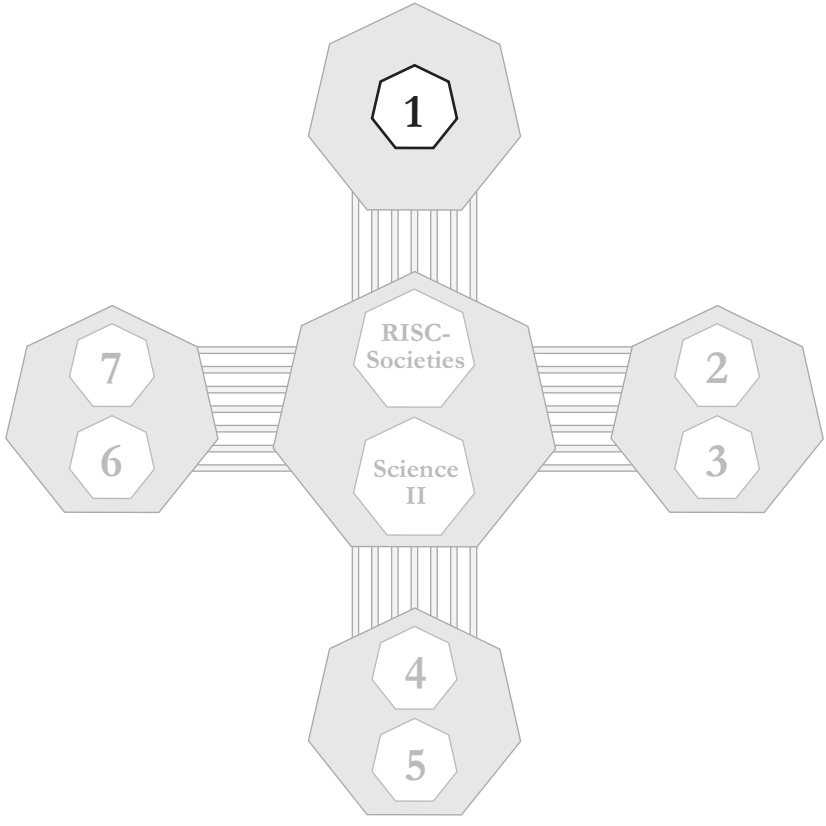
Introduction to Part I

The first part of the book consists of a single article which covers important aspects in the transition from Science I – the period between the emergence of modern science in the 16th century up to the decades around 1900/1950 – to Science II. In closer detail, the first article aims to reach three major objectives.

- First, several characteristic drifts in the long-term evolution of science have been specified and are discussed in greater detail. These science drifts become important because one of the overall aims of the new kind of social science is to provide cognitive support and, thus, additional strength to these contemporary and future science drifts.
- Second, an attempt has been made for a dynamic mapping of the overall science landscapes for three different periods, namely for
  - the science system around 1900 to 1950
  - the contemporary science system of the year 2012
  - the future science system for the period 2050–2100
- Finally, the article presents the results from an online survey which was sent out to experts in the field of science studies worldwide. Surprisingly, a large number of the assumptions for Science II like the emergence of the life sciences as a new leading field could be supported empirically through this online-survey.

Through these three stages Part I wants to show the scientific background dynamics which become relevant for the shape and the profile of the new kind of social science.

1 The Complex Drift Towards Science II



"Towards a New Kind of Social Science" sees itself located and embedded within several broad contemporary and future-oriented science drifts where this new kind of social science and the overall science drifts should support each other mutually. However, identifying major science drifts is obviously confronted with major problems as well. With respect to the past, the special challenge lies in a multiplicity of general patterns of the long-term evolution of scientific knowledge and in their mutual inconsistencies.

1.1 Science Drifts in Four Different Directions – and an Initial Stop Sign

While the multiplicity of patterns for the evolution of science in the past is confronted with the challenge of an under-determinacy of data, one of the most fascinating barriers in a deeper analysis of the scientific evolution of the evolution of science lies in the impossibility, so it seems, to predict future knowledge developments in science. Here, one is confronted with a seemingly insurmountable barrier which can be qualified as Popper's barrier, due to a large number of arguments and proofs by Karl R. Popper on the impossibility of forecasting future knowledge. Nevertheless, this section will attempt to synthesize various patterns of science evolution in the past to a more robust form. This new robust pattern will, then, be tested with the help of an online-survey on the past and the future evolution of scientific knowledge which was accessible only for s small number of specialists in the area of science studies worldwide.[1] Finally, this new robust pattern will become the necessary dynamic environment in which the main themes of the new kind of social science will be placed.

A Halting Problem

But before proceeding to the general patterns of long-term knowledge evolution a special barrier has to be overcome and passed which has been referred to already as Popper's barrier. In fact, Popper's barrier has the potential of preventing any predictive capability with respect to future knowledge domains in science. As an unusual starting point for introducing Popper's barrier, a reference will be made to Donald Rumsfeld, former Secretary of Defense in the Bush-administration, who made an unusual distinction on the three different domains of knowledge and ignorance. In a speech from February 12, 2002 Rumsfeld proposed the following demarcations..

1 For more details, see Müller *et al*., 2010.

> ... as we know, there are known knowns: there are things we know we know. We also know there are known unknowns: that is to say, we know there some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know.

Paradoxically as it seems at first sight, the second and the third domain of known unknowns or unknown unknowns has at least one remarkable instance which, not surprisingly, has to do with knowledge itself and, more specifically, with future knowledge.

For Popper, forecasts were reserved for systems and configurations which were characterized by attributes like being closed, stationary or ergodic [Popper, 1965c:339]. But the universe we observe and operate in is intrinsically open and emergent. In fact, Popper provides a beautiful example that observations, descriptions and explanations of the world add, by necessity, to its genuine openness.

> The incompletability and openness of the universe is perhaps best illustrated by a version of the well-known story of the man who draws a map of his room, including in his map the map which he is drawing. His task defies completion, for he has to take account, within his map, of his latest entry. [Popper, 1982a:129]

In a more advanced form Popper sets out to prove that future knowledge belongs to the domain of known unknowns which, by necessity, cannot be known in advance.

> (1) If complete self-prediction can be shown to be impossible, whatever the complexity of the predictor, then this must also hold for any 'society' of interacting predictors; consequently, no 'society' of interacting predictors can predict its own future states of knowledge;
> (2) The course of human history is strongly influenced by the growth of human knowledge ...
> (3) We cannot, therefore, predict the future course of human history; not, at any rate, those of its aspects which are strongly influenced by the growth of our knowledge [Popper, 1982a:63].

But future knowledge has another highly intriguing property. From a long-term evolutionary knowledge perspective future knowledge was always full of unknown unknowns as well. Time and again, new theories, mechanisms, models or measurements moved the knowledge boundaries into hitherto new domains and dimensions. Both the astronomic and the sub-atomic space-time scales and processes belong to the unknown unknowns for a natural scientist around 1750 or even 1850. Additionally, the effects of the unknown unknowns to the known configuration belongs to the unknown unknowns as well.

Thus, Popper's barrier looks well-founded and, especially important, insurmountable. Future knowledge, due to its dual qualities of belonging to the class of known unknowns and unknown unknowns lies beyond the domain of possible scientific

investigations. Being confronted with Popper's barrier the most natural alternative would be to restrain from the analysis of future knowledge and restrict oneself to the historical aspects of knowledge evolution alone.
Well-founded as Popper's barrier stands it does not prevent, however, two groups of analysis of future scientific knowledge.

- The first cluster of research problems lies in the area of known unknowns and is centered on the diffusion of contemporary knowledge domains or of scientific disciplines. Like in innovation research it is worthwhile to study diffusion histories of scientific fields or disciplines in detail and to apply the findings from these studies for current innovations in scientific knowledge and their likely trajectories in the future.
- The second cluster of research questions is situated in the domain of unknown unknowns. Here, researchers can be asked repeatedly about their subjective assessments whether fundamental changes in specific knowledge domains are highly likely or unlikely and whether a state of cognitive equilibrium has been reached in these particular areas or not.

These two groups of research issues can be dealt with independently and despite Popper's barrier. While these two clusters of research questions cannot remove Popper's stop sign with respect to the predictability of future knowledge, they remove effectively an attitude of *ignoramus*, *ignorabimus* [du Bois-Raymond, 1885] which Emil du Bois-Raymond cultivated in his talk on the limits to the knowledge of nature, held 1872 in Leipzig. Thus, despite the unknown unknowns a lot more can be said about them aside from being simply unknown unknowns.

1.2 Four Potential Long-Term Science Drifts

After leaving the confinements of Popper's barrier, the next pages will present an overview of those approaches that are focused on the long-term dynamics of science. For this task, various starting points are feasible. John Losee for example, in his "Theories of Scientific Progress" [2003], proposes three theory groups under the headings of incorporation, revolutionary overthrow and descriptive theories. Similarly, Daniel Rothbart, in his "Explaining the Growth of Scientific Knowledge" from 1997,[2] offers a very interesting view on the scientific innovation engine which becomes very productive in the case of a juxtaposition of apparently incongruous cognitive systems which enable the production of a new and

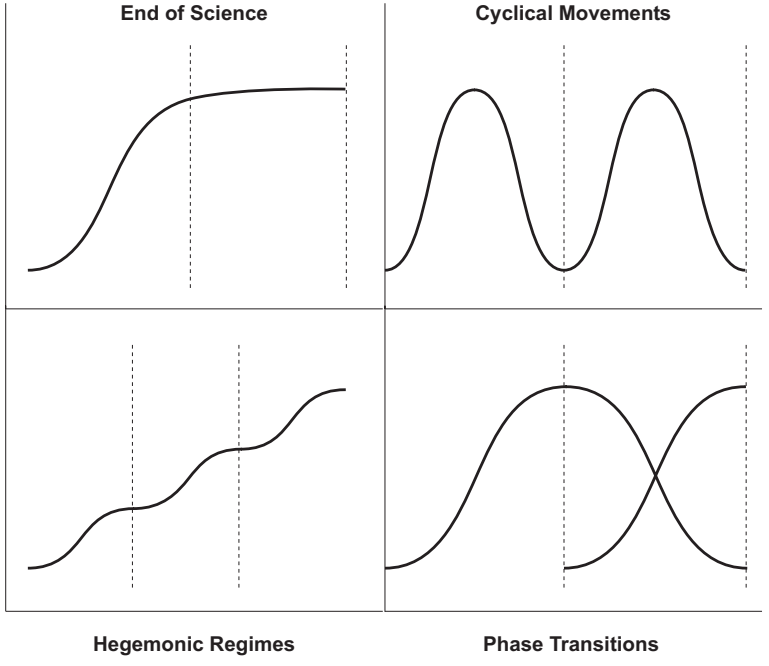
2 See also Rothbart, 2007 with a very illuminating view on the role of instruments and machinery in the production of scientific knowledge.

innovative scientific horizon. Following Rothbart, this chapter could concentrate on periods of intensive scientific growth and the underlying incongruent schemes and building blocks.

While all these and similar approaches[3] would allow a summary on scientific growth, a different approach will be taken in the subsequent pages. Using Humberto R. Maturana's and Francisco J. Varela's term of a drift [Maturana/Varela, 1987], science drifts can be introduced as a generic concept for long-term directions in the evolution of scientific knowledge. In particular, four patterns or theory-groups will be introduced which can be classified according to their characteristic development configuration or, alternatively, science drifts as

Pattern I – End of science
Pattern II – Cyclical development
Pattern III – Hegemonic regimes
Pattern IV – Phase transitions.

FIGURE 1.1 **Four Trajectories for the Long-Term Cognitive Evolution of Science**



3 See, for example, also Kantorovich, 1978, 1979 or 1993.

Figure 1.1 summarizes these four different perspectives on the long-term cognitive evolution in science. Clearly several of these general patterns like the first one – "end of science" – and the second one with cyclical trajectories in Figure 1.1 are mutually inconsistent. From a logical point of view, all four groups cannot be true, while all of them might turn out to be false or erroneous.

The Path towards Global Cognitive Equilibrium

Stephen Hawking [Hawking, 1991:10] has proposed for one of the core-scientific disciplines, namely for particle physics, that the prospect for a complete, unified theory of everything, explaining all relevant phenomena in the micro-universes of particle physics are well under way. Thus, particle physics, according to Hawking's account, may be drifting to a stable or meta-stable state of cognitive equilibrium. In a very similar and more generalized vein, John Horgan has proclaimed a cognitive end of science [Horgan, 1997] where, like in Wittgenstein's "We are satisfied that the earth is round" [Wittgenstein, 1971b, OC 299], all fundamental cognitive achievements have been reached already and, thus, a state of stable cognitive saturation has been reached. In particular, science has moved to a state where the basic structures, the adequate theory levels or the fundamental constants have been identified and subsequent research, while highly innovative and also necessary, will consist in smaller recombinations within a rather constant overall configuration.
A slight variation of this pattern comes from Nicholas Rescher[4] who uses financial constraints and Rousseau's law as a fundamental constraint for the expansion of science. In the near future the science system as a whole will experience limits to growth due to the fact that, put in a simple manner, a linear increase in truly innovative outputs requires an exponential increase in financial support. Due to this Malthusian variant in the field of birth rates for innovations, science enters a state with significantly slower to marginal cognitive growth rates only.

The Trajectories of Hegemonic Science Cultures

The second pattern assumes a limitless progress through the succession of different stages which are all marked by the dominance of a specific leading field or discipline. So far, this succession of leading fields manifested and will manifest itself in two – and probably three – basic formations. The second general pattern has been captured with the help of Figure 1.3.

4 See especially Rescher, 1982 but also 1998 or 1999.

FIGURE 1.2 **The End of Science-Configuration – a Drift Towards Cognitive Equilibrium**

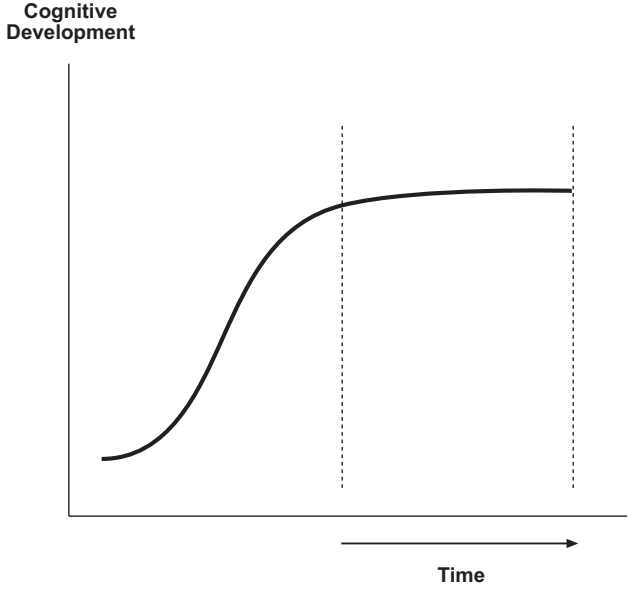


FIGURE 1.3 **Hegemonic Regimes and Rises in Complexity Levels**

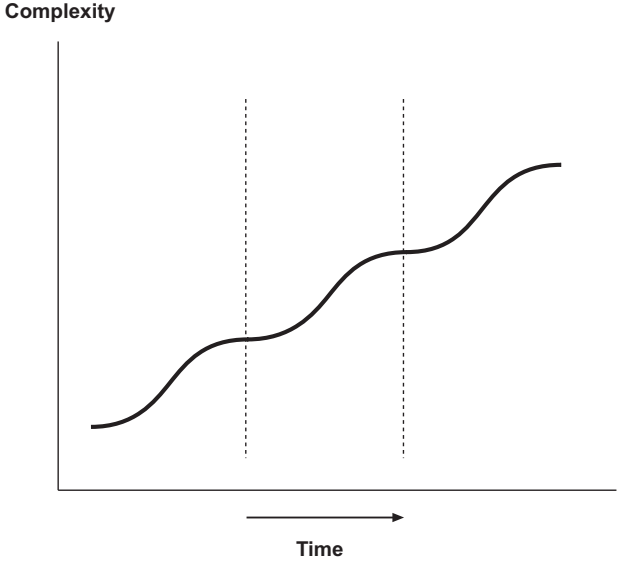


Table 1.1 presents a summary of two and possibly three stages of hegemonic regimes which, despite being part and parcel of the scientific method, are also characterized by significantly different epistemic practices.[5] These three hegemonic regimes can be classified as

- the age of theoretical physics [1687–1900/1950]
- the age of life sciences [1859 – app. 2030/2050]
- the age of cognitive neural sciences [from 2030/205050 onwards].

More specifically, the succession of theoretical physics to molecular biology implies also a shift in the cognitive routines from, following Karin Knorr-Cetina, theoretically closed forms to open, tinkering, trial and error procedures.

TABLE 1.1 **Leading Science Fields in the Evolution of Science, 1650–2150**

Leading Science Field	Characteristics
The Age of Physics [1687–1900/1950]	Rise of Newtonian Physics; Application across a Large Number of Fields; Maximum Level through the system of Maxwell-equations (Unification to an electromagnetic field theory); Tipping Point: Einstein's Special and General Theory of Relativity as well as the Quantum Physics drift towards a GUT (Grand Unified Theory) Electro-Mechanic Technologies across a Large Number of Fields;
The Age of the Life Sciences [app. 1859–2050]	Pre-phase 1859–1950 (Darwin's theory of evolution) Breakthrough into a self-sustained take-off via the decoding of the genetic code [Watson and Crick 1951] Evolutionary theories and models for evolutionary dynamics move along a "grammar of becoming" Recombinant Bio-technologies
The Age of the Cognitive Sciences [app. 1948–2150]	Pre-phase 1948–2050 (Pre-phase for the Cognitive Sciences) Breakthrough to a new leading discipline around 2050 Cognitive technologies

5 For a highly relevant account in this respect, see especially Karin Knorr-Cetina, 1999.

To provide additional strength to this pattern, approximately ten years ago, Leonard Krishtalka identified ten grand challenges for the sciences in the 21st century, namely –

1. What is the origin, structure, and fate of the universe?
2. What is the fundamental structure of energy and matter?
3. We need to decipher Earth's physical systems—its climates, geology, hydrology, ocean systems ...
4. What is the diversity of life on Earth?
5. We need to understand the tree of life which tells us the evolutionary kinship of every single species of plant, animal, and microbe.
6. The sixth grand challenge is to decipher the language of life.
7. How do these four phenomena—Earth's physical systems, diversity of life, tree of life, and language of life—interact to form the planet's web of life?
8. The eighth grand challenge focuses on the ... Homo sapiens. From urban systems to agrosystems, we need to understand and model human systems, or human ecology.
9. The ninth grand challenge is in neuroscience.
10. Finally, if we are going to tackle these grand challenges, the 10th and greatest grand challenge is understanding and modeling complexity.[6]

Viewed from the perspective of leading or hegemonic fields, the ten grand challenges for the 21st century are distributed well among all three leading disciplines. Two of the challenges fall under the responsibility of the leading scientific regime of the past, the majority of the challenges, the challenges three to eight, fall under the currently hegemonic field of life sciences and the ninth and tenth challenge belong to the emerging hegemonic regime of the cognitive sciences.

More support for a drift towards the life sciences and, furthermore, to the cognitive sciences can be found in John Brockman's "The Next Fifty Years" [2003] where twenty-five scientists give their assessments on the long-term dynamics of science.

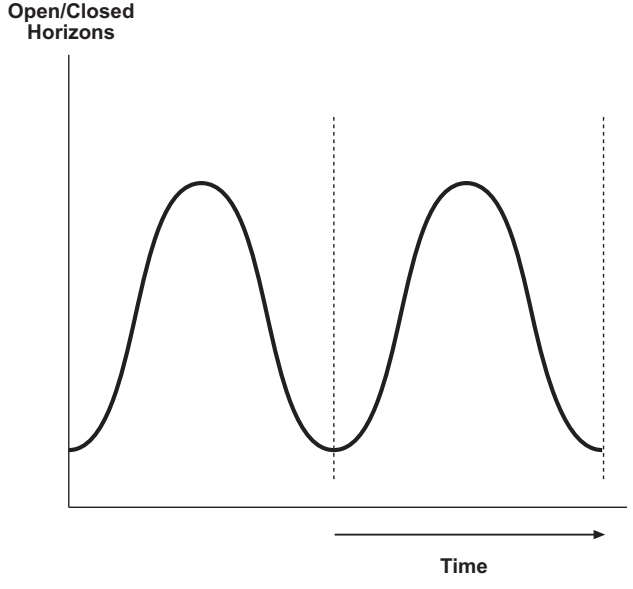
The book is divided into two parts, namely into a theoretical part – "The Future, in Theory" – and a more application oriented part – "The Future, in Practice". The first noteworthy fact is that theoretical physics has lost its dominant position across all these accounts. Even in the theory part, only two out of twelve articles are devoted to the issues of astrophysics and cosmology, the rest of the articles are distributed across issues like mathematics, complexity theory, biology, cognitive science and an unusually widely understood science of social relations. In the thirteen articles of the second part, roughly one half is focused on the cognitive sciences and the second half on the life sciences, broadly conceived.

6 The quotation was taken from Krishtalka, 2002.

Cyclical Patterns

So far, the previous long-term patterns were characterized by following some upward pattern. In sharp contrast, one finds also a theory group which has its focus on a cyclical pattern of the long-term evolution of science. One of the most interesting dynamic approaches lies in the discrepancies between actual knowledge and yet unexplored knowledge domains. An intuitive model of the very long run would consist, as a variation to the end of science model, in the vision of a closing gap, starting with huge distances at the beginning of modern science in the renaissance, with medium discrepancies for the present time and with a self-contained and closed body of knowledge in the distant future. Following Nicholas Rescher however,[7] one can draw a cyclical picture of diminishing and increasing distances. Here, the first peak period for the body of scientific knowledge, coming close to an age of objective or finalized knowledge, occurred around the time of Kant and Diderot and the second peak-phase towards the fin de siècle. On the downward side of the cycle, the lower turning points lie, according to Rescher, in the last quarter of the seventeenth century, associated with the emergence of the Newtonian program, around the middle of the 19th century and, finally, in the 1950's. *e.g.* [Rescher, 1982:31]

FIGURE 1.4 **A Cyclical Pattern for the Long-Term Evolution of Science – a Drift towards Open and Closed Horizons**



7 See especially Rescher, 1982 or 1999.

Thus, knowledge spaces can be characterized, on the one hand, by periods of wide-spread proportions of terrae incognitae like in the case of the infant stages of the Newtonian program and, on the other hand, by phases of common terrae cognitae where John Horgan's end of science becomes a plausible topic for discussion. In the long run, the structure of scientific revolutions leads, following Nicholas Rescher, to a cyclical pattern of close and wide distances with respect to a perceived final horizon of knowledge production.[8] While the low status around 1850 seems to be highly debatable, a cyclical pattern of cognitive completeness seems to be highly interesting and illuminating in itself. Moreover, Figures 1.4 and 1.5 exhibit the basic swing in the 20th century which started as a revolution in physics and was accompanied by a considerable opening in medical science and psychology by the new science of psychoanalysis as well as by a fundamental insight into the necessary incompleteness of logical systems and mathematics.
The most important point in Figures 1.4 and 1.5 though, lies in the cognitive status of the period between 1940 and 1960. According to Nicholas Rescher this particular phase shared a unique feature in the history of science, namely a very high value for the level of perceived ignorance and, thus, a minimal value for the ratio Θ of the level of cognitive completeness which results from the ratio of the level of perceived knowledge Φ and the level of perceived ignorance Γ. Thus,

$$\Theta = \Phi / \Gamma \tag{4.1}$$

After an already long-lasting period of scientific evolution, open cognitive horizons or frontiers can only emerge through a complete recombination in the cognitive foundations and in the scientific as well as in the technological knowledge base by discrediting old paradigms, traditional cognitive networks and the established technological infrastructure. Instead, one can observe the proliferation and diffusion of new paradigms with radically different cognitive network structures and a new technological infrastructure as well. As an empirical support it should be added that during the two decades between 1940 and 1960 the science system was placed on a new inter- and transdisciplinary platform, due to the emergence of –

- a general theory of systems
- a general theory of information
- the transdisciplinary science of cybernetics
- the emergence of the cognitive sciences

as well as on a new science landscape. Since the beginning of the 20th century, the normative sciences – logic, mathematics, ethics, etc. – have been expanded,

8 On this point, see also, Maddox, 1998.

augmented and, above all, opened by various new levels and frameworks. In mathematics, for instance, one can observe the transition from David Hilbert's vision of a fully self-contained mathematical axiomatics at the turn of the century to a state of necessary incompleteness and to an algorithmic re-definition of effective calculability by Church, Kleene, Gödel, Herbrand, Post, and Turing. This brought about a radical paradigm shift, in which the basic architecture, the potentials, but also the necessary boundaries, *i.e.* the blind spots and unavoidable limitations of arithmetical or deductive operations could be clearly identified and established. In the field of logic, for example, one finds a multiplication of logical systems between 1910 – when Bertrand Russell and Alfred N. Whitehead's "Principia Mathematica" was first published – and the 1930s, 1940s, and 1950s, which had taken the shape of many-valued logic, inductive logic,[9] modal logic, deontic logic, and many others.

The empirical sciences also experienced a gradual shift of gravity and focus within the period of 1940 to 1960, thus successively ending the Golden Age of physics of the preceding four decades. After a few years of hectically searching for a unifying pattern, the basic structure of the genetic code was decoded in 1953, finally making it possible to translate it into the language of biology and subsequently into bio-technology.[10] Just like the planetary structure of the atom proposed by Ernest Rutherford at the beginning of the 20th century, Francis Crick and James Watson's discovery of the DNA structure was an important starting point, which would turn out to be the beginning of a gradual rise of biology or, more generally, the life sciences as a new leading discipline. Physics, as a key field, maintained its status as an area of large-scale research and a complex of mainly big science. From a technological point of view and in terms of its basic models and mechanisms, however, it slowly started to lose ground to a very extensively structured biological or life science field, which comprised, among other components, large parts of brain research, physiology, and medicine.

Another characteristic feature of the scientific landscapes of that time lies in the new connections between formal and natural sciences, which had likewise been established between 1940 and 1960. In those years, the key empirical disciplines achieved a substantial number of formal syntheses, which eventually led to a re-definition of their basic theoretical foundations. In 1943, for instance, Warren McCulloch and Walter Pitts developed a model of the neuron and the neuronal connections, which was strongly based on Carnap's system of logic.[11] At the

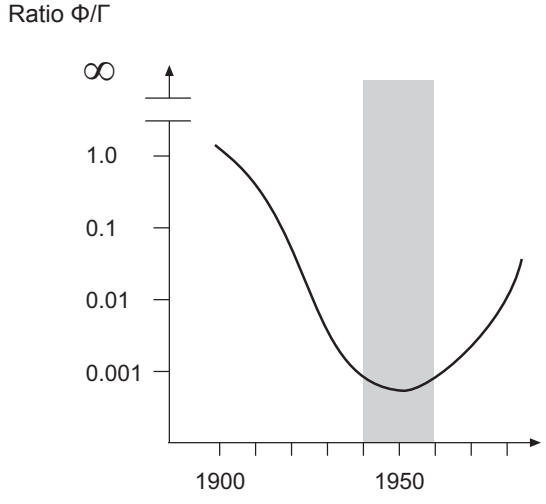
9 See, for example, the rather voluminous edition of Carnap, 1950.

10 For James D. Watson's own account of the story, which is also quite thrilling from a historical point of view, see Watson, 1970.

11 It strikes as rather interesting that this pioneer work by McCulloch and Pitts only contains

end of the 1930s, Claude E. Shannon transformed logic, which was originally expressed by Boolean algebra, into a circuit language [Shannon, 1940]. Moreover, the Turing machine constructed in 1936 can clearly be seen as the godfather of the new computer generation that started to evolve about ten years later. The structures and forms of the Bourbaki group became a central point of reference in the formulation of developmental psychology.[12] Finally, John von Neumann and Oskar Morgenstern used logic and strategic interactions to formalise game theory [von Neumann/Morgenstern, 1944]. Logics and linguistics also led Noam Chomsky to develop new syntheses in the field of generative grammars[13] – and this is by far not the end of the list. Compared to thirty, or even sixty or a hundred years ago, the world of science had also considerably changed with regard to its disciplinary foundations and its normative – empirical boundaries. To conclude, these twenty years are characterized by a maximum degree of open frontiers.

FIGURE 1.5 **Open Cognitive Horizons 1900–2000**



three references to other publications, all of them dealing with logic – to Rudolf Carnap, to Hilbert/Ackermann, and to Russell/Whitehead [*cf.* McCulloch/Pitts, 1988:39, orig. 1943]

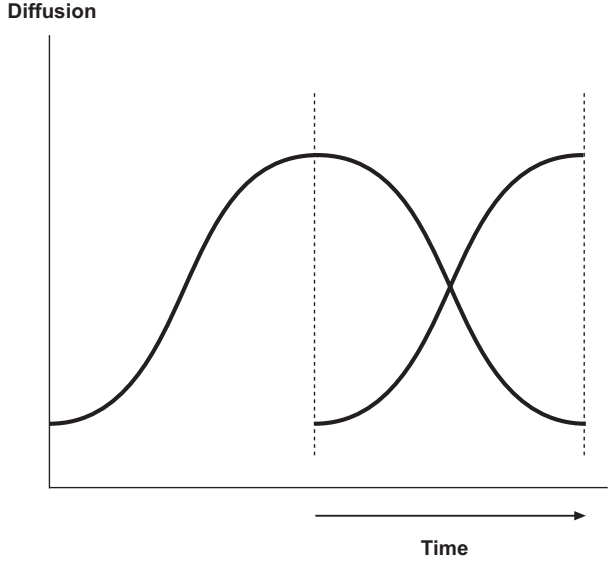
12 For an overview see Piaget, 1973 and 1983. Piaget defines the common structuralist reference point of the Bourbaki group as follows:
The Bourbaki method was such ... that they used isomorphisms to identify the most general structures, to which all kinds of mathematical elements can be subordinated, regardless of their nature and of the area they come from. [Piaget, 1973:24]

13 In this respect, see Chomsky, 1957, 1964, 1965.

Phase Transitions

The fourth theory group comprises a heterogeneous group of different approaches and can be summarized under the heading of a phase transition from a traditional period or mode to a new era or mode. Graham and Dickinson [2007] provide a summary of current views on phase-transitions and present three approaches, namely the transitions from Mode 1 to Mode 2, the shift towards a Triple Helix[14] and, finally, the emergence of Post Normal Science (PNS).[15]
Figure 1.6 offers a general pattern for a phase transition which is the common underlying pattern for a variety of different approaches.

FIGURE 1.6 **The Pattern of a Phase Transition**



While PNS and the Triple Helix do not offer long-term historical schemes, the third approach has its focus on scientific knowledge production and on the change from a traditional mode of productive knowledge organization labeled as Mode 1 to a new Mode 2 which is characterized by a bundle of new features in the organization of scientific work.[16] Table 1.2 presents a summary of the differences

14 For a theoretical background, see Leydesdorff, 2006.
15 PNS is largely restricted to complex problems in the environmental or earth sciences and will not be worked out in detail. On the historical background of PNS, see, for example, Tognetti, 1999.
16 For a wider discussion on Mode 1-Mode 2 changes, see, for example, Etzkowitz and Leydesdorff, 2000, Fuller, 2000, Gibbons/Limoges/Nowotny/Schwartzman/Scott/Trow,

between Mode 1 and Mode 2 where one can see that Mode 1 is the university-based research which has become characteristic from the 2nd half of the 19th century up to the present time. Mode 2, in contrast, emerged, according to the main proponents of this particular modal differentiation, only in recent decades and can viewed as an alternative and societally more accountable way for research practices. The most important difference between the two modes lies in their application domains. Mode 1 operates on a strict dichotomy between contexts of discovery and contexts of application, whereas Mode 2 is characterized by an integration of these two contexts and by basic science in the context of trans-disciplinary problems and of specific problem solutions and applications.

TABLE 1.2 **A Phase Transition in Knowledge Production from Mode 1 to Mode 2 [1950–2020]**

Attributes	Mode 1	Mode 2
Knowledge Production	Separation between context of discovery and application	Basic discoveries in the context of application
	Basic-science	Applied basic science
	Focus on disciplinary matrices	Focus on trans-disciplinary problems
Research Programs	Closed, Deductive	Open, Recombinative
Organization	Homogeneous Research-teams	Heterogeneous Research teams
	Stable spatial locations Long-term orientation	Distributed across space limited periods, temporary configurations
Extra-Scientific-Domains	Irrelevant	Reflexivity and societal responsibilities
Quality Control	Peer review, Internal	Wider set of criteria, including extra-scientific Elements like societal Acceptance, etc.

The most dramatic change within the fourth group of approaches comes, however, from the next differentiation. According to the next perspective, the science system as a whole has entered within the last decades a phase of radical transformations from an old regime, called Science I, to a new regime under the name of Science II.[17] Science I was the dominant form of science from the

1994, Godin, 1998, Hessels and van Lente, 2008, Nowotny/Scott/Gibbons, 2001, Rip, 2002, Shinn, 2002 or Ziman, 2000.

17 On this distinction between Science I and Science II, see especially Hollingsworth/Müller,

beginning of modern science in the 16th century up to the period of 1900 to 1950. Science II, consequently, emerged over the last decades and will turn out to be the new hegemonic regime, although Science II will not replace Science I completely. In a variety of domains and applications Science I-models and methods will still be used.

In the context of Science II the theoretical, epistemological and methodological background knowledge for scientific disciplines undergoes significant changes. In a non-metaphorical way, several building blocks can be identified which will become characteristic for a science of living systems by living systems and which, therefore, become characteristic for the emerging theoretical, epistemological and methodological background knowledge in Science II. Clearly, these new building blocks will exert a considerable cognitive pressure on the theory and research organization from the era of Science I and should lead to new theory structures and research designs for the social sciences or the humanities as well. Table 1.3 summarizes those changes in background knowledge that will become of particular relevance for scientific investigations across disciplines in the future.

TABLE 1.3 **Changes in the Theoretical, Epistemological and Methodological Background Knowledge of Science I and Science II**

Domains of Background Knowledge	Science I [Theoretical Physics as Leading Discipline (LD)]	Science II [Life Sciences as LD]
Objects of Investigation	Objects Simple Action Schemes Cognitive Isolationism Single Account Sufficient	Living Systems Embedded Cognition Cognitive Holism Requisite Variety Necessary
Subjects of Investigation	Observer Exclusion	Observer-Inclusion
Interactions (between Subjects and Objects)	Sequential, Linear Equilibrium Dyadic, Asymmetric Forms	Recursive, Non-Linear Eigenforms Triadic, Symmetric Configurations

As can be seen from Table 1.3, the main differences between the old and the new background knowledge cover the entire domain of analyses, namely the subjects of investigation, the objects of analysis and, finally, the interaction

2008 and on a wider discussion of this separation see Boyer, 2008, Mayntz, 2008, Nowotny, 2008 or Sornette, 2008.

modes between subject and object of analysis. All three domains differ strongly between Science I and Science II. In short, Science II has become a science of living systems for living systems in which the subjects of analysis, being living systems themselves, are an indispensable and inclusive part of an investigation. The objects of analysis, namely living systems, turn out to be far more complex than the physical objects within Science I. Finally, the interactions between subjects and objects are organized, as will be shown later, in a closed triadic as well as recursive manner. The methodological and theoretical elements of the new background knowledge emerge from the leading field of Science II, namely form the cognitive life sciences, broadly conceived whereas the new epistemological components come from a diverse group of frameworks which are particularly focused on the specificities of living systems like the approaches by Robert Rosen [Rosen, 2005] and Walter M. Elsasser [Elsasser, 1998], radical constructivism or, as specially relevant subsets of radical constructivism,[18] second-order cybernetics[19] or the autopoietic approach.[20] These and similar perspectives are especially relevant for shaping the core epistemologies of Science II-research.[21] From both sides, the theoretical-methodological and the epistemological one, the conventional wisdom of research in the SSH-domain is not only questioned in its core aspects and in its central designs,[22] but SSH-research is also very much encouraged to change its traditional perspectives in order to become compatible with the new Science II landscapes.[23]

As a final hint on the changes between Science I and Science II the role of the environment should shift considerably. Table 1.4 exhibits some of the characteristic differences between the two forms of environments in Science I and in Science II. In Science II, the environment becomes the necessary co-evolving counterpart for living systems in general because, phrased in a very general way, living systems need, for their own reproduction and survival, a responsive environment and an active counterpart for their own internal operations, cognitive and otherwise.

18 On radical constructivism in general, see, as summaries Watzlawick, 1981, Watzlawick/Krieg, 1991, Schmidt, 1987 or Glasersfeld, 1997.

19 For second-order cybernetics, see especially von Foerster, 2003.

20 On the autopoietic approach, see, for example, Maturana, 1985 or Maturana/Varela, 1987

21 Second-order cybernetics has been developed explicitly by Heinz von Foerster as a science of living systems for living systems. On Heinz von Foerster and his work at the Biological Computer Laboratory, see especially Foerster, 2003, Müller/Müller, 2007 and Müller, 2008.

22 For interesting overviews and approaches, see Palombo, 1999 or Ryckman, 2000,

23 The morphological approach in the previous chapter can be seen as a typical example for a new design which corresponds rather well with the new theoretical background knowledge of Science II.

TABLE 1.4 **The Changing Roles of Environments between Science I and Science II**

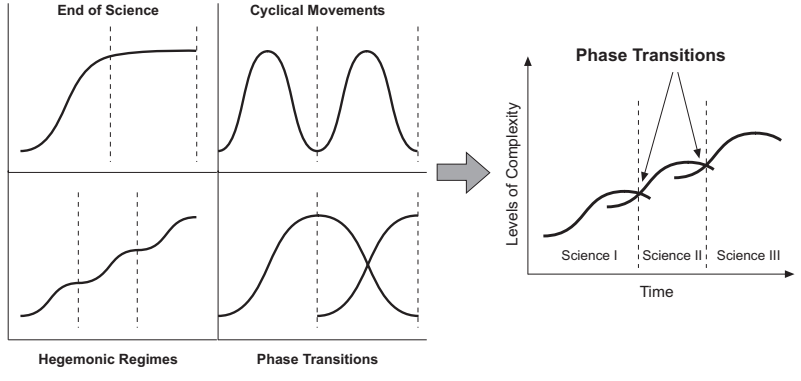
Environments in Science I	Environments in Science II
Weak Boundaries	Strong Boundaries
Direct Crossings	Indirect Crossings
Cause – Effect	Triadic Relations
Direct Environmental Effects	Boundary Transformations, Indirect Effects
External Dynamics	Internal Dynamics
Adaptation	Internal Complexity Drifts

1.3 A Second-Order Investigation of Science Drifts

At this point the short presentation of four groups of approaches to the long-term development of science has come to an end. It would require too much space for the questionnaire to transform all four different patterns on the long-term knowledge evolution into appropriate survey questions. Thus, a brief second order investigation on the science drift of science drifts was undertaken in order to identify a more general and more robust science drift pattern which, then, should become the main topic of the online questionnaire.

Figure 1.7 demonstrates that a more general science drift has been extracted from the four different patterns discussed so far which integrates several key components from each of the diffusion patterns.

FIGURE1.7 **Synthesizing the Four Patterns of Long-Term Science Drifts**



- First, this new science drift pattern exhibits a very long-term gradient towards higher complexity levels where complexity can and should be understood in a multi-dimensional manner, comprising, following Nicholas Rescher [1998], constitutional complexity with the two dimensions of compositional and taxonomical complexity, structural complexity with the two dimensions of organizational and hierarchical complexity, functional complexity with the two dimensions of operational and nomic complexity and, finally, algorithmic complexity with the two dimensions of procedural and computational complexity. From a theoretical perspective, these complexity levels have no inherent barriers or limits, although the wide variety of societal systems and networks, including their embedded technologies, operate under complexity constraints..
- Second, the new science drift pattern operates in a cyclical manner, too, since the rise in complexity-levels is not accomplished in a linear manner, but through a very long cyclic movement of the rise and decline of leading disciplines which occupy the core areas of scientific landscapes during their hegemonic position. So far, one can distinguish between two hegemonic regimes, namely Science I with the dominance of Theoretical Physics and Science II with the hegemonic status of the life sciences.
- Third, a highly risky guess, has been made by assuming that in the future Science III could emerge with the cognitive neuro-sciences as the leading field. Thus, Figure 1.7 shows three stages of long-term evolution of science.
- Fourth, the new science drift pattern is characterized not only by a sequence of leading fields, but also by phase transitions of different epistemic regimes whereby a new science regime changes the underlying theoretical or model-architecture of science in an irreversible manner. From science studies in different contexts[24] one can assume that Science I can be characterized by an epistemic culture which, essentially, was closed and hierarchical. Science II can be characterized by attributes like tinkering, open-ended search and weakly heterarchical. Likewise, Science III can be viewed as transdisciplinary, recombinative and strongly heterarchical, taking its theories, models and mechanisms from a stock of different clusters or families of theories, models

24 See especially Knorr-Cetina, 1999. In this book, it was stringently demonstrated that research practices in high energy physics on one side and molecular biology on the other, can be split into two different clusters. High-energy physics can thus be characterized as an empirically closed program while molecular biology appears as exploratory and open. Also from this side strong support is given that the two leading science fields – theoretical physics and the life sciences – differ by basic epistemic markers, and follow their own research heuristics and operations, although both are located in the wider field of natural science and, above all, of empirical sciences.

and mechanisms and recombine them for the particular area of investigation.

– Fifth, these epistemic cultures are characterized, inter alia, by a specific mix of intra-scientific co-operation. Phrased in a very general manner, the predominant interaction mode for Science I was rather weak across scientific disciplines which were the strong arenas for conducting research. Moreover, the scientific disciplines were safeguarded by a strong network of discipline specific gate-keepers like journals and, even more powerful, by the organization of universities which were divided into collections of scientific disciplines. Science II shifts to a much higher level of co-operation, operating with a high degree of inter-disciplinary transfers and co-operation and with a considerably weaker system of gate-keeping. Finally, Science III should be classified as the age of full co-operation since the academic disciplines will, in all probability, be no longer relevant for conducting frontier research, but will be restricted to the teaching and education domain only.

It can be safely argued that the new form for a more general and more robust science drift integrates elements from all four previous patterns although certain aspects of the previous four long-term evolutionary knowledge patterns were not taken into account. For example, the notion of a cognitive equilibrium which is a strong component of the first pattern was not included because even Popper, despite his emphasis on objectivity and realism, was speaking of an unended quest and of an infinite task for science, without reaching the Archemedean points for cognitive rest, equilibrium and god's eye views.

Turning to the dynamic aspects inherent in the new and more robust pattern of a science drift more specifically, two phase-transitions

With respect to the first phase transition from Science I to Science II, one can refer, in addition to the relevant literature, three further points which also support the plausibility of such a change.

– First, one must mention Friedrich A. von Hayek who already in 1967 wrote a rather neglected article entitled "The Theory of Complex Phenomena" respectively "Die Theorie komplexer Phänomene" [Hayek, 1967, German edition 1972]. In this article, Hayek developed a typology of complex phenomena and processes, achieving a strong differentiation from the simple typology of phenomena and processes. Table 7 lists the results of these fine distinctions between simple and complex phenomena in several types, and relates them to the primary differentiation between science I and science II. Over the following two equivalences, which do not occur in Friedrich A. Hayek of course, namely:

  Simple phenomena ≡ Science I
  Complex phenomena ≡ Science II

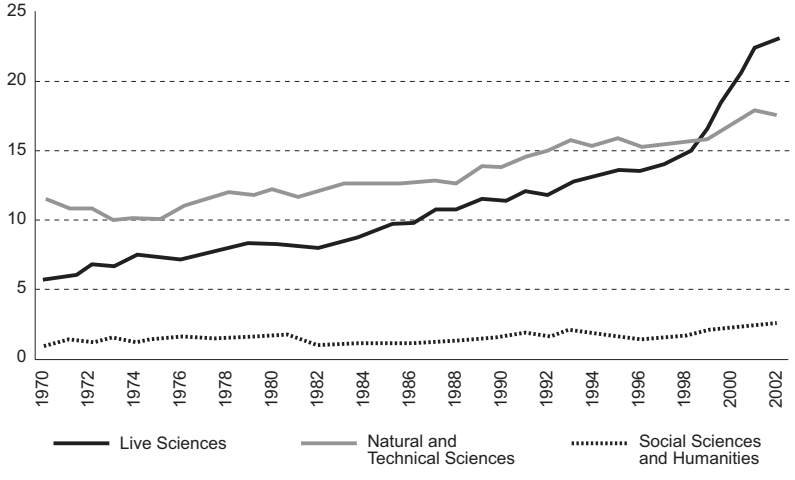
Science II can be equated to complex and science I to simple phenomena and processes.

According to the Table 1.5 the central concepts for complex alias science II manifest in patterns, in pattern recognition, in pattern forecasts as well as in the pattern production or pattern formation. Accordingly, the analysis of complex phenomena proves to be model based, and is in a striking contrast to the law-based paradigm for simple phenomena and processes.

TABLE 1.5 **Friedrich A. Hayek's Main Distinctions between Simple (Science I) and Complex Phenomena (Science II)**

Dimensions	Simple Phenomena (Science I)	Complex Phenomena (Science II)
Degree of Complexity	Low	High
Measure of Complexity	Small number of Variables	Large number of Variables
Bond between Variables	Causality	Generative Relations
Spezification		
Schema	Laws	Pattern
Mode of Analysis	Covering Law-Model	Pattern-recognition
Prediction	Lawbased	Pattern-prediction
Leading Science	Classical Physics	Evolutionary Biology and Complexity Sciences

FIGURE 1.8 **The Shifts in the Financing of U.S. Basic Research, 1970–2002 (in Billion U.S. Dollars at Prices of 2000)**



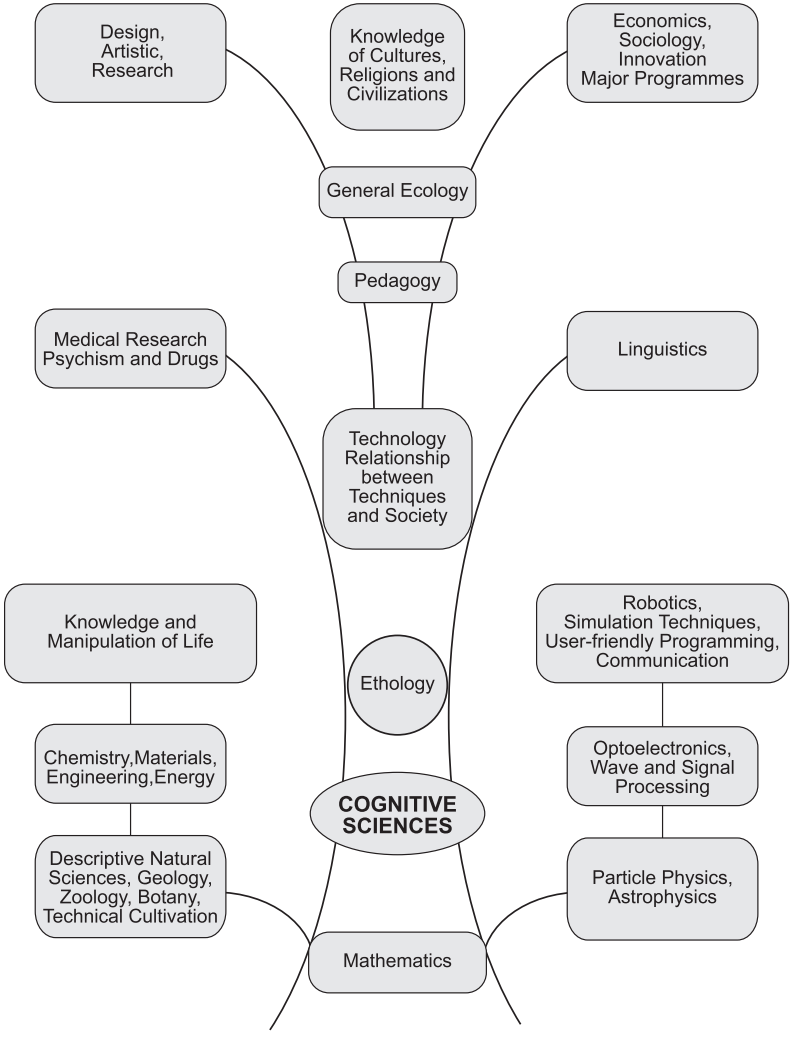
Secondly, shifts in basic research in the current scientific hegemon's region, namely in the United States can be referred to. As is evident from Figure 1.8, around 1998 an important exchange has occurred. This year, expenditure on basic research in life sciences, were surpassing for the first time, those for the natural and engineering sciences. In 1970, the expenditure for the natural sciences and engineering had been around the double of those for life sciences, but 1970–1998 there was a convergence in spending – and since 1998, the costs of basic research in Life Sciences have been rising strongly, whereas the expenditure on natural sciences and engineering increased only lightly.

Turning to the more speculative change from Science II to Science III an additional element will be introduced, namely a science map for the years 2100 which was created by the Foundation 2100.[25] When combining the new pattern of a long-term science drift with the knowledge landscapes around 2100 as they were laid out by the Foundacion 2100, several interesting aspects for long-term changes come to mind for the decades ahead.

- One of the interesting characteristics is linked to the central position of the cognitive neuro-sciences, becoming the leading scientific field and the essential background domain for areas as diverse as medical research, ethology, technology or linguistics.
- The combination of science-technology-society (STS) on the one hand and pedagogy could serve, in conjunction with the core of the cognitive sciences and ethology, as the major foundational parts for social, cultural and artistic research.
- The central parts of the contemporary social sciences like economics or sociology will turn into relatively marginal areas, being linked as well as dependent on more general social and environmental science programs in the area of general ecology.
- The reductionist view and architecture in which particle physics occupies a basic position, will shift towards a more diversified triadic configuration in which the complex of particle physics and astrophysics becomes de-centered and a side stem. The second side stem is formed by the life sciences and bio-technology, the leading field from Science II. However, the main stem is formed by the cognitive neuro-sciences which lies at the core for so different areas as ethology, pedagogy, general ecology of culture study, very broadly understood.

25 This picture was slightly modified from its original form in www.foundacion 2100.

FIGURE 1.9 **A Knowledge Map for 2100**[26]



– In Figure 1.9 the normative sciences appear under a single label, namely mathematics only. Here one can add other fields like logic, information science, statistics, ethics or aesthetics as well. These domains will retain their universal utilization contexts for any type of scientific endeavour, thus including and integrating the empirical basic triad of current and previous

26 This map has been reporduced from Gaudin, 1995.

leading fields, namely the cognitive neuro-sciences (Science III), particle physics and astrophysics (Science I) and the life sciences (Science II).
– Finally, the normative sciences, broadly understood, can be assumed to re-organize themselves into a heterarchic form, superseding the previous hierarchic structure with logic as the most fundamental area and mathematics, statistics, etc. as higher levels. In the new heterarchic form several basic concepts in logic, mathematics or information science can be based on the same underlying operation of making a distinction.[27]

So far, a new and more robust pattern for the evolution of science in the very long run has been compiled. In the next section this general pattern will be transformed into an appropriate online-survey.

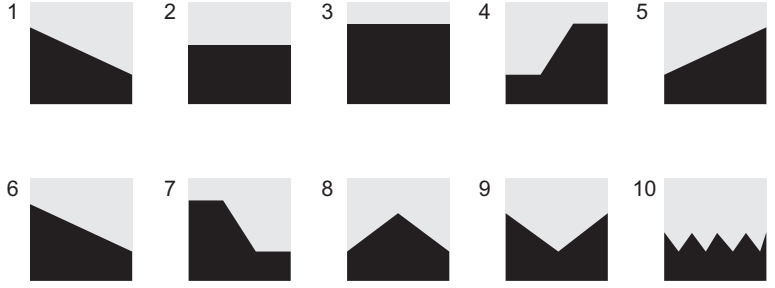
1.4 Mapping Science Landscapes

The online survey will be a so-called visual survey where the central inputs are not language based, but pattern-based. Before proceeding to the online questionnaire directly, a few remarks are appropriate why the format of a visual online survey has been selected.
The most important reason for shifting to visual surveys has to do with the contemporary changes in science landscapes and especially with the shift from universal laws to pattern recognitions and pattern productions. Survey designs which rely more on pattern recognition and pattern production than on verbal stimuli can be considered in line with this general drift towards patterns. In essence, these surveys are composed of measurement and scaling designs which produce two types of outputs. The first output group consists of a series of patterns where the task of respondents lies in the selection of a single, most appropriate pattern. The second output group is composed of visual tasks which end up in a specific pattern, generated by the respondents themselves.[28] While desirable in principle the second way of pattern formation turned out too difficult to implement. As a consequence, the survey design used pattern and pattern recognitions as its primary input and output source.
A single example should be sufficient to demonstrate this type of visual survey. This particular example deals with a pattern recognition task and is exemplified by Figure 1.10. Here, one sees a collection of visual patterns which represent one's life course so far. The task of respondents is twofold. Either they select one

27 On this point see especially Spencer-Brown, 1969.
28 For an overview, see Müller, 2004.

of the pre-given patterns or they can produce a new one. This specific item has been used in several large Austrian social surveys and has been also used in the German welfare survey. This example is particularly interesting because it can be hardly approximated with verbal responses. In principle, the patterns in Figure 1.10 can be produced verbally as well, but the sequence of verbal items would be rather complicated to read and the selection process would be extremely difficult to perform.

FIGURE 1.10 **Measurement Method as Pattern Recognition**



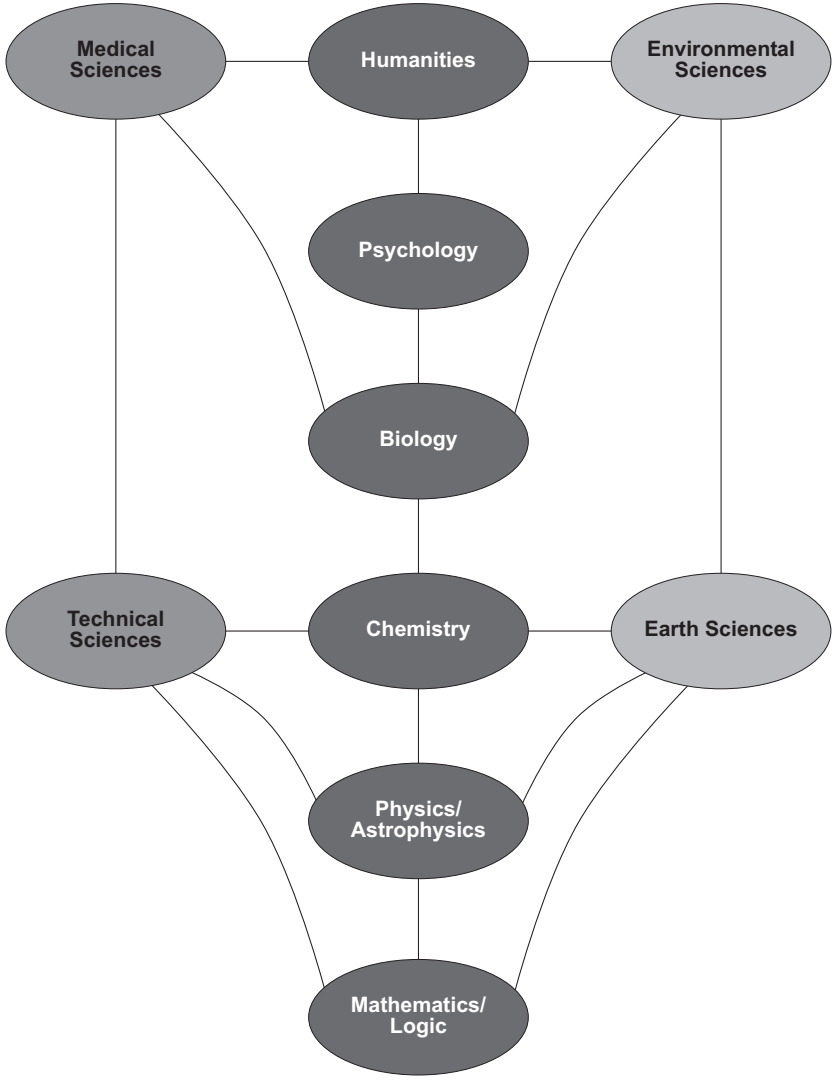
The second reason for a visual survey was the science map in Figure 1.10 which provided a reference point for the visual inputs. Thus, the online survey produced three science maps for three different periods, namely for the period around 1900, for the current stage and for the future era around 2050/2100.
First it should be emphasized that the science landscapes for 1900 and for 2010 have been built in accordance with the arrangement which Thierry Gaudin has specified for the year 2100. This means that in Figures 1.11 to 1.13 the vertical and horizontal axes can be weakly interpreted in the following manner (although several exemptions to this rule can be found in Figures 1.11 to 1.13):

- Vertical axis: Very small space-time dimensions and scales → medium space-time dimensions and scales
- Horizontal axis: Side stem I (technology domains) → main stem → side stem II (other areas).

With respect to the first science map for the period around 1900 one finds an organization of science which corresponds to the reductionist paradigm of science which has been propagated especially between the 1930s to the 1950s where theoretical physics occupied the central positions and higher strata are viewed as reducible, in principle, to lower strata and, ultimately, to theoretical physics. Thus, chemistry becomes the second stratum, followed by biology, psychology and the widely understood humanities comprise studies on human

societies. While this reductionist structure can be considered as the main stem one sees two side-stems, namely technology-related fields on the left side and the earth and the environmental sciences with a special focus on agricultural domains on the right side.

FIGURE 1.11 **The Science Landscapes around 1900**



Thus, the succession of the Figures 1.11 to 1.13 points to a possible long-term transition in science landscapes from a reductionist disciplinary organization

in Figure 1.11 to an inter-disciplinary configuration in Figure 1.12 with large transfers of models, metaphors and mechanisms and, finally, to transdisciplinary recombinative structures in Figure 1.13 where all higher strata outside mathematics are characterized as proper recombinations of underlying strata and components.

FIGURE 1.12 **The Science Landscape around 2010**

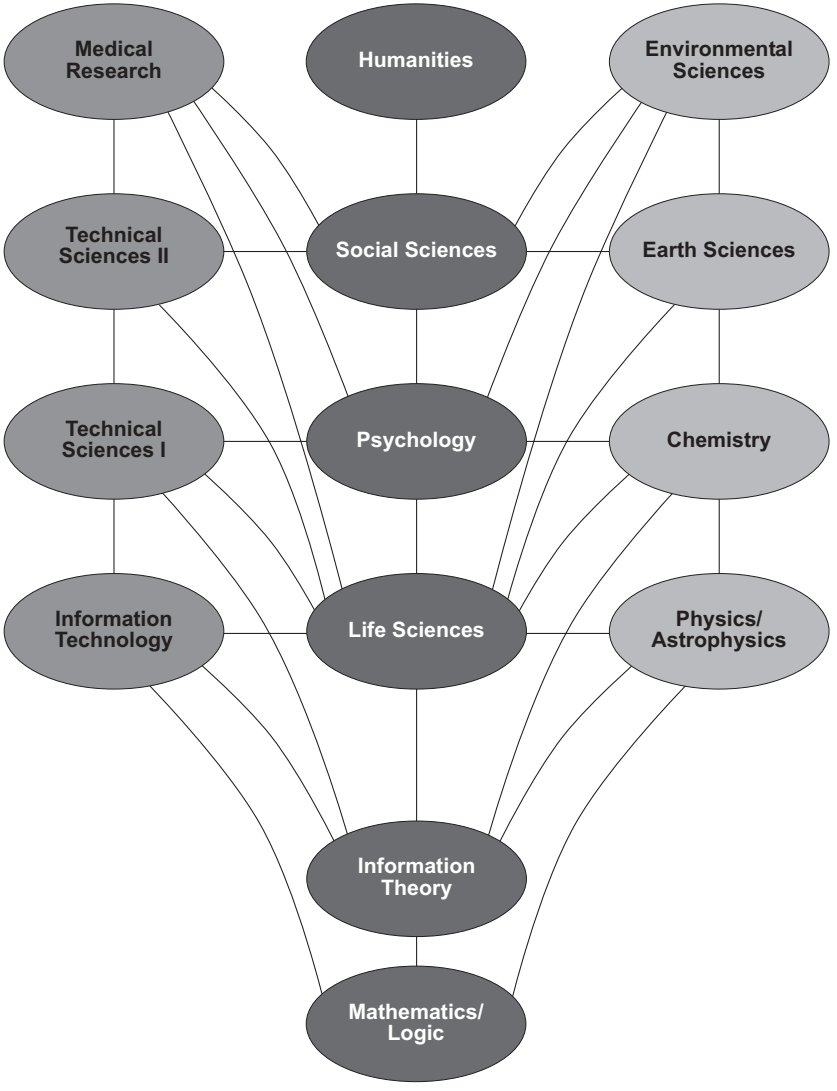
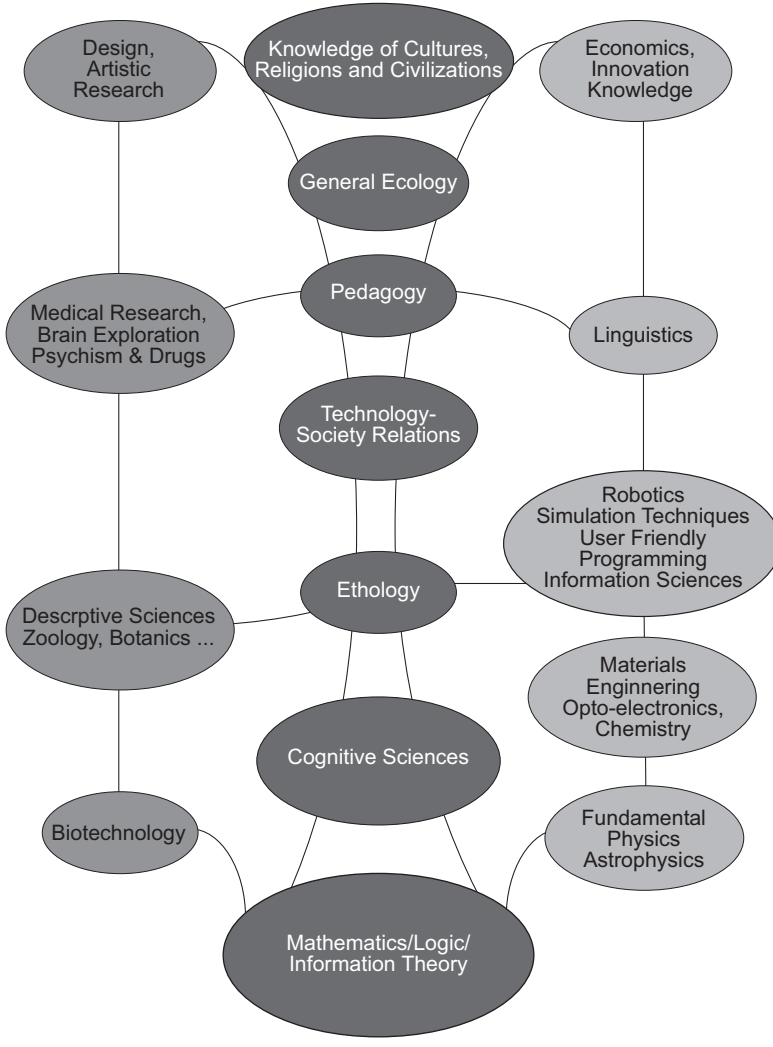


FIGURE 1.13 **The Science Landscape Towards 2050/2100**



This particular organization can be classified as holographic since each node uses components from other nodes and recombines them in a particular way.
Thus, Figure 1.13 shows a possible distribution of scientific fields in the future and places heavy emphasis on the recombinative side of theory and model structures. Quite obviously, this configuration is only one of very many possible scenarios. It will become, however, the central question for the online survey whether the drifts, implicit in the three Figures 1.11 to 1.13, is shared by a group of international experts in the field of science studies – or not.

1.5 The Structure and the Results of an Online Expert-Survey

The online survey used science maps and, thus, visual inputs as its main stimulus. The three science maps were used as reference points for the three most important elements of science drifts –

- the current change in the leading disciplines of theoretical physics to the life sciences (Science I → Science II)
- the future shift of the life sciences to the neural cognitive sciences (Science II → Science III)
- the irreversible transition from academic disciplines to recombinant fields as networks of disciplinary and transdisciplinary nodes (holographic organization).

This online survey was divided into three parts, namely,

- in an initial part concerning the distribution of main academic fields around 1900 and the changes during the 20th century
- in a second part concerning the current science landscape and its changes over the next years and decades
- and in a final part concerning possible scientific landscapes for the later decades of the 21st century.

This survey was made available to a group of experts in science studies or to leading figures across science fields. The respondents for the online survey were selected primarily by the following two criteria:

- First, the respondents had achieved sustainable breakthroughs in their respective field of science.
- Second, the respondents can be regarded as specialists for long-term processes in science dynamics.

Thus, the online survey was generally not designed as an open access-survey and no snowballing techniques were used. Approximately 150 persons were contacted and roughly 50% answered the online survey.
Turning to the main results of the survey, Figure 1.14 shows the distribution of the entire group of respondents by countries.
As is evident from Figure 1.15, a good international mix was achieved by this survey, since

- approximately a third (35.7%) of respondents comes from Austria reflecting the fact that a larger group from Austria was selected in order to be able to compare the similarities and differences between Austrian assessments and international evaluations and

– nearly two-thirds of respondents come from abroad, including the United States and Great Britain which are represented by about 26% in the sample.

FIGURE 1.14 **The Regional Distribution of the Sample**

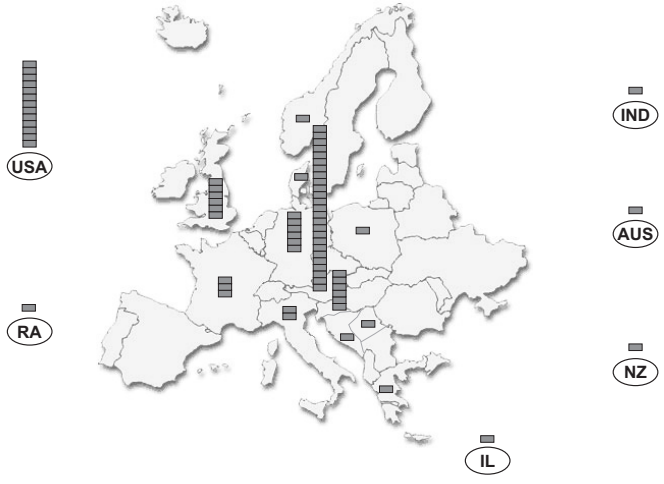
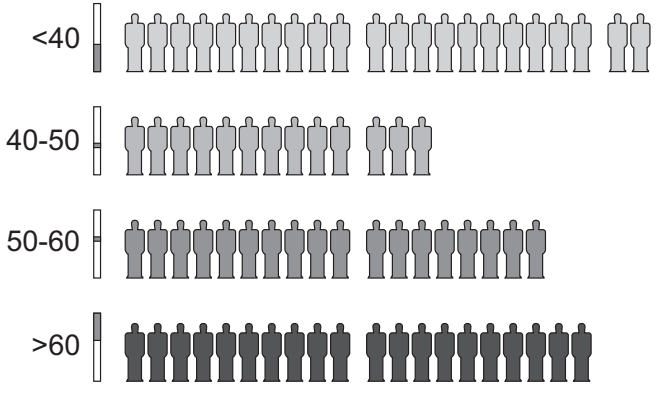


FIGURE 1.15 **The Age Distribution of the Sample**



The age distribution of the participants of the online survey exhibits an equal distribution across age-groups. According to Figure 1.16, persons under the age of 40 are represented by about 30% and respondents over 60 years account for about 27%. It can therefore be assumed that different age-based perspectives on science maps were accounted for and that the overall survey results reflect the views of several generations of scientists alike.

FIGURE 1.16 **The Gender Distribution of the Sample**

With respect to the gender proportion of the respondents the survey sample includes approximately 27% of female respondents. This gender gap reflects the still prevalent male dominance in science, but 27% of female respondents provides at least a weak corrective for an exclusively male view on science evolution, past, present and future.

Figure 1.17 shows the results of assessing the viability or the usefulness of the science maps. With respect to the science maps for 1900 or for 2010 the following evaluation rules can be tentatively applied:

- For values of 0 (totally useless) to 4 (very limited usefulness), one can assume that these maps cannot be used as a visual stimulus for discussing long-term aspects of the evolution of science.
- Values of 5 (slightly useful) to 7 (useful) indicate that these maps can be used cautiously as a visual stimulus for discussing long-term aspects of the evolution of science.
- Values of 8 (very useful) to 10 (extremely useful) demonstrate that these maps can and should be used as a visual stimulus for discussing long-term aspects of the evolution of science.

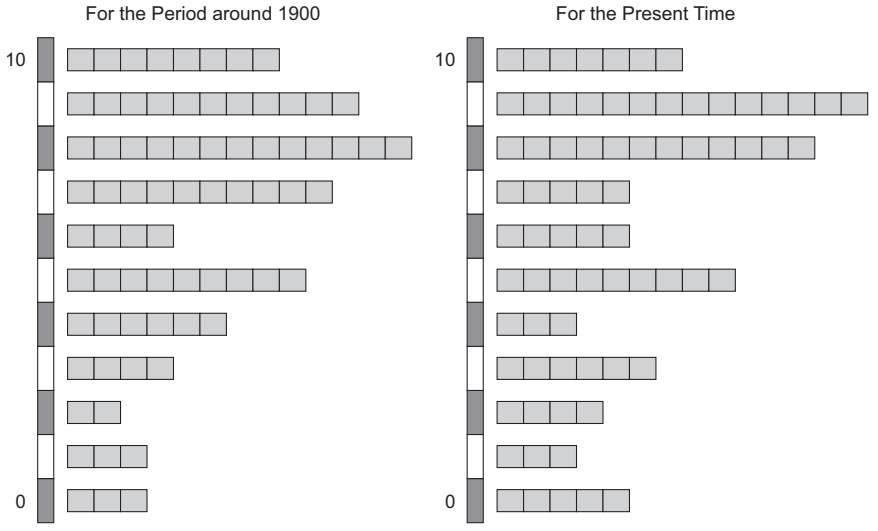
For the first science map, only 23.6% or about a quarter of respondents see a very limited or no utility in this form of mapping. With respect to the second science map for 2010 only 28.7% of the respondents fall into the category of limited or no viability or utility. This means, in turn, that roughly three quarters of the respondents view this type of mapping as at least weakly useful and more than 40% give a highly favorable assessment for this kind of science mapping. 43.9% of the respondents chose values of 8 to ten for the science map of the period around 1900 and, especially important, 45.2% of the respondents agreed very strongly with the science map for the present time.

From these distributions it can be concluded that the science maps in the online questionnaire have a high visual potential for further development as a visual instrument for diagnostic and analytic purposes in the field of long-term science studies. This result corresponds very well with a current study on the knowledge organization of Austrian universities[29] where this form of science mapping has

29 See especially Turnheim/Hanisch, 2010.

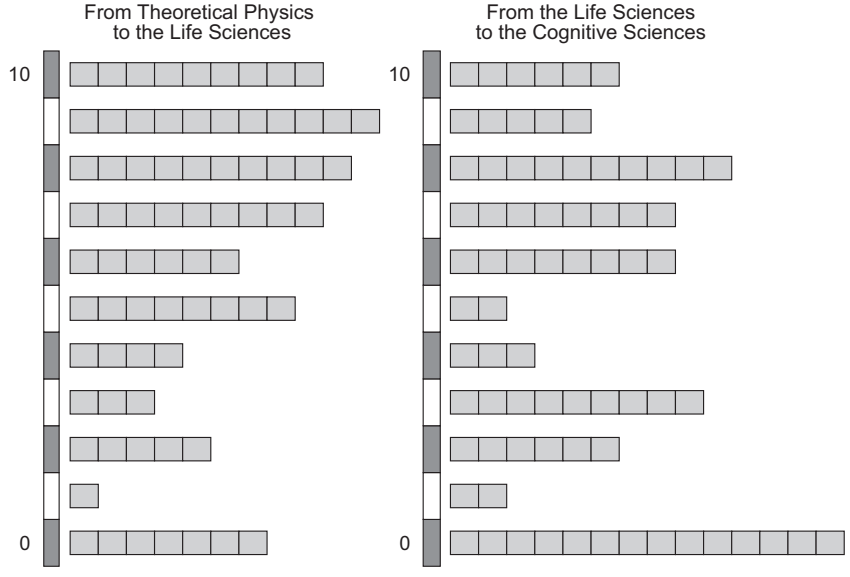
already been used explicitly as a diagnostic instrument for the knowledge bases of universities.

FIGURE 1.17 **The Viability of the Science Map for the Period around 1900 and for the Present Time**



Against this background Figure 1.18 turns to the plausibility of the current shift in the leading science fields from theoretical physics to the life sciences.
Here, the mean value of the scale, viz. 5, indicates an indifferent position while values larger than 5 showing mild to strong agreement and values less than 5 indicate small to very strong rejections. From the left side of Figure 1.18 one can see that one finds only 27% in the negative group and approximately 61% in the favorable group. It was interesting also to note that a detailed analysis of the Austrian respondents led to the result that Austrians responded significantly more skeptical and that foreign respondents expressed higher approval rates. It is impressive to see that the groups with strong approval rates with values 8 to 10 – or with strong rejection rates with values 0 to 2 are very asymmetrically distributed: 41.1% of all respondents agree strongly with the current transition in the leading scientific fields, while only 17.8% of the respondents consider such a shift as highly implausible. In this sense, the results of the questionnaire provide, a rather strong indication that currently an important phase transition from Science I to Science II is well under way which manifests itself, inter alia, in an exchange in the leading science fields towards the life sciences.

FIGURE 1.18 **Current and Future Science Drifts – The Changes in the Leading Fields Form Theoretical Physics to the Life Sciences** (Left Diagram) **and from the Life Sciences to the Cognitive Sciences** (Right Diagram)



The right side of Figure 1.18 provides the assessments for a potential science drift from the life sciences to the cognitive sciences. The assumption of a future change in the leading sciences turns out to be the riskiest hypothesis of the questionnaire because only a slight majority of 50.7% thinks of it as at least weakly plausible. In addition, there are hardly any differences on this issue between the Austrian and international respondents. Virtually no one – only 2.7% – remain indifferent about this question. And thus a strong skeptic group of 46.6% is found, which, weakly to decisively, rejects a future shift from the life sciences to the cognitive sciences. It is also interesting that a relatively large group of around 20% considers such a transition in the leading sciences to be virtually impossible.

Figure 1.19 lays out the development and the diffusion of major science fields that could be assessed on a scale between -5 to +5. For these evaluations the following rules of interpretation can be established:

Here, the mean value of the scale, viz. 5, indicates an indifferent position while values larger than 5 showing mild to strong agreement and values less than 5 indicate small to very strong rejections. From the left side of Figure 1.18 one can see that one finds only 27% in the negative group and approximately 61% in the favorable group. It was interesting also to note that a detailed analysis of

the Austrian respondents led to the result that Austrians responded significantly more skeptical and that foreign respondents expressed higher approval rates. It is impressive to see that the groups with strong approval rates with values 8 to 10 - or with strong rejection rates with values 0 to 2 are very asymmetrically distributed: 41.1% of all respondents agree strongly with the current transition in the leading scientific fields, while only 17.8% of the respondents consider such a shift as highly implausible. In this sense, the results of the questionnaire provide, a rather strong indication that currently an important phase transition from Science I to Science II is well under way which manifests itself, inter alia, in an exchange in the leading science fields towards the life sciences.

- Scientific fields are considered as strongly expansionary if fewer than 20% of the respondents choose values less or equal to 0.
- Scientific fields can be interpreted as medium expansionary if less than 35% but more than 20% of the respondents select values less or equal to 0.
- Science fields can be categorized as weakly expansionary, if less than 50% but more than 35% of the respondents opt for values of less or equal to 0.
- Finally, major science areas can be classified as stagnant, if more than 50% of the respondents take values less than 0.

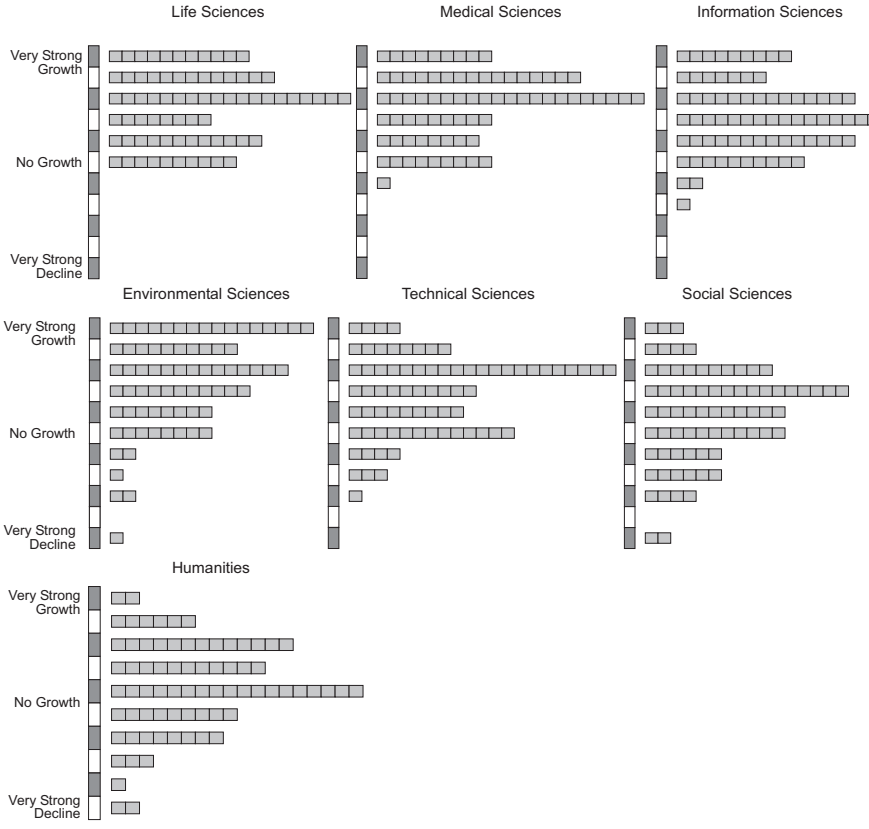
From Figure 1.19 one can see clearly that the future diffusion of major fields was assessed by the survey respondents in quite different ways.

Figure 1.19 makes it very clear that the science drift towards the life sciences is also supported by the assessment on the future development potential of the life sciences. Interestingly, none of the respondents chose even a modest decline as a likely future trajectory. The answers differed only in the growth rates of the future the increase of the life sciences. In addition to the life sciences – and thus strongly connected the medical sciences have, according to the opinions of all respondents, a very strong expansion potential, which is seen as highly similar to that of the life sciences.

It is interesting to note that two other large fields associated with the life sciences are classified as strongly expansionary, namely, on the one hand, the information sciences with its strong interface of bioinformatics and, on the other hand, the environmental sciences. Here one may assume a mutually supportive cluster of science fields, which forms the cognitive backbone of the science drift in the coming years and decades.

It is quite telling that the technical science are granted a strong potential for expansion, but it is significantly lower than that in the preceding group of science fields. After all, a strong quarter (28.8%) of the respondents assigned values of 0 or lower to the technical sciences. Likewise, only 16.5% see a very strong expansion potential for technological sciences in the future.

FIGURE 1.19 **The Expansion and Contraction of Major Scientific Fields for the Next Decades**



The social sciences appear even more restricted in their future expansion because only a weak expansive development was considered to be likely. Almost 40% – 39.7% – of the respondents expect a stagnant or even declining future for the social sciences.

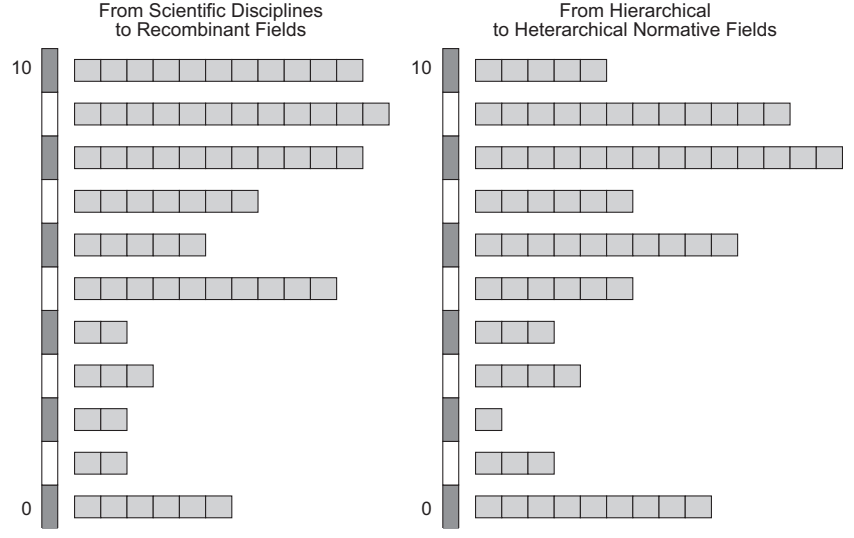
This finding for the social sciences is only surpassed by the humanities, for which only a stagnant future was specified as a likely option. 56.2% of the respondents chose values of 0 or less in the humanities, hence giving this particular domain, in comparison with other major science fields, the lowest ranking.

To sum up, the respondents provided a ranking of major science fields into four groups. Thus, the hierarchy of scientific fields with respect to their future diffusion was established in the following way:

- Strong Expansion: life sciences, medical sciences, information sciences, environmental sciences
- Medium Expansion: Technical Sciences
- Weak expansion / stagnation: Social Sciences
- Stagnation / decline: Humanities.

The agreement with respect to future science drifts is much more pronounced with respect to two other aspects of the science drift, namely with respect to the changes from the traditional scientific disciplines to recombinant fields, constituted as networks of multiple disciplines and with respect to the shift from a hierarchy of normative disciplines to a heterarchic cluster of normative fields for logic, mathematics and information theory.

FIGURE 1.20 **The Long-Term Science Drift – from Scientific Disciplines to Recombinant Fields and an Integrated Field of Logic, Mathematics and Information Theory as a Normative Basic Platform**

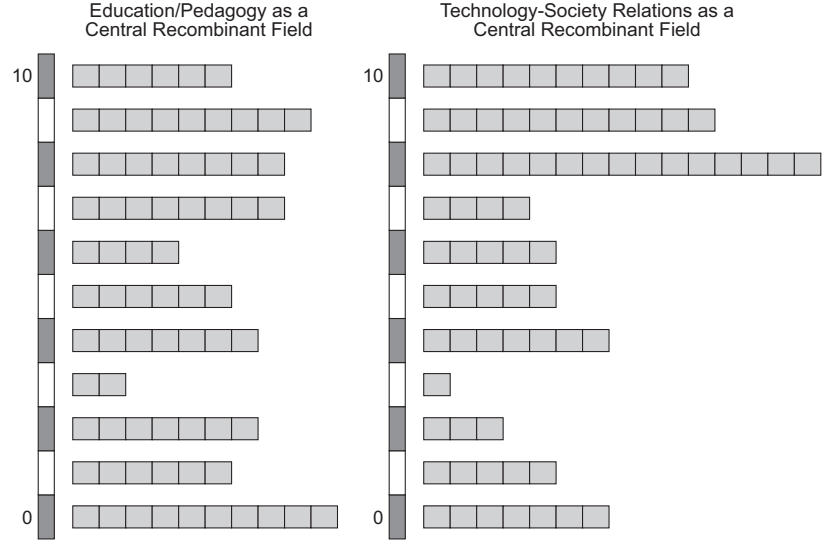


From the left side of Figure 1.20 one can see that only 20.4% of the respondents reacted with weak to strong rejections, that 13.7% were indifferent to this recombinant thesis and that nearly two-thirds – 65.9% – of the respondents expressed weak to strong approval for such a metamorphosis in the cognitive content fields of science. The right side of Figure 1.20 demonstrates that the second science drift in normative domains is accepted in similar proportions to the recombinant thesis from academic disciplines areas to recombinant and transdisciplinary science fields.

Figure 1.21 reproduces the results on significant long-term rises in recombinant fields. The first assessment for an important recombinant field for the future was undertaken for the field of pedagogy or, alternatively, for a general field of learning theory. Compared to the other evaluations the results were almost evenly divided between acceptance and rejection. It can be assumed that an agreement to a strong expansion in this domain is linked to the assessment of the future role of the cognitive sciences. Accepting a future drift towards the cognitive sciences makes an acceptance of a strong role for pedagogy as a recombinant field more likely and *vice versa*.

Finally, another recombinant field in the future main stem of the science landscape lies in the area of technology-actor relations or, more generally, technology-society relations. This recombinant domain addresses issues related with the big future boost in cognitive technologies at the nano levels, at the level of biotechnologies and at the level of bio-medical technologies as well as with their implications for societal micro and macro levels. In general, the agreement to this recombinant field is significantly higher than in the case of pedagogy, since only about a third – 31.5% – of the respondents replied to such a special recombinant field for the future in weakly to strongly negative ways.

FIGURE 1.21 **The Long-Term Science Drift – Education / Pedagogy and Technology-Society Relations as Future Recombinant Key Fields**



With Figure 1.21, the overview of the main results from the online questionnaire can be completed. From the analysis so far, three general conclusions can be drawn.

- First, the responses are characterized by a high degree of internal consistencies. They give a clear picture on those aspects of science drifts that are seen as rather unproblematic and in a largely consensual manner like the current changes in the leading fields from theoretical physics to the life sciences. And the overall results point to those areas which can be considered as highly controversial like the future shift in the leading fields from the life sciences to the cognitive sciences. Yet even for this scenario in the science drifts, a very weak majority was found among the respondents which gave a favorable assessment for such a phase transition in the future.
- Second, the answers to the online survey accumulated considerable cognitive support for the underlying general pattern of science drifts which has been extracted on the basis of the available literature on science drifts.
- Third, hardly any significant differences between the Austrian and international respondents were brought to light by a more fine grained analysis of the online survey although this part of the analysis has not been included in the present overview.

To conclude, the visual online survey proved to be a rather interesting and novel instrument for identifying long-term changes in the evolution of science. Moreover, a new visual instrument of science maps and science mapping has been created which should be of particular use for studying research organizations in different countries. Finally, the overall results on science drifts should provide a vital input for the shaping of the program of a new kind of social science..

1.6 Embedding the New Kind of Social Science in the Contemporary Science Drifts

After a summary of the current science drifts the present paragraphs will introduce necessary dynamic features of the new kind of social science which are situated right in the center of these science drifts. These characteristic dynamic features should guide in the specification of relevant domains for the new kind of social science and their attributes. Basically, this list of dynamic properties can be attached to each of the six chapters which will be specified in the subsequent section.

- The first long-term drift from the physical sciences to the life sciences and from there to the cognitive sciences makes it clear that the core issues for the

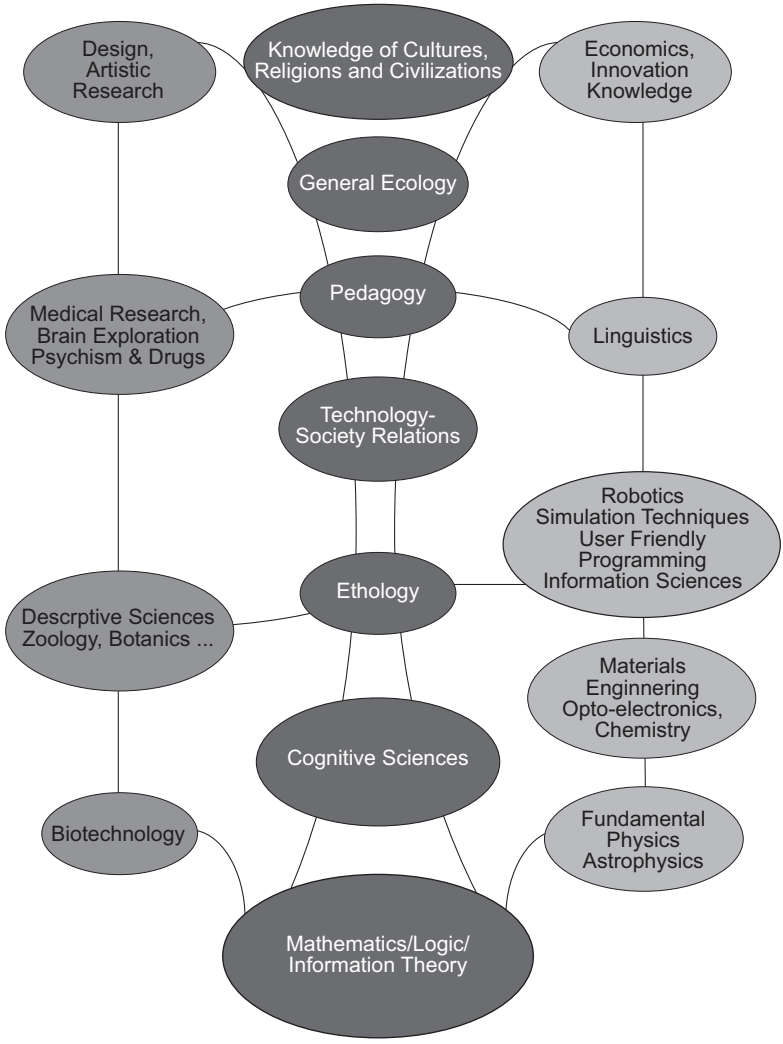
new kind of social science should be dealing with cognitive processes. Due to the overall importance of self-reflexivity, these cognitive processes should be focused on the cognitive routines and practices of actors, including scientific observers. Thus, the new kind of social science positions itself as one of the elements within the cognitive sciences, but with a special emphasis on embedded cognitive operations.

- With respect to the drift from Science I to Science II practically all Science II-features become relevant for the organization and structures of the new kind of social science. Nevertheless, two elements of Science II will be emphasized particularly strong, namely
  - self-reflexivity
  - observer inclusion
- Finally, the third drift towards recombinations and recombinant designs points into the direction of establishing the new kind of social science primarily as a first-order discipline, but with elements of a second-order discipline as well which has first-order disciplines as their objects.

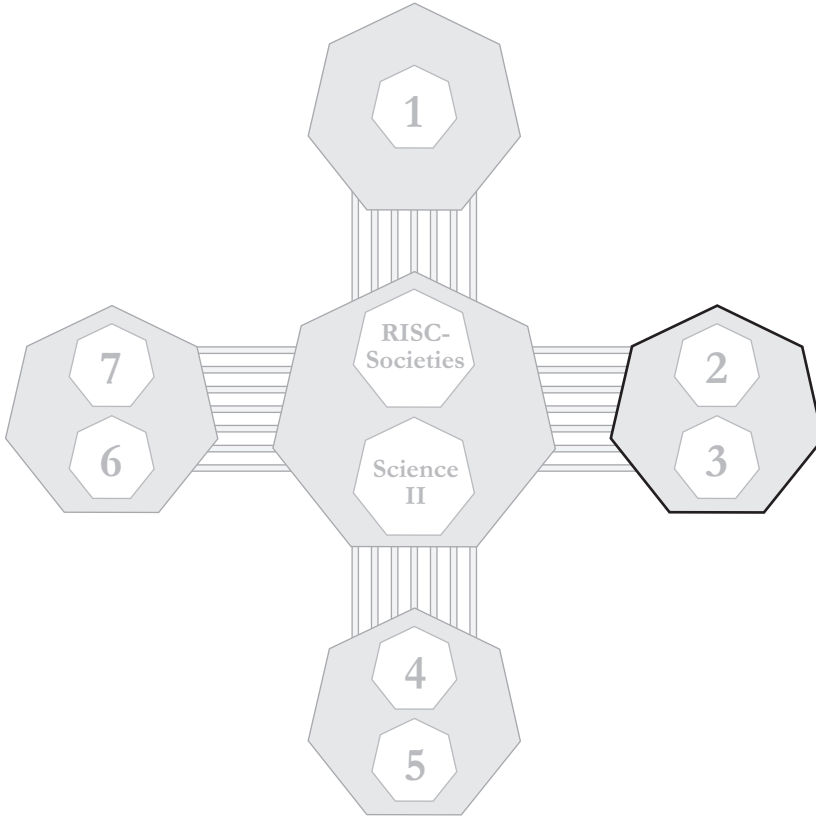
As a concluding move it is worthwhile to present the new kind of social science as ethology within the context of the science map of the future which has been used already in the online-survey [see Figure 1.22].

In general, "*Towards a New Kind of Social Science*" constitutes itself as a new type of a recombinant discipline which can be qualified as trans-scientific as well because it moves beyond the boundaries of established or traditional social science methods.

FIGURE 1.22 **Towards a New Kind of Social Science within a Science Landscape of the Future**



Part II
Science II and Its Impact on Social Research



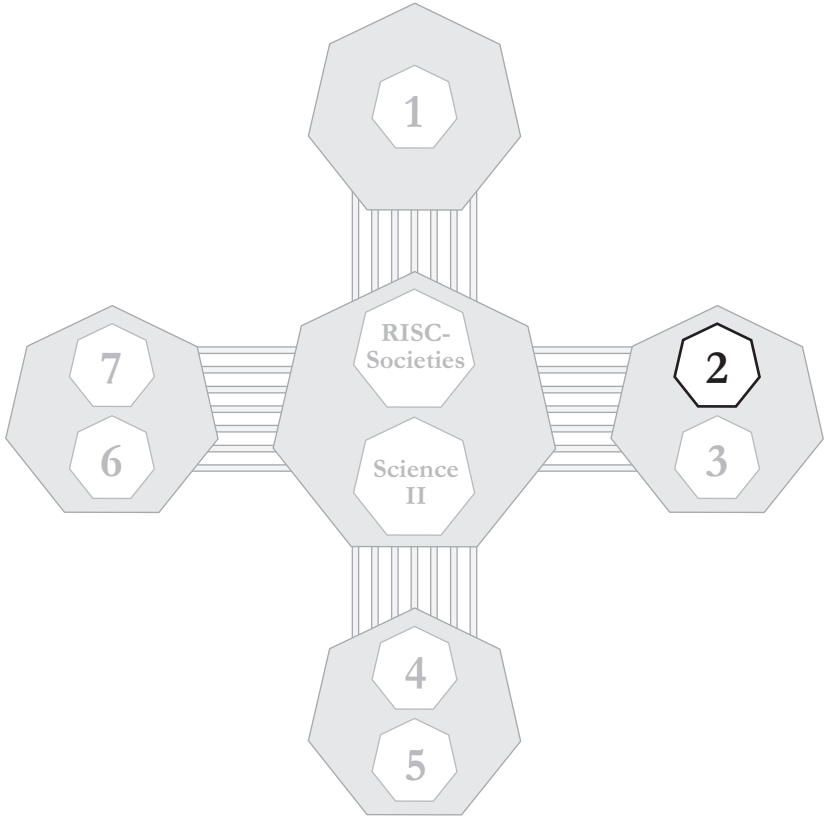
Introduction to Part II

The second part of the book is focused mainly on standardized empirical survey research and is concentrated, thus, on the measurement and observation side. While survey research has reached its peak and its perfection in terms of diffusion and methodological sophistication, its underlying assumptions are embedded in the framework of Science I in general and of trivial machines in particular. The two subsequent articles show that a Science II-framework should and will exert a significant impact on the observation and measurement processes of traditional survey research.

- The first article introduces a distinction between under-learned and over-learned responses or facts which differentiates between a repertoire of subjective "hard" and context-invariant responses or facts which an actor is able to reproduce in an identical way across time and a rich variety of just in time productions which at the surface look like "hard" facts, but which are generated in a completely different manner. The article then continues to present the underlying logic of under-learned responses or facts.
- The second article stresses several knowledge-components of Science II which are relevant for the background knowledge of survey research. Again, a series of these knowledge elements is introduced and its potential impact on the methodology of survey research is being discussed.

Thus, Part II leads to a new kind of survey research within a Science II-framework that will operate in a significantly different manner than its current version which has already reached the limits of its diffusion and development potential.

2 Survey Research in the Age of Science II



This article wants to draw the reader's attention to new theory structures and models in the cognitive sciences[1] which, so far, were considered to lie outside the domain of contemporary survey research. However, the subsequent sections attempt to show that the cognitive sciences, broadly understood, should constitute the relevant theoretical background knowledge for survey research. Such a shift from the current folk psychology-traditions to the cognitive sciences should exert a considerable influence in re-shaping survey methodologies, survey analyses and, equally important, the theory constructions for survey-based research. Adapting and accommodating to this new background knowledge, survey research, in our assessment, should and will leave behind its established core routines and its standard procedures as special cases, very much as Newtonian physics has become a special niche within contemporary physics.

2.1 The Tipping Point for Survey Research

At the outset, a few general remarks will be undertaken on the current status of survey research. For the moment it seems that survey based research has become the most frequently used publication mode across the social sciences. The following table, compiled by Willem E. Saris and Irmtraud N. Gallhofer,[2] shows a remarkable increase of survey-based research in wide segments of the social sciences, including, surprisingly, social psychology and economics as well.

TABLE 2.1 **The Rise of Survey Research from 1950 to 1995**

	Economics (39.4%)	Sociology (59.6%)	Political Science (28.9%)	Social Psychology (48.7%)	Public Opinion (95.0%)
1949/50	5.7%	24.1%	2.6%	22.0%	43.0%
1964/65	32.9%	54.8%	19.4%	14.6%	55.7%
1979/80	28.7%	55.8%	35.4%	21.0%	90.6%
1994/95	42.3%	69.7%	41.9%	49.9%	90.3%

1 On current summaries of the neuro-cognitive architectures of these different faculties, see Gazzaniga, Bizzi and Black, 2004 or Calvert, Spence and Stein, 2004. Within the cognitive neuro-science arena, one finds meanwhile numerous sub-fields and disciplinary niches specializing on a particular senso-motoric, emotional or cognitive faculty. For a diverse set of literature, see Calvin, 1996, Calvin and Bickerton, 2000, Campbell, 1984, Damasio, 1994, 2003, Deacon, 1997, Edelman, 1987, 1990, 1992 or 2007, Hofstadter, 1982, Hofstadter and Dennett, 1982, Hofstadter 1985, 1995 or 1997, Holland, 1995, Lakoff and Nunez, 2000, Minsky, 1990, Norretanders, 1997, Pinker, 1997, Plotkin, 1997, Pollock, 1989, Ratey, 2001, Roth, 1999 or Sternberg and Wagner, 1994.

2 See the summaries by Saris and Gallhofer, 2007:2p.

Table 2.1 suggests that survey research is on a continuous victory march. However, it will be argued that survey research, despite its continued successes at the level of data production in the social sciences, has reached its tipping point already. Survey research, so the argument goes, will be challenged more and more especially on cognitive grounds, but also for epistemological and wider societal reasons. The next section will point to four fundamental forms of incompleteness in survey research which, in combination, significantly reduce the development capacities for survey research in its conventional form in the future.[3]

2.2 The Fundamental Incompleteness of Survey Research in at Least Four Dimensions

Initially, an argument will be provided that a phase transition in the overall science landscapes is currently under way which has been labeled as the transition from Science I to Science II. Science I was the dominant form of science from the beginning of modern science in the 16th century up to 1900/1950. Science II, consequently, emerged over the last decades and will turn out to be the new hegemonial regime, although Science II will not replace Science I completely. In a variety of domains and applications Science I-models and methods will still be used.[4] In view of the overall changes from Science I to Science II four significant deficiencies of survey research become apparent which, in combination, lead to the verdict of a fundamental incompleteness of current survey designs.

The first incompleteness is fundamental in nature and comes from the reliance on internal assessments and internal descriptions only.[5] Under the flag of Science I it was both necessary and sufficient for survey research to have a single internal descriptive account of a respondent as the basis for subsequent analyses. This single account was considered as necessary and sufficient for two different

3 It belongs to the well-known results of innovation research that old technologies are usually replaced at the height of their efficiency and their relative strength. Thus, analog cameras have been substituted by digital ones at the height of their performance-levels. On this point, see especially Utterbeck, 1989, 1996 or von Foerster, 2003:284.

4 On the distinction between Science I and Science II, see especially Hollingsworth and Müller, 2008 and on a wider discussion of this separation see Boyer, 2008, Mayntz, 2008, Nowotny, 2008 or Sornette, 2008.

5 Here, the terms external description on the one hand and internal description on the other hand are to be used in the following way. External descriptions comprise any description by a competent observer of the overt manifestations and of the results of cognitive operations by an observable actor. In contrast, internal descriptions are tied to the self-description and self-evaluation of a competent actor alone.

domains, namely for the internal preferences, goals, attitudes, evaluations, etc. of a respondent as reported by the respondent and for the actions and interactions of a respondent as a manifestation of these underlying preferences, goals, attitudes, evaluations, etc. This focus on individual respondents was supported by the view of individuals as carriers of stable internal preferences, goals, attitudes, evaluations which, due to their inscriptions in long-term memory, can be measured directly, albeit with a certain amount of measurement errors.

The second incompleteness of survey research stems from the restricted code in which survey items are presented. Currently a single survey item should be composed of an introduction, a motivation part, information regarding the content, instruction of the respondent, interviewer instruction, requests for answers and of answers with categories or response scales [Saris and Gallhofer, 2007:121]. However, the mode of fixed responses as well as asymmetric question and answer interactions become more and more marginalized in contemporary life worlds.

The third form of incompleteness has to do with the interactions between respondents and researchers which happen in a highly restricted and only in a media-mediated manner. Currently, no information mechanisms link the side of survey researchers with the respondents and no recursive interactions between researchers and respondents occur. Surveys are usually restricted to a single measurement affair only.

The fourth fundamental incompleteness of survey research is due to the absence of survey researchers from survey research. This does by no means mean that survey researchers should report on their profile of responses in the survey they have constructed. Rather, the emphasis lies on a detailed documentation of a survey in terms of its targets as seen by a single researcher or a research group, its actual composition, its selection procedures that led to the final version, its relations, similarities and dissimilarities to existing surveys and, above all, the intended novelty and the "cash value" [Wilfried Sellars] of producing a new survey data set.

2.3 Towards New Typologies for Survey Measurement Processes

Due to the fundamental incompleteness of survey research it is worth asking what types of measurements are performed within survey settings. It is interesting to note that in the formative years of survey and attitude research social scientists like Richard T. LaPiere have shown beyond reasonable doubt, but also with no lasting success, that survey research is faced with a deadly threat because attitudes and actions are separated by an unbridgeable gap. LaPiere's assessment from the year 1934 seems as valid and as controversial now as it was then.

> The questionnaire is cheap, easy and mechanical. The study of human behavior is time-consuming, intellectually fatiguing and depends for its success on the ability of the investigator ... Yet it would seem far more worthwhile to make a shrewd guess regarding that which is essential than to accurately measure that which is likely to prove quite irrelevant. [La Piere, 1934:237]

Following this counter-tradition to the dominant forms of comparative survey research Peter Converse's article on the nature of belief systems in mass publics in 1964 marks another hallmark in approaching survey measurements and survey data in a radically different way. His article on non-attitudes can be seen as another important reference point for an alternative view of the survey measurement processes. According to Converse, attitudes measured in normal survey research qualify as non-attitudes only and as such they are highly volatile and subject to frequent changes.

Subsequently, the issue of non-attitudes provoked a new account on the part of conventional survey research which emphasized the "real" measurement of "real" attitudes in surveys, but allowed for varying degrees of measurement errors. Thus, non-attitudes quickly changed into true attitudes again, albeit in a slightly blurred and fuzzy version.

Thus, it seems worthwhile to go deeper into the issue of measurement processes and of measurement types not only in survey research,[6] but across different scientific domains. Table 2.2 presents an elementary division of measurement types for measurements across the natural and the social worlds. Here, two measurement dimensions are used, the first one on the repeatability of measurements (exhaustive/repetitive) and the second one on the degree of observer dependency.

- Exhaustive measurements lose, due to the measurement process, the possibility of a renewed measurement whereas repetitive measurements can be performed over and over again.
- Similarly, strong observer dependency means that the measurement process itself produces or generates the quantity to be measured whereas in weak observer-dependent contexts the quantities to be measured could be measured, in principle, before or after the actual measurement process as well.

Normally, the first measurement type in Table 2.2 is linked to the realms of quantum physics, where measurements are both exhaustive and strongly

6 On measurements in survey Andrews, 1984, Blalock, 1968 or 1990, Edwards and Bagozzi, 2000, Esposito and Rothgeb, 1997, Hox, 1997, Krosnick and Abelson, 1991, Lass, Saris and Kaase, 1997, Lord and Novick, 1968, Miethe, 1985 or Sniderman and Therbiault, 2004.

observer-dependent [*e.g.*, Zeilinger, 2005], and the fourth type to the macro worlds across nature and society. Following the conventional wisdom [*e.g.*, Hand, 2004 or Henshaw, 2006], measurements and observations in survey domains, if properly designed and conducted, can be treated like measurements of velocities, length, temperature or distances in the macro-natural arenas. In short, measurements in survey research, if adequately adjusted for measurement errors, correspond to type IV [Saris and Gallhofer, 2007].[7]

TABLE 2.2 **Types of Measurement**

	Strong Observer- Dependency	Weak Observer- Dependency
Exhaustive	Measurement Type I	Measurement Type II
Repetitive	Measurement Type III	Measurement Type IV

In sharp contrast to an established consensus on survey measurements, it will be argued subsequently that measurements in survey contexts, as performed according to the rules and guidelines of empirical social research,[8] fall under the first measurement type and not under the fourth type.

With respect to the dimension exhaustive/repetitive, asking a survey question once destroys the possibility for asking it again immediately afterwards. Asking the same item two, three or more times in a row creates a new context for respondents. Likewise, asking the same survey questions in a repeated manner meets definite barriers and constraints on the side of respondents.[9] Thus, along the first dimension measurements in survey research are in no way similar to consecutive and repeated measurements for physical macro-objects and their properties like velocity or temperature.

7 Measurement type II is reserved for those cases where the measurement process destroys the conditions of the possibilities for renewed measurements. For example, measuring the breaking point for materials makes a renewed measurement impossible. Measurement type III applies whenever the measurement process creates a measurable quantity via the measurement process itself. Like in the case of a roulette, a croupier as a strong observer produces a sequence of numbers from 0 to 36 in a just in time-manner.

8 See, for example, the handbook of survey methodology by de Leeuw/Hox/Dillman, 2008.

9 Respondents could be asked, however, if they are willing to participate in a weekly or even in a daily survey. But such a demand must be stated clearly in advance and must be fully accepted by respondents. Again, in a daily questionnaire it will become exceedingly difficult to ask the same question twice. Additionally, daily surveys will be accepted by respondents only if they deal with daily changing processes. This condition is usually fulfilled in the field of consumption, media utilization within the last 24 hours or in the area of social contacts. But it should become exceedingly difficult to ask respondents on their trust in institutions in daily intervals.

For the dimension of weak/strong observer dependencies two broad alternatives are feasible in survey interactions. According to the conventional wisdom in survey research, responses are based on stable assessments which are well embedded in the cognitive-behavioral repertoire and inside the neuro-cognitive organization of respondents. Thus, Jon A. Krosnick, Charles M. Judd and Bernd Wittenbrink adhere to the storehouse or file drawer image of attitudes and see a great theoretical and practical value ... to hypothesize that a single attitude exists in a person's mind: the net evaluation associated with the object. [Krosnick, Judd and Wittenbrink, 2006:26]

In this conventional view, survey measurements are founded on respondents' introspective reports of their stable long-term attitudes and beliefs which are well-stored in the long-term memory of respondents. On this account, survey measurements can be subject to measurement errors which, however, can be corrected and adjusted.

In the alternative perspective, survey responses are created just in time within the context of a survey itself, without prior fixed quantities or specific values in the cognitive repertoire and organization of respondents. Rather, due to the fixed menu of admissible survey responses, respondents can be assumed to match this unusual format with their ordinary language routines and, albeit in a spontaneous manner, with some of their past experiences. In this perspective, survey responses are creative reactions on unusual requests which in most instances are produced and delivered in a spontaneous manner.

By necessity, the second alternative in conjunction with the exhaustive character of survey measurements, leads to the first measurement type in Table 2.2. It will become the main task in the next sections to build up additional support from the cognitive sciences to justify the assumption that survey responses are exhaustive in nature and are the results of strong observer dependencies.

Consequently, the next sections will introduce two basic models from the field of the cognitive neuro-sciences, the first one a meanwhile classical model for non-trivial systems and the second one a cognitive model for learning under the name of genetic algorithms.[10] Both models, in combination, provide new insights into the central actors in survey research, namely into the cognitive states of respondents.

10 On genetic algorithms, see, for example, Goldberg, 1989, Holland, 1986, Holland *et al*., 1989, Holland, 1989, Koza, 1992, Michalewicz, 1992, Mitchell, 1996 or Rawlins, 1991.

2.4 Survey Respondents as Non-Trivial Actors

In the discussion of different measurement types one could already see that proponents of conventional measurement theory refer to the internal cognitive organization of respondents, although this reference is usually made in an ad-hoc manner.

As a first step, a very general model will be introduced which points to a central feature of respondents which, however, is constantly neglected in survey measurement theory. In a series of publications[11] Heinz von Foerster uses the distinction between trivial and non-trivial ensembles. For him, this separation was vital in order to be able to differentiate between trivial physical systems on the one hand and non-trivial biological systems on the other hand. Thus, Heinz von Foerster's two models should be relevant both for the study of human actors and for models of learning or other cognitive abilities as well. In general, these two models or machines exhibit the following characteristics.

0.1 Trivial machines: (i) synthetically determined; (ii) independent of the past; (iii) analytically determinable; (iv) predictable.

02. Non-trivial machines: (i) synthetically un-determined; (ii) dependent on the past; (iii) analytically non-determinable; (iv) unpredictable [Foerster, 1993:74pp.]

Trivial machines like input-output machines can be determined from their input and output data only. The basic distinction between trivial and non-trivial systems lies in the internal organization and structures of the latter.

> Non-trivial machines have 'inner' states. In each operation, this inner state changes, so that when the next operation takes place, the previous operation is not repeated, but rather another operation can take place. [Foerster, 1993:76]

Due to their state-determination, non-trivial systems with even a small number of input and output activities and inner states, move beyond the realm of synthetic or analytic determination.

03. Let n be the number of inputs and outputs ..., then the number N_T of passible trivial machines, and the number N_{NT} of non-trivial machines is: $N_T(n) = n^n$, $N_{NT}(n) = n^{nz}$, where z signifies the number of internal states of the NT machine, but z cannot be greater than the number of possible trivial machines, so that $z_{max} = n^n$ [Foerster, 1993:77].[12]

The relevance of the distinction between trivial and non-trivial systems for survey research should be obvious. If one assumes that respondents in surveys are state-

11 See, for example, Foerster, 1984, 1993 or 2003.

12 As a simple example, a trivial machine with n = 4, the result is $N_T(4 = 4^4 = 256$ However $N_{NT}(4) = 4^{4z}$ with $Z = 4^4$ which, after some calculations, becomes 2^{2048} or approximately 10^{620}.

determined non-trivial actors, then the identification problem of internal states becomes of utmost importance. Conventional measurement theory operates, however, on a model of trivial actors where the problem of internal states can be safely neglected. Obviously, the conventional measurement theory for surveys has been operationalized for trivial systems, but not for non-trivial systems. To conclude, Table 2.3 highlights the differences between trivial and non-trivial models for respondents.

TABLE 2.3 **Trivial and Non-Trivial Models of Survey Respondents**[13]

Trivial Models	**Non-Trivial Models**
Models	
Input/Function/Output	Functors (Operators)
Independent Variable/Function/	Operating on Functions
Dependent Variable	State-Determined Systems
Cause/Law/Effect	with Non-Linear Dynamics
Stimulus/Nervous System/Response	(Discontinuous, Qualitative
Goal/System/Action	Changes, Chaotic
Environment/Organism/Behavior	Behavior, etc.)
Motivation/Character/Actions, etc.	
Model Characteristics	
Predictable	Unpredictable
Independent of Pre-History	History-Dependent
Synthetically determined	Synthetically un-determined
Functions Identifiable	Functions not identifiable
Analytically computable	Analytically not computable
Value of functions effectively computable)	Value of functions not effectively computable)
Reductionist	Relational, systemic

13 The subsequent differentiations in Table 2.3 have been put forward essentially by Heinz von Foerster, like in Foerster 1984:8ff.

2.5 GA-Systems as Cognitive Models of Survey Interactions

In this section a brief sketch of new groups of cognitive models from the domain of evolutionary computation[14] will be introduced because they provide the necessary ingredients for modeling the cognitive competencies and the social interactions inherent in the questioning and answering of surveys.

Using genetic algorithms (GA) as a specific framework, it will be assumed that both an interviewer and a respondent in a survey are organized as GA-ensembles. In the context of survey interactions, a GA-system is situated in an environment that produces a flow of verbal inputs for the GA-system which enter into the domain of internal processing. In turn, a GA-system generates verbal outputs for its environment which, once again, lead to a new round of verbal inputs for the GA-system.

The basic ingredients of a GA-system have been captured in Figure 2.1. Internally, a GA-system consists of an internal message list, a set of encoded classifiers $\{C_1, C_2, ..., C_n\}$ as if → then rules and an output interface which generates a flow of verbal responses for the environment.

John Holland, one of the inventors of GA-systems, provides the following short summary of the GA's processing cycle.

The basic execution cycle of this system proceeds as follows:

1) Place all messages from the input interface on the current message list.
2) Compare all messages on the current message list to all conditions of all classifiers and record all matches.
3) For each set of matches satisfying the condition part of some classifier, post the message specified by its action part to a new message list.
4) Replace the current message list with the new message list.
5) Process the message list through the output interface to produce the system's current output.
6) Return to step 1. [Holland *et al.*, 1989:106]

A GA-system is basically a rule system and is equipped with three types of rules. Empirical rules are composed of different sets like categorical rules (If type T_1 has property P_1, then also P_2), associative rules (If type T_1 has property P_1, then activate category C_1), predictive rules (If type T_1 meets type T_2, T_1 will produce Action A_1) or diachronic rules (If Event E_1 occurs, then react with Action$_1$).

The second class of rules consists of inferential rules which are based on inductive generalization procedures like specialization rules, unusualness rules,

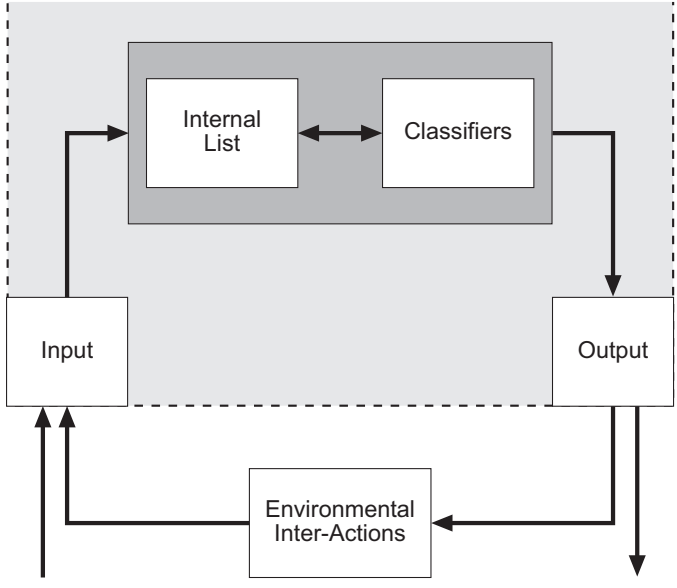
14 Evolutionary computation is an emerging field with different areas like genetic programming, genetic algorithms, evolutionary strategies or evolutionary programming. For an overview, see de Jong, 2006.

law of large number heuristics or regulation schemes. The primary function of inferential rules is to produce better empirical rules. [Holland *et al*., 1989:43] Finally, a set of unchangeable and in-built operative rules can be seen as the innate hardware of any GA-system:

> Operating principles are neither learnable nor teachable. They are innate system manipulation procedures ... These include the procedures for calling up the relevant empirical rules for representing the environment; the bidding system by which such rules compete to construct the current representation of reality ... Other operating principles invoke some of the procedures of knowledge alteration ... [*Ibid*:46]

The cognitive processing within a GA is based on a bidding process in which one of the GA-rules gets activated and executed. Given an internally encoded input from the environment, a suitable or viable GA-response is selected among a group of different available alternatives. This selection process is dependent on the strength of each of the classifiers which, in turn, is a function of their previous strength and their specificity, a drift towards higher internal complexity or a volatility of outputs.

FIGURE 2.1 **A Scheme for a GA-Classifier System**



Aside from the bidding process, a classifier system develops, in evolutionary time, a higher degree of internal complexity by a cross-over process and by the production of new classifiers as a recombination of previously successful ones. The cognitive organization of a GA-system exhibits several remarkable properties

which are necessary for their overall flexibility and for their absorption of environmental complexities like a potential multiplicity of internal rules for a given input, blatant overall inconsistency or an emphasis of specific over general rules.
This short overview of GA-systems should be sufficient to use GA-architectures for the interactions in survey contexts.

2.6 Towards a Logic of Over-Learned and Under-Learned Responses

Drawing on the two cognitive models of learning actors, a distinction will be introduced which should prove useful for the interpretation of the data generated under the auspices of conventional survey designs. This basic distinction is frequently used in memory research[15] and, at least partially, in the research on embedded cognition,[16] Here, a separation can be made between over-learned and under-learned contexts. In memory research, the terms over-learned and under-learned refer essentially to the duration and to the frequency of learning processes or to the all or none character of learning.[17] In embedded cognition, an over-learned or an under-learned context is characterized by the stability or the instability of action sequences. In over-learned contexts one finds either identical, sequentially fixed or constant actions irrespective of varying contexts or different pre-histories. In over-learned configurations, a single fixed operation or a fixed series of operations is required, expected and, in the case of violations, sometimes even sanctioned. In under-learned contexts, one usually finds varying, un-stable, context-dependent and fluid actions which are genuinely innovative, are created on the spot and are highly volatile, depending on the degree of openness in a particular situation.
Turning to a special instance of over-learned and under-learned contexts, namely to responses, the following basic distinctions can be made.
An over-learned response is triggered by a question, a command and the like and is characterized by a fixed word, a number, a sentence, a sequence of numbers or a short narrative which essentially remain unchanged in the short run and which change only under exceptional circumstances in the long run.[18] Typical

15 On over-learned and under-learned facts in memory research, see, *e.g.*, Bower, 1977 or Taylor, 2004.
16 See, for example, Underwood, 1996.
17 See, for example, Glass/Lian, 2008.
18 It should be mentioned that the production of over-learned responses has been characteristic of traditional education systems.

examples for over-learned responses include the name of a person, her or his date of birth, a person's education level, or the employment status. Over-learned responses can be differentiated into general and specific responses. The former contain numerous instances which belong to the cognitive repertoire of minimally competent persons like one's first name, the latter are dependent on the knowledge and performance levels of a concrete individual.[19]

In contrast, under-learned responses are highly volatile even in the very short run, they are subject to frequent changes in short time intervals and they are sensitive both to contexts and to pre-histories. They, too, like the specific over-learned responses, depend on the cognitive organization and repertoire of individuals. Another rather obvious feature of under-learned responses is that they are easily forgotten within a very short period of time. Table 2.4 offers several basic distinctions between under-learned and over-learned responses.[20]

TABLE 2.4 **An Overview of Over-Learned and Under-Learned Responses**

Over-Learned Responses	Under-Learned Responses
Single Solution	Multiple Solutions Possible
Stable, Fixed	Highly Volatile, Unstable
Trivial	Non-Trivial
Repetitive	Creative
Key Input Only	Highly Selective of Inputs
Encoded in Long-Term Memory	Short-Term Memory only
Constant Reproduction across Time	Just in Time Productions
Context-Independent	Context-Sensitive
Path-Independent	Path-Dependent
State-Independent	State-Dependent
Global Consistency	Global Inconsistency
Observation Errors	Only Trivial Observational Errors
Identifiable	Possible

19 A specialist on World War II and an expert on ants-research, for example, will share very large sets of general over-learned responses but will differ significantly with respect to their specific over-learned responses.

20 The distinction between over-learned and under-learned responses has been introduced, quite obviously, also with respect to surveys and survey questioning. From the dichotomy in Table 2.4 a survey is usually a mixture between over-learned and under-learned responses. The former are highly concentrated in the socio-demographic section of a survey with questions on age, gender, occupation and the like whereas the latter are distributed over most of the remaining parts of surveys, especially over all the so-called attitudinal or evaluational segments.

A final important distinction between over-learned and under-learned responses refers to the notion of observation and measurement errors. In over-learned responses measurement errors can be identified and, equally important, corrected. This correction can be accomplished due to the possibility for repeated measurements and due to the stable and fixed solutions in over-learned contexts. In fact, over-learned responses correspond to the fourth measurement type in Table 2.2. In sharp contrast, under-learned responses cannot be subject to measurement errors since an under-learned response misses an essential component, namely the reference values or the so-called true values. In under-learned responses one is confronted with a series of creative state-, input-, context- and history-dependent just in time responses where each of these responses, in the absence of neuro-physiological data from the cognitive neuro-sciences, must be treated as a "true value" under a set of specific, but highly varying circumstances.

With the distinction of overlearned and underlearned responses, it will be assumed hypothetically that the survey interactions between respondents and interviewers take place as a dialogue between two GA-systems. Here, the part of the interviewer will not be analyzed in greater length although this side could produce interesting new results, too. The center of the investigation is occupied with the GA-respondents, their cognitive architectures and the characteristic features of the interaction processes.[21]

As a starting point, it is fair to assume that for GA-organized respondents many of the survey questions, especially the ones related to attitudes or evaluations, will belong to the under-learned category. The available inputs in terms of questions, the restricted options for answers, the quantitative scales, etc. are not matched directly by the internal rule repertoire which could correspond to these specific inputs directly. Thus, answers to survey questions like trust in various institutions, life satisfaction in its various aspects, to name some prominent examples, require a creative response by a GA-respondent and qualify, thus, as under-learned. Turning to the GA-respondent side only, the following characteristic features of the interaction process can be specified.

One of the most important elements of the GA-based interactions lies in the sheer multiplicity of available responses by GA-respondents. The GA-organization

21 It goes without saying that a GA-architecture in its current form is under-critical and under-complex in view of the complex cognitive tasks inherent in survey responses. Thus, the present outline should be seen as a counter-factual sketch which is focused on GA-systems and which brings to light several characteristic features of the cognitive organization of respondents where the underlying GA-architecture can offer heuristic guidelines and a weak explanatory support.

allows a permanent recombination of new rules and, equally important, the co-existence of older and newer rules. The GA-organization acts rather graceful and very seldom removes older rules from its rule-set. This special feature of a multiplicity of answers has been noted by survey researchers as well. As pointed out especially by John R. Zaller [1992], respondents in surveys have a much richer repertoire of different responses at their disposal. Consequently, Zaller's response axiom states that

> Individuals answer survey questions by averaging across the considerations that are immediately salient or accessible to them [Zaller 1992:49].

What becomes of particular relevance here is that the high number of available responses is directly related to the under-learned situation and to the unusual requests for answering which require a creative response. In GA-language, due to the under-learned situation of a specific survey-question, a multiplicity of rules become activated since none of the available rule matches the input of a survey question.

The multiplicity of responses can be shown whenever a survey question does not require a selection of a single option, but asks for assessments of each of the options sequentially. Take, for example, the question of different images of society which has been used in the Austrian Social Survey in 1993. Here, respondents were asked to which of the following four general views or images of society they could agree: to a meritocratic-conservative (a), to a "Marxist" (b), to a corporatist (c) or to a social relations-oriented view (d). As it turned out, even the contradictory pair of images, namely (a) and (b), was clearly treated in a non-contradictory manner. Only 54% of the respondents opted for one of the consistent options (a+/b-, a-/b+) and 46% agreed to inconsistent options. With respect to all four images of society, the largest single group agreed to all four images, followed by an agreement to three different images.

Second, this multiplicity of alternatives covers only the bright side of the coin. There is a dark side to this coin, too, because this multiplicity of alternatives contradicts an implicit assumption of survey designs and especially of survey designers. Usually, survey questionnaires are developed on the tacit assumption that respondents possess a consistent belief-system which can be captured through the items and dimensions of a multi-thematic survey. Wilson and Hodges [1992] describe this hidden assumption as the mental file view where respondents possess a well-ordered mental drawer, consisting of mental files on issues like legalized abortion, migration or trust in the police. Whenever a survey question is asked, they look for the appropriate file and report its content. However, one of the most obvious characteristics of a GA-system lies in the global as well as in the local inconsistency of its rules which differ only in their relative

strength. Surveys very seldom are designed to exhibit underlying inconsistencies in the attitude and belief system of respondents. The GA-architecture is structured in a way that the usual consistency relations do not apply. 80% of the respondents may be optimistic about their long-term future or about the future of the society as a whole. Any interpretation which would indicate that 100 – 80 = 20% of the population are quite concerned about the future would be extremely misleading. Normally, roughly 80% of the respondents will reply as well that they were very much concerned and worried with respect to the state of the environment and the sustainability of the mode of economic production and distribution. Global and local inconsistency is an essential element of a GA-architecture and this feature is reflected strongly in survey responses, too.

Apart from the global inconsistency of the GA-architecture, the third general characteristic deals with the logic of under-learned responses which does not comply with classical logic. Assume, in line with two valued logic, the availability of conceptual pairs like true/false, confirmed/rejected, allow/forbid, etc. As Hippler and Schwarz [1986], for example, demonstrated the conceptual pairs allow/forbid and not forbid/not allow are treated in surveys not as equivalent, but quite distinctively since allow and forbid are consistently seen as stronger statements than not allowing and not forbidding. Moreover, Hippler and Schwarz provide an un-intended support for the distinction between under-learned and over-learned responses because this observed asymmetry only holds for respondents with weakly developed attitudes (under-learned), not for persons with very strong attitudes (over-learned).

Another logical feature of under-learned responses is that the usual transitivity relations a > b, b > c → a> c do not hold.[22]

Furthermore, another seemingly illogical feature can be observed in the relation of generality and rule strength. One of the tacit assumptions especially in value-related survey research lies in the importance of general values as an essential determinant for preferences or specific routines. However, the GA-architecture reveals an interesting inversion between rule strength and generality. In brief, the most general rules turn out to be the weakest ones, the most specific rules, due to their context specificity, usually become the strongest ones.

Fourth, an underlying GA-architecture points to the important role of path dependencies, context effects and to the sensitivity to small input variations in survey-interactions. This special part has been studied in survey research extensively under labels like response effects, question order effects and the

22 For a wonderful article on the topology of nervous nets and the non-transitivity of values, see McCulloch 1980.

like.[23] The important point to be emphasized from a GA-perspective, however, lies in the simultaneity of a large variety of contexts, of a sensitivity to small input variations and of different pre-histories which cannot be isolated or decomposed in an un-ambiguous matter. Contexts may vary with interviewers and with specific events during a survey interaction, the wording of questions and, more importantly, the subsequent interpretation may vary with the pre-history of survey respondents prior to a survey interaction, etc. The simultaneity of these variations cannot be controlled sequentially which, in turn, raises another insurmountable problem for any comprehensive theory of measurement errors. Aside from a multiplicity of potential replies, the overall inconsistency of these multiple alternatives, the non-classical logic underlying survey responses and context or history effects, volatility becomes a fifth essential feature of GA-based survey interactions. From a GA-based perspective, this volatility is composed of four different components. Initially, the volatility is partly due to the probabilistic bidding process which constitutes a necessary component of variation. Another part of the volatility comes from the necessity of producing creative responses which, by itself, must be considered as a non-trivial and inherently instable process. Additionally, the bidding process is, due to varying contexts of survey interactions, highly complex which, once again, adds to the volatility of responses. Finally, a fourth important aspect with respect to the volatility of under-learned responses lies in the scales which are available in many survey questions. When confronted with a scale between 0 and ten for example, respondents in under-learned situations usually are indifferent with respect to a broad range of values which adds another element in the overall volatility of responses.[24]

Numerous examples have been generated which point to the instability and the variation in responses. John R. Zaller gives an illuminating example in terms of changes in wordings.

> A record instance of the effect of changes in question wording may be a New York Times poll in 1983 which found that public support for a 'freeze' on nuclear weapon production varied between 18 and 83 percent, depending on how the issue was framed. [Zaller 1992:29]

A particular striking example comes from the German Welfare Survey 1984 in which one of the most central questions, namely overall life satisfaction, was,

23 See, for example, Bradburn and Mason, 1964, Cronbach, 1946, Krosnick and Alwin, 1987, Martin, 1964 or Schwarz and Hippler, 1991.

24 While this indifference range may vary between respondents, it can be assumed that each respondent is indifferent with respect to at least two values on such a scale.

by mistake, asked twice in an identical fashion. The correlation between both responses was only 0.60.[25]

Sixth, a highly fascinating feature in the creative nature of under-learned survey responses reveals itself by focusing on GA-architectures. Usually, the input side in survey interactions consists of a series of verbal items which, in conjunction, should be taken into account by a GA-system. But in a GA-architecture, it cannot be taken for granted that the entire input has been used in the process of producing an answer.

Thus, one is suddenly confronted with the possibility that other forms of understanding outside the intended domain of survey researchers were operative in generating a specific answer. For obvious reasons, the term "un-intended consequences" of a survey question points to the possibility that respondents did not reply to an intended question, but to a different one which was composed of selective elements of the original one.

Take, for example, a seemingly straightforward question like a self-assessment of one's overall position in society and a measurement method, using a scale from 1 to 10.[26] More than 80% of the unskilled workers positioned themselves above the societal average (6 and higher), in contrast to roughly 57% of the skilled workers. In GA-language it seems very likely that many respondents in the unskilled group produced an answer with respect to their subjective overall position from 0 to 10, and not to the intended societal positions from 0 to 10.

Another feature of unintended effects comes into play whenever under-learned items like work satisfaction, using a scale from 0 to 10, are asked in various, seemingly different dimensions. As has been shown in another publication[27], the answers to different dimensions of work satisfaction tended to be quite similar across Europe, despite very heterogeneous working and living conditions. In GA-language, the seemingly different dimension of work satisfaction became subject to a default operation which, among other results, would have produced very similar outcomes, had the list of dimensions been longer than the existing one.

The feature of defaults is of critical importance for a new perspective on comparative analyses because these defaults offer empirical support for similarity relations between non-identical questions within identical larger domains like work satisfaction.

The seventh feature of under-learned survey responses leads outside the GA-domain proper and to the domain of long-term and short-term memory. Under-

25 See for more details Glatzer, 1984.

26 This example comes from the Austrian Social Survey 1993 and is discussed at length in Müller, 1998.

27 See Reautschnig, 2009 and Müller and Reautschnig, 2010.

learned responses, due to their under-learned nature, do not enter into long-term memory and are, thus, quickly erased from the memory screen in a very short period of time.[28] Within survey settings, twenty to thirty minutes are sufficient for having completely forgotten a specific under-learned response to a survey question.

These seven GA-based features conclude the presentation of the new cognitive background theory for survey interactions.

2.7 Towards New Designs for Comparative Survey Research in the Age of Science II

In our judgement, the next years and decades will experience a fundamental change in the core approaches to identify attitudes,[29] to determine subjective as well as objective living conditions or to capture individual life styles. The paths for comparative survey research of the 20th century and its trajectories in the 21st century will be situated in significantly different cognitive territories. It would require several separate articles to present the consequences of the new cognitive foundations for survey research in more detail. But we would like to indicate the general direction for such a reconfiguration of survey methodologies. This re-shaping requires, above all, recursive research designs where the step S_{t+1} operates on the results of step S_t. In this way, research designs should move towards cognitive equilibrium areas or attractors. Table 2.5 shows that a small number of research designs are already available which can be qualified as recursive.

It will become one of the major tasks in the future to present an overview of new recursive designs in survey research which, moreover, correspond to the new cognitive foundations, outlined in the present article.

28 Following Saris and Gallhofer, 2007:220, twenty minutes within a conventional survey interview are sufficient for practically forgetting an under-learned response to a survey question.

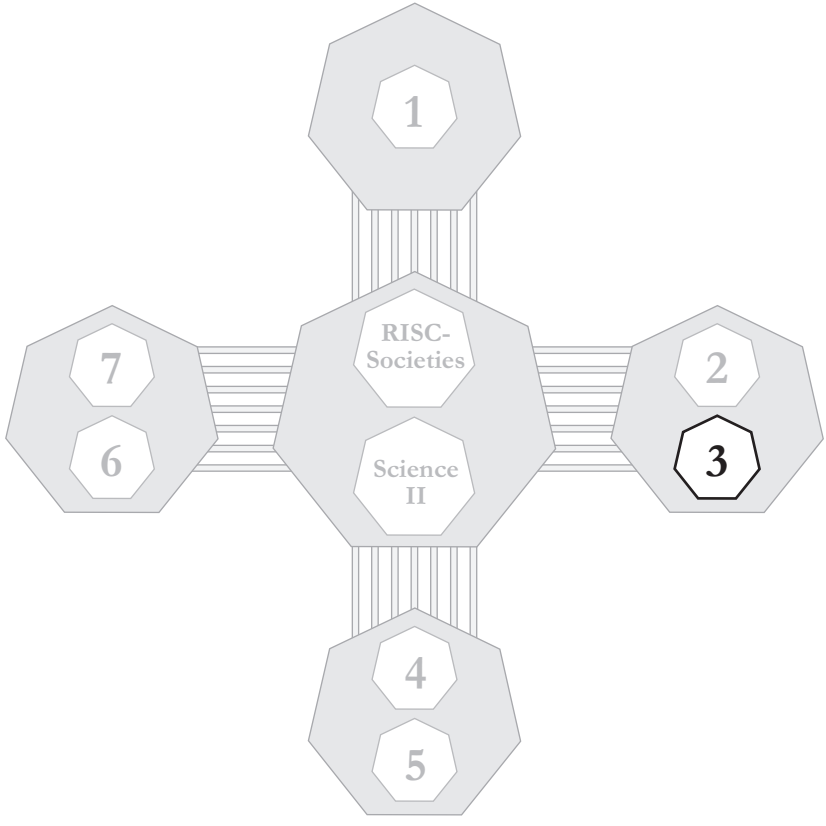
29 On classical approaches to attitudes, see, *e.g.*, Ajzen, 1989, Ajzen and Fishbein, 1980, Eagly and Chaiken, 1993 or Fishbein and Ajzen, 1975.

TABLE 2.5 **Recursive Designs in Social Science Research**

Methods	Applications	Similarity Relations	
		Recursive Operations	Eigenforms
Circular Questioning[1]	Social or Cognitive Perspectives	Recursive, towards a Homogenization of Perspectives	Stable Social or Cognitive Group View
Delphi-Methods[2]	Scenarios, Cognitive Assessments	Recursive, towards Consensus Formation	Group-Consensus
Generative Social Sciences[3]	Rule-based Dynamics	Recursive, toward Stable Configurations	Equilibrium, Limit Cycles, Strange Attractors, etc.
Meta-Analysis[4]	Results of Empirical Research	Recursive, towards Robust Knowledge	Robust Results of Empirical Tests
Triangulation[5]	Utilization of Different Research Methods	Recursive, towards Robust Knowledge	Stable Results

1 On circular questioning see, for example, Pfeffer, 2001.
2 Delphi-Methods have been introduced already in the 1950s. See, for example, Rescher, 1998.
3 Generative social science has become a generic term for rule and actor based designs. For a summary, see Epstein, 2006.
4 Meta-Analysis has become a common procedure in the eighties and nineties of the 20th century in areas like clinical research and psychology. For a summary, see, for example, Hunter and Schmidt, 2004.
5 Triangulation has become popular quite recently as a design to integrate a heterogeneous set of research methods across the quantitative and the qualitative spectrum. See, for example, Punch, 1998:242–246.

3 The New Background Knowledge for Survey Research in the Framework of Science II



The present article starts from a bird's eye view on scientific landscapes and on their evolution in the very long run. From this macro-scientific perspective of the très longue durée it can be observed that a deep structural change is currently taking place which affects the disciplinary matrices [Kuhn, 1973 or 1977] as well as the cognitive co-operation potentials of practically all major disciplines across the natural, social and technical sciences.[1] Quite naturally, such a comprehensive phase transition should exert a deep impact on the social sciences and on their boundaries or links with neighbouring or seemingly distant academic fields. In particular, the relevant background knowledge for the social sciences in general or for special areas like survey research in particular should be changing significantly. In the subsequent sections of this article some of the implications of this on-going metamorphosis in the science landscapes for the area of survey research will be outlined in greater detail. As its central claim the article suggests that the current changes in the background knowledge of survey research should have a strong influence in re-shaping and re-inventing survey research significantly.

3.1 Significant Changes in the Background Knowledge for Survey Research in the Age of Science II

Before entering into content issues, the concept of a background knowledge (BK) for a scientific discipline SD_i must be introduced in a clear and accessible manner. In a general way, the theoretical, epistemological and methodological background knowledge for a scientific discipline SD_i is composed of building blocks from three different domains.

- The first class of background knowledge elements (BK^I) for a scientific discipline SD_i or field of analysis is based on those disciplines that can be assumed to constitute or form the basis of SD_i. With respect to the social sciences or the particular field of survey research the cognitive neuro-sciences (CNS) can be seen as the constitutive background knowledge area for the social sciences or, more specifically, for survey research. Here, the model and theory structures of CNS, its prevalent epistemologies and its dominant methodologies are all included in the BK^I-group for the social sciences or for survey research.

1 On this phase transition from Science I to Science II across different dimensions of the science landscape, see especially Hollingsworth and Müller, 2008 as well as Hollingsworth/Müller/Hollingsworth/Gear, 2008 or 2010.

- The second set of BK-building blocks (BK^{II}) comes from the leading field (LD_t) at a given time t, the theory structures of LD_t, its dominant epistemologies and its general methodologies. Thus, the life-sciences and their mode of operations[2] constitute the second BK^{II}-group for the social sciences or for survey research.
- The third and final group of background-knowledge building blocks (BK^{III}) is transdisciplinary in nature and applies to all scientific disciplines, including the leading discipline as well. Paradigmatically, the third BK-group is composed of a semantic network with universal categories like space, time, matter, energy or information, of a system of constants across the natural and social worlds, of basic logical and numerical calculi and of general rules for scientific operations across all relevant scientific disciplines.

In the days of Science I with theoretical physics as the leading scientific field, the search for universal laws or a reductionist view of theory structures with theoretical physics as its basis were typical elements of the theoretical background knowledge for the social sciences in general or for survey research in particular. Likewise, epistemological or methodological rules, associated with theoretical physics like objectivity, scientific realism or the covering law model of explanations became characteristic building blocks for the background-knowledge of the social sciences.

Currently, we live amidst the diffusion of Science II, with the life sciences as leading field and with its corresponding epistemologies or methodologies. In the context of Science II the theoretical, epistemological and methodological background-knowledge for scientific disciplines outside the leading field of the life sciences undergoes significant changes, too. In a single catch-phrase, the transitions in background knowledge can be summarized as a shift from a vertically grounding background knowledge to a horizontally embedding one or, in line with Table 3.1, from a hierarchically structured background knowledge to a heterarchical one [Müller, 2011].

At this point, the article will be focused on those changes in the background knowledge which are of particular relevance for survey research. In a nutshell, at least seven building blocks can be identified both from the area of the life sciences (BK^{II}) and from the embedding domains of the neuro-cognitive sciences (BK^{I}) which should exert a strong influence on the future forms of models, methods and instrument constructions in survey research. As will be shown later on in more detail, the new background knowledge should have

2 On characteristic differences between the operation rules in high energy physics and molecular biology, see especially Knorr-Cetina, 1999.

sustainable effects on internal, non-trivial actor-models which should replace the current trivial versions, on more complex external actor models and their interactions with their environments as well as on the links between survey research and the bio-medical sciences. Table 3.1 as well as Figure 3.1 summarize those changes in background knowledge that should exert a significant impact on survey research.

TABLE 3.1 **Changes in the Theoretical, Epistemological and Methodological Background Knowledge of Science I and Science II**

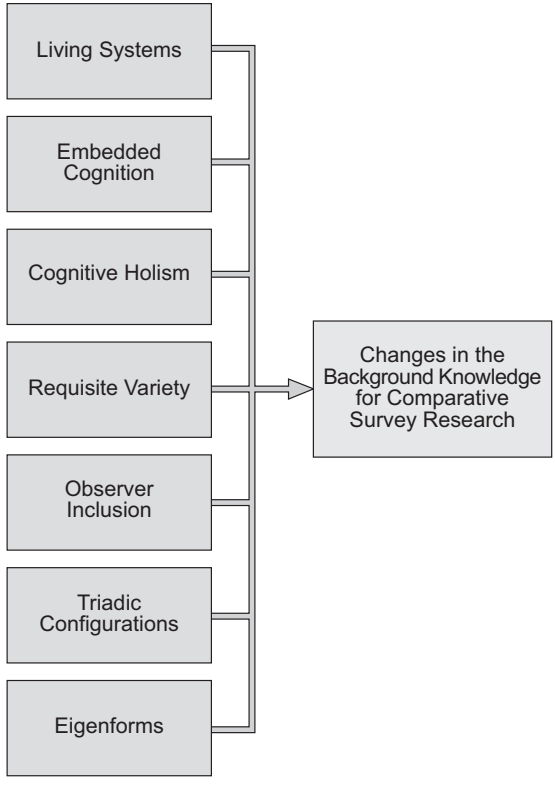
Domains of Background Knowledge	Science I [Theoretical Physics as Leading Discipline (LD)]	Science II [Life Sciences as LD]
Objects of Investigation	Objects Simple Action Schemes	Living Systems Embedded Cognition
	Cognitive Isolationism Single Account Sufficient	Cognitive Holism Requisite Variety Necessary
Subjects of Investigation	Observer Exclusion	Observer-Inclusion
Interactions (between Subjects and Objects)	Sequential, Linear Equilibrium Dyadic, Asymmetric Forms	Recursive, Non-Linear Eigenforms Triadic, Symmetric Configurations

As can be seen both from Figure 3.1 and from Table 3.1, the main differences between the old and the new background knowledge cover the entire domain of analyses, namely the subjects of investigation, the objects of analysis and, finally, the interaction modes between subjects and objects of analysis. All three domains differ strongly between Science I and Science II. In short, Science II has become a science of living systems for living systems in which the subjects of analysis, being living systems themselves, are an indispensable and inclusive part of an investigation. The objects of analysis, namely living systems, turn out to be far more complex than the physical objects within Science I. Finally, the interactions between subjects and objects are organized, as will be shown later, in a closed triadic as well as recursive manner.

The methodological and theoretical elements of the new background knowledge emerge predominantly from the embedding area for the social sciences, namely from the cognitive neuro-sciences whereas the new epistemological components come from a diverse group of frameworks which are particularly focused on the specificities of living systems like the approaches by Robert Rosen [2005] and

Walter M. Elsasser [1998], radical constructivism or, as specially relevant subsets of radical constructivism[3], second-order cybernetics [esp. Foerster, 2003] and the autopoietic approach [Maturana, 1985a, Maturana/Varela, 1987]. These and similar perspectives are especially relevant for shaping the core epistemologies of Science II-research.[4] From both sides, the theoretical-methodological and the epistemological one, the conventional wisdom of survey research is not only questioned in its core aspects and in its central designs [see, for example, Palombo, 1999, Ryckman, 2000], but survey research is also very much encouraged to change its traditional perspectives in order to become compatible with the new Science II landscapes.

FIGURE 3.1 **The Emerging Epistemological, Methodological and Theoretical Science II-Background for Survey Research**



3 On radical constructivism in general, see Watzlawick, 1981, Watzlawick/Krieg, 1991 or Schmidt, 1987 which paved the way for radical constructivism as a wider research tradition.

4 Second-order cybernetics has been developed explicitly by Heinz von Foerster as a science of living systems for living systems. See especially Foerster, 2003, Müller/Müller, 2007 and Müller, 2008.

3.2 Seven New Components in the Background Knowledge for Survey Research in the Age of Science II

Following Figure 3.1 and Table 3.2, the first distinctive feature between the background knowledge $BK^{I\text{-}II}$ of Science I and Science II lies in the units of analysis and has been captured by the dichotomy of objects (Science I) and living systems (Science II). As it turns out, living systems as the main actors on the stage of Science II are structured and organized in a significantly different way than the physical objects in the phase of Science I. Living systems can be characterized by attributes like autonomy, internal state-determination, multi-level organization, learning and the like. The most important differences to the objects under Science I lie, however, in the relations between a researcher and her or his domain of investigation. Under Science I, objects and researchers were situated in different ontological domains whereas under Science II the researcher her- or himself is a living system, too, and can be described with categories like autonomy, internal state-determination, multi-level organization, learning and the like. This point has far-reaching implications, some of which will be dealt with under the notion of observer inclusion [see, once again, Figure 3.1].

Aside from an analytical distinction in terms of living actors, a second new element in the theoretical background knowledge $BK^{I\text{-}II}$ for survey research is related to the description of the environments of living systems which should be conceptualized in a significantly different way, too. In Science I, physical objects could be studied as embedded in a physical environment and with directly observable interactions between objects and their surroundings. Under Science II, cognitive models and methodologies must follow more and more along the pathways of embedded or situated cognition [see esp. Adams/Aizawa, 2008, Bodenhausen/Lambert, 2003, Gibbs, 2005, Noe, 2009 or Robbins, 2008]. This road towards embedded or situated cognition is so important because it puts special emphasis on the distributed nature of cognition, on thinking environments and why, following a well-known reversion by Humberto R. Maturana, the mind is not the head [Maturana, 1985].

In situated cognition, a brain needs not only a senso-motoric active organism, but also a responsive environment for its own internal cognitive operations. In this view, the environment becomes the necessary co-evolving counterpart for individual actions and interactions. Table 3.3 exhibits some of the characteristic differences between the two forms of environments in Science I and in Science II.

TABLE 3.2 **The Changing Roles of Environments between Science I and Science II**

Environments in Science I	Environments in Science II
Weak Boundaries	Strong Boundaries
Direct Crossings	Indirect Crossings
Cause – Effect	Triadic Relations
Direct Environmental	Boundary Transformations
Effects	Indirect Effects
External Dynamics	Internal Dynamics
Adaptation	Internal Complexity Drifts

Cognitive holism becomes the third new component of the background knowledge BK^{I-II} for survey research, but will be introduced in more detail in the next section because the building block of cognitive holism offers a new bridge from the cognitive neuro-sciences to the inner side of actor models.

The fourth point of departure between the old and the new background knowledge BK^{I-II} moves away from the descriptive requirements for living systems and their environments or from the theoretical requirement of a holistic organization of cognitive theories. Instead, the fourth point emphasizes the importance of a requisite descriptive and data variety. Under Science II, the focus shifts away from descriptions and measurements at a single level to more general configurations and, above all, to different levels of descriptive and data variety. The study of living systems requires a multiplicity of data sources which cover the entire range of measurements, ranging from the cellular and neural level, to high-level brain measurements, up to the levels of internal or external verbal accounts or the observations of acting and interacting persons and transactional data in the case of human societies. All these different levels, measurement types and data formats are needed in order to reach a fuller understanding of living systems in their contexts or environments.

The most important challenge with respect to the requisite variety of measurements and observations will be to bridge the currently deep gap between behavioral observations and the level of the brain scans and neural measurements. But Science II, in contrast to Science I, will generate a rich flow of neural and brain data not only on different types of thought processes, but on daily routines and practices as well. For comparative survey research, this new stage of a requisite descriptive and data variety will bring about a dense stream of neural patterns and data for the different stages in survey interactions which should allow to tackle classical issues and controversies like the one on non-attitudes or under-learned responses in a fresh manner.

Fifth, aside from the requisite descriptive variety, another epistemological point of considerable relevance for Science II-research in general lies in the inclusion of observers or, alternatively, of researchers in their research. Focused on survey research in particular, research designs will change more and more from an exclusive into an inclusive mode, with social researchers as an indispensable element in it.

In the world of Science I, mass, space and energy were the fundamental building blocks for a science of objects. Warren McCulloch was probably the first to note the peculiarity that breakthroughs in physics require the invention of surprising regularities or theorems of great abstraction which, however, are not included in the conceptual machinery for physical objects.

> Let us now compel our physicist to account for himself as a part of the physical world. In all fairness, he must stick to his own rules and show in terms of mass, energy, space and time how it comes about that he creates theoretical physics. [McCulloch, 1988:73]

Thus, in Science II one is, by necessity, confronted with a more inclusive task. Following, once again, McCulloch, a physicist

> must then become a neurophysiologist ..., but in so doing he will be compelled to answer whether theoretical physics is something which he can discuss in terms of neurophysiology ... To answer 'no' is to remain a physicist undefiled. To answer 'yes' is to become a metaphysician. [*Ibid*.]

In other words, Science II is the era of living systems, being researched by living systems. This new configuration brings the observer or the researcher as a necessary component back into her or his research domain. Thus, Science II becomes to a remarkable extent a self-referential and self-inclusive form of science.

Sixth, another element of the new background knowledge $BK^{I\text{-}II}$ for survey research lies in the closed organization of relations into which living systems, the observing scientist included, can and should enter. In Science II, the new minimal configuration for the study of living or learning systems by living systems is not a dyadic relation between subject and object which has been characteristic of the conventional scientific method, but is built in a triadic fashion, with the observing scientific researcher as one node, the domains under observations as another node and with a final node linking and closing these two nodes to a triadic ensemble. In short, Science II-research designs are to be built in their minimal form not with one, not with two but with three components.[5]

5 See also the paper from 1976 by Francisco J. Varela where he moves beyond the usual dualistic suspects of observer/observed, subject/object, describer/described, operator/operand and the like. [Varela, 1976]

Science II, in contrast to Science I, will be characterized more and more by designs and by operations in configurations of a closed triadic nature which includes the observing researcher R, the domain under observation which usually is composed of observing living systems or, alternatively, of participant observers PO. Additionally, R and PO are closed by an inter-mediate element like rule systems or theories about the neural organization of PO and R which acts as a generative mechanism GM between R and PO.
Characteristically, the types of relations in triadic configurations change from causal relations to generative relations. Figure 3.2 as well as Table 3.3 highlight the significant differences between the causal forms of Science I and the generative configurations of Science II.

FIGURE 3.2 **Triadic and Generatively Closed Research Designs**

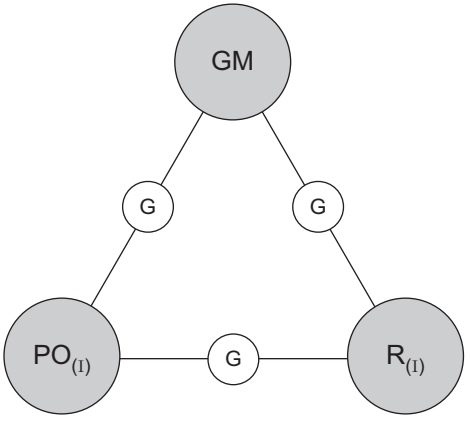


TABLE 3.3 **Causal and Generative Relations**

Causal (A →B)	**Generative [PO(A, B), LS, GM]***
Asymmetrical in time	Symmetrical in time
Separation into cause and effect	No causes and effects
Cause is necessary, sufficient or both	Mutual dependence
Observers excluded	Observers included
Non-recursive	Recursive
Openness	Closure
Generalizations	Necessary Eigenforms

*: A, B: Events

PO: Observer, GM: Generative Mechanism
LS: Living Systems as Field of Research

Seventh, Table 3.3 included already the notion of necessary Eigenforms, inherent in triadic and generative configurations. Thus, the seventh ingredient of the new background knowledge $BK^{I\text{-}II}$ emphasizes the production of Eigenforms. This implies that the recursive interactions between researchers and their living fields of investigation, if properly organized in a triadic fashion, lead to new stabilities or, to use an expression by Heinz von Foerster, to Eigenforms. Eigenforms become one of the central goals of research processes within Science II.[6]
The remaining sections of this article will build three broad bridges from survey research to the core domains of Science II in general and to the cognitive neuro-sciences and to the area of bio-medical and health research in particular. These three bridges should offer fresh incentives for pursuing and intensifying new ways for survey research both for generating data and for analyzing them.

3.4 Bridges from the Cognitive Neuro-Sciences to New Complex Internal Actor-Models for Survey Research

Following the new focus on living systems and the notion of embedded cognition, one of the basic differences between the old and the new background knowledge lies in the complex nature of cognitive processes of living systems. The study of cognition under Science II departs more and more from the pathways of conventional folk-psychology or from typical Science-I traditions like behaviorism.
One of the challenging general heuristic rules for the study of cognitive processes is called cognitive holism, was already included in Figure 3.1 and has been propagated strongly as early as 1969 by Heinz von Foerster [Foerster, 2003].
According to this rule, it is possible, in principle, to isolate conceptually certain components in the stream of cognitive processes, for instance the faculty to perceive, the faculty to remember,[7] the faculty to infer or many other senso-cognitive as well as cognitive-motoric faculties. However, one should not expect that these conceptual separations between perception, memory or inference find a 1:1 correspondence in the neural organization of actors. In its generalized form the principle of cognitive holism can be formulated in the following way:

6 Among the many variants of a theorem on the necessary emergence of eigenforms, see, for example, Francisco Varela and Joseph Goguen's version 1979.

7 In principle, it would be possible to differentiate between a large number of these faculties like the faculty to infer, the faculty to learn, the faculty to evaluate, the faculty to communicate or the faculty to move, to name just a few more additional faculties.

> If one wishes to isolate these faculties functionally or locally, one is doomed to fail. Consequently, if the mechanisms that are responsible for any of these faculties are to be discovered, then the totality of cognitive processes must be considered... [Foerster/Müller, 2003:29f.][8]

The inseparability of these faculties can be shown by a reduction ad absurdum. It can be demonstrated that the assumption of independent faculties in isolation leads to absurd consequences. In particular, it can be demonstrated that, if one of these faculties mentioned above is omitted, the entire system is devoid of cognition.

Phrased differently, actor models with one of the above faculties like actor models with memory only turn out strikingly incomplete because a variety of additional internal faculties are required in order to account for the capacity to memorize. Thus, cognitive holism poses a very big challenge for the development of new internal actor models. But once actor models are available which correspond to the principle of cognitive holism a new bridge is opened up between survey research in general and between the interactions of respondents and interviewers in particular. As has been demonstrated already [Müller/Toš, 2009], these new interaction models, based, for example, on genetic algorithms, can offer profound new insights on the nature of survey questions and on several fallacies which result from a traditional folk-psychology view on domains like values or self-evaluations. In particular, fully developed internal actor models could lead to a new typology of survey questions which is based on the cognitive production type of survey responses. In order to separate survey items into various groups, a new dimension can be introduced which refers to two different types of cognitive response productions which have been labeled as over-learned and under-learned responses [Müller/Toš, 2009]. Over-learned responses can be considered as relatively stable, constant and insensitive to different contexts or pre-histories of actors. Over-learned Under-learned responses are, by necessity, creative, highly volatile, instable and sensitive to contexts or pre-histories. This distinction varies from one person to the other and it always involves the cognitive organization of actors as a whole. Table 3.4 offers some further hints on the differences between these two types of responses. Probably the most important element of this distinction between over-learned and under-learned responses lies in the fact that under-learned responses are quickly forgotten and play no relevant role in the overall cognitive organization of actors.

8 Aside from the functional and the local theses, one could put forward two additional theses, one on genetic holism and one on epistemological holism as well. For more details, see Foerster/Müller, 2003.

In the spirit of cognitive holism over-learned responses can be considered as a permanent and stable component of the overall cognitive repertoire of actors and under-learned responses as just in time-reactions to a particular communicative interaction. Under-learned responses become a typical by-product of a communicative interaction and bear no or very little relevance for recurrent practices or for other relevant preferences of actors.

TABLE 3.4 **Over-Learned and Under-Learned Responses in Surveys**

Dimensions	Over-learned Responses	Under-learned Responses
Response	Single Response	Multiple Responses Possible
Response across Time	Stable across Time	Highly Volatile, Unstable
Inputs	No Sensitivity to Question Inputs	Highly Selective/Sensitive of Question Inputs
Memory	Long-Term Memory	Short-Term Memory
Production	Recall	Just in Time Productions
Type of Task	Non-Creative	Creative
Context	Context-free	Context-Sensitive
Path-Dependency	Path-Independent	Path-Dependent
State-Dependency	State-Independent	State-Dependent
Consistency	Global Consistency	Global, Local Inconsistencies
Errors by Respondents	Errors by Respondents Possible	No Error by Respondents Possible
Bias	No Biases	Multiple Biases
Complexity	Trivial Configuration	Non-Trivial Configuration

One can introduce a second dimension with respect to different forms of observation which becomes relevant for survey items. Along this second dimension survey items can be differentiated between externally observable domains like recurrent practices which can be observed in principle by third parties and internal domains like assessments which rely predominantly on the respondents' answers alone. Survey items with externally observable domains can be validated with the help of other observational data whereas items with only internal domains offer no links to observable practices and routines of actors.
It becomes highly interesting to arrange these two domains of cognitive response production and the two different types of observational domains. Table 3.5 presents such a matrix with four different groups of survey items.

TABLE 3.5 **A 2 x 2 Matrix of Survey-Items**

	Externally Observable Domains (Recurrent Practices, Knowledge-Items, etc.)	**Internal Domains (Assessments, Attitudes, Fictional Stories, etc.)**
Over-learned Responses	Group I	Group II
Under-learned Responses	Group III	Group IV

Due to the differentiations in Table 3.5 the interpretation of these-four groups of survey items should and must differ radically from one another.

- Group I-items can be interpreted at face-value and can be compared and checked with other external data as well with respect to measurement errors or biases. Items on the daily time from home to work, on information activities, on the voting behaviour or on knowledge-items for fall under the first category. Unfortunately however, Group I-items are not the most common ones in surveys and rather restricted to the socio-demographic section of surveys only.
- Group II-items, due to an internal cognitive production process only, cannot be linked with comparable external data sets, but may have similar data in the past or from other regions. Group II-items are also strongly connected with the long-term cognitive repertoire of actors which manifests itself in these stable and context-independent responses. Most importantly, several additional items are usually needed to determine a Group II-membership of a particular item, otherwise a Group II-item becomes unidentifiable. While specific preferences or assessments might qualify as a Group II-item, Group II-items cannot be interpreted in terms of recurrent practices but must be understood as stable fixed-points in the cognitive domain of actors only.
- Group III-items are composed of externally observable survey questions which contain an unusual component like a particular scaling device. For example, asking for daily TV-consumption in terms of minutes requires a creative reaction and, thus, an under-learned response. Usually, Group III-items are characterized by weak links to recurrent practices, although additional external information on TV-consumption patterns for various TV-networks would be needed for any substantial interpretation. For Group III-items, additional external information is necessarily required in order to transform the weak links to recurrent practices into stronger ties.
- At first sight, Group IV-items look similar to the other three groups although these items are fundamentally different form the rest of the groups. Responses

to these items are produced just in time, are forgotten almost instantly and, moreover, highly volatile and unstable within respondents. Trust in national or European institutions on a ten point scale can be considered as a paradigmatic example for a Group IV-item. In terms of interpretation, Group IV-responses offer no hints on recurrent practices and need, additionally, a large amount of similar cross-regional and inter-temporal data in order to identify a relevant explanandum at all. Persistent differences across and within countries on the trust in institutions-item, for example, makes it worthwhile to search for relevant external data on recurrent practices which are relevant for trust-issues. In a strong sense Group IV-items by themselves are void of interpretative content.

This short typology of survey-items, based on a holistic cognitive actor model, makes three very clear points on the current distances between survey items and recurrent societal practices.

- First, relatively few survey-items, namely Group I-items only, allow a direct interpretation in terms of recurrent societal practices. Moreover, Group I-items can be analysed further with respect to significant differences in terms of class or stratification, gender differences or age groups.
- Second, Group II and Group III-items require a substantial amount of additional internal and especially external data in order to become interpretable at all. In combination with large external or internal data these items can be interpreted at least in terms of weak ties to recurrent practices or the cognitive organization of respondents.
- Third, Group IV-items need an enormous amount of additional internal as well as external data in order to close the gap to observable recurrent societal routines at least in a weak sense.

The upshot of the typology of survey-responses lies in the observation that only few items in traditional surveys can be interpreted directly with the help of statistical analyses. The majority of survey items, especially Group IV-items, need a large amount of additional external as well as internal data in order to be interpretable at all. However, surveys are usually interpreted as if they were composed of Group I-items only. In other words, by relying on surveys and the established forms of interpretation a researcher positions her- or himself in relatively large distances to recurrent societal practices which, after all, were the target domain for surveys in the first place.

3.5 Bridges from the Cognitive Neuro-Sciences to New External Actor Models

The second bridge is situated in the domain of actor-environment coupling and crosses the great divide between survey research and the fields of the cognitive neuro-sciences. The second bridge is built with the help of a well-known principle in the cognitive neuro-sciences which has been labeled as the principle of undifferentiated encodings (PUE). PUE has been postulated already by Johannes P. Müller in 1826 and has been put forward in recent decades again and again by Heinz von Foerster [*e.g.*, Foerster, 2003] or Ernst von Glasersfeld [Glasersfeld, 1997]. In order to describe PUE at greater length, it can be divided into three parts.

- Undifferentiated Signaling: The first part concerns the sensory border between actors and their environments and asserts that only undifferentiated quantities at different levels of intensities, but not qualitatively differentiated signals cross the border between the external and the internal worlds of actors. Thus, sensory inputs enter as undifferentiated quantities and not in differentiated qualities.

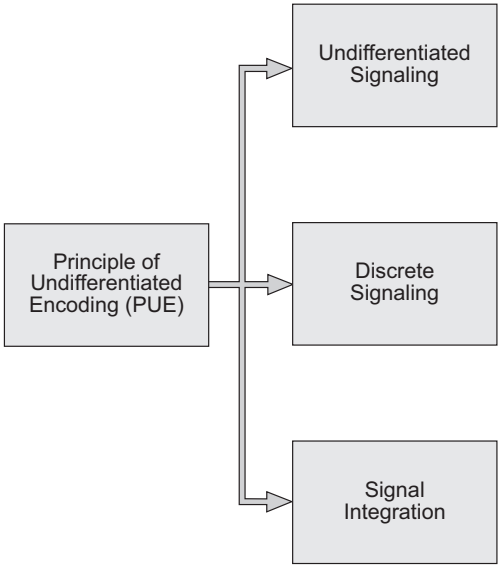
  > The response of a nerve cell does not encode the physical nature of the agents that caused its response. Encoded is only 'how much' ..., but not 'what'. (von Foerster, 2003:215)

- Discrete Signaling: The second PUE-part stresses the fact that the quantities are not encoded in a continuous fashion, but in a discrete manner.
- Signal Integration: Finally, the third PUE-element emphasizes the necessity for an overall integration of sensory inputs into an overall pattern or result.

At first sight there are no family resemblances
in sight which could lead from the principle of undifferentiated encoding within the cognitive neuro-sciences to conventional survey research. Upon second thought however, the following methodological links can be identified which help to cross the distance between PUE in the cognitive neuro-science domains on the one side and survey research on the other side.

Due to PUE and the emphasis on undifferentiated signaling a strong support can be offered for the functional equivalence of different dimensions within an identical broader survey domain. Surveys, by necessity, are capable of selecting only a small fraction of the daily routines and of their impact on the preferences and evaluations of individuals. Likewise, surveys are capable of identifying individual coping capacities in a highly selective manner, too. Thus, a single survey offers a highly selective minimal model of the overall stream of routines and of the cognitive evaluation patterns of actors.

FIGURE 3.3 **The Elements of the Principle of Undifferentiated Encoding (PUE)**



PUE could and should open new bridges especially for a secondary analysis of seemingly incomparable data-sets which are characterized by different dimensions within an identical common domain. Here, PUE can be used to treat different dimensions within a commonly shared domain as equivalent. With discrete signaling one can build a discrete quantitative scale for qualitatively different inputs. And signal integration can be transformed into a special algorithm for all the aggregation of selected survey dimensions.

Table 3.6 offers an example for two common survey domains in Survey A and Survey B[9] with different dimensions for each of the two common domains.

Both surveys offer a functionally equivalent account of the overall neuro-cognitive pattern of undifferentiated encodings, discrete signaling and the signal integration between the cognitive-neural organization of actors and their socio-economic environments.

Due to the rich availability of different dimensions within a set of common domains, one could produce new, but identically generated group formations which can be used for comparative analysis, despite significant differences in the underlying dimensions. Due to PUE, these constructs can be considered

9 Survey A and Survey B both use different items form the European Social Survey (ESS). This procedure was taken in order to demonstrate the comparability between these different dimensions within a common domain. For more details, see Müller/Toš/Bischof, 2010.

as equivalent in terms of their overall neuro-cognitive repercussions and implications. Thus, through the PUE-bridge a large number of new designs for secondary analyses should be opened up because one can use different dimensions in surveys that share a set of common domains and aggregate them in an identical manner [see Bischof/Miheljak/Müller/Toš, 2009].

TABLE 3.6 **PUE-Equivalent Item Batteries in Survey A and Survey B**

Survey A	Survey B
Common Domain I: Working Conditions	
Allowed to be flexible in working hours	Allowed to decide how daily work is organized
Allowed to influence job environment	Allowed to influence decisions about work direction
Allowed to change work tasks	Get a similar or better job with another employer
Start own business	Satisfaction with the way things are handled at workplace
Common Domain II: Resources	
Household's total net income, all sources	Highest level of education
Borrow money to make ends meet, difficult or easy	Feeling about household's income nowadays
Life Satisfaction	Happiness
Father's highest level of education	Mother's highest level of education

3.6 New Bridges from Survey Research to the Bio-Medical Sciences

The third new bridge leads from designs for survey analysis to the areas of bio-medical and health research. Through this bridge one can move from various domains of vertical socio-economic dimensions, from socio-economic inequalities as well as the self-reported health status to a deeper language level and to a homogeneous vocabulary of stressors and of neuro-immunological processes.

Initially, it is useful to start with a taxonomy of different types of stressors which can be found within the relevant body of literature [see, for example, Cooper, 1996, Horwitz/Scheid, 1999, or Sarafino, 2002]. Here, one is confronted with a heterogeneous set, comprised of sensory stressors (strong light, noise, sensory deprivation, etc.), block-stressors (preventing essential routines like eating, sleeping, social contacts, etc.), achievement stressors (tests, examinations, work-

tasks, but also monotony at work, etc.), social stressors (large crowd of people, loneliness, isolation, etc.), environmental stressors (noise, pollution, toxic materials, etc.), decision-based stressors (goal conflicts, quick decisions, but also lack of decision-making, etc.) or future-based stressors (fear, anxiety of the future, etc.).

Seemingly, the heterogeneity of stressors is accompanied by a heterogeneity of stress reactions which vary in time (minutes, hours, days, weeks...), in intensity or in emotions, associated with each stress reaction. Nevertheless, common to all these stress reactions is an attempt to reduce the discrepancy between the effects of stressors and internal target values. Moreover, all stress reactions involve the activation of the hypothalamus-pituitary-adrenal axis and produce comparatively high quantities of endocrine hormones, particularly corticosteroids, with cortisol as the most important one, and catecholamines. Likewise, all physiological reactions to stress manifest themselves in a broad range of measurable changes like a higher production of stress hormones, higher degrees of blood pressure, heart rate, respiration rate, galvanic skin responses or in larger amounts of free fat acids.

The general pattern of stress responses possesses at least two main connections to the domain of sickness and ailments, namely through their direct effects on the cardiovascular system on the one hand and through their immediate impact on the immune system on the other hand.

With the short background on stress-research, it appears plausible to create a bridge from survey research to special classes of stressors like social, environmental, future-based or decision-based stressors. In order to move along this bridge, one needs a special subset of survey dimensions which are linked to societal inequality. In particular, the lower segments of dimensions like degree of education, income, but also working conditions, work autonomy or environmental constraints like pollution or traffic noise can be seen as external determinants of societal inequalities. From this perspective, the following subset-relation can be put forward:

$$\text{Lower Segments } S^L \text{ of Dimensions of Societal Inequalities} \subset \text{Stressors}$$

It is quite obvious that this subset-relationship needs a very detailed justification which cannot be provided within the framework of the present article. However, five main arguments can be given, however, which should offer some plausibility for a sub-set relation between S^L, the lowest decile, lowest quarter up to the lower third in the different dimensions of societal inequalities and stressors.

– First, S^L-positions, which can be specified in a wide array of living and working conditions, are characterized, inter alia, by their relative permanence. Thus, many of the S^L–parts of socio-economic inequality dimensions like low, insufficient or deteriorating incomes or low degrees of qualifications are

to be classified as long-lasting or, like in the case of low qualifications, as (nearly) permanent. Thus, being positioned in the S^L–parts normally acts as a continuous stressor and not as a single, rare or isolated occurrence.

- Second, there exists a remarkable symmetry between the language of societal inequality, in particular the focus on the lower parts of a distribution on the one hand and the physiological stress language on the other hand. In both cases, no equivalences can be found for the upper side of the inequality dimensions. Feeling unsafe in the public sphere does have a corollary in terms of stressors. But feeling very safe in the public domain does not constitute an alternative source for stressors. Likewise, a noisy environment at the workplace or at home implies at the same time an environmental stressor whereas a quiet atmosphere at work or at home cannot be associated with a different group of stressors. Thus, the lower segments of the distribution of inequality dimensions can be linked to stressors, whereas upper segments in the distribution imply, by and large, the absence of stressors.
- Third, the distribution-dependent specification for thresholds for the S^L–parts provides additional support for the subset relationship between the S^L–areas of dimensions of societal inequality and stressors. Since the majority of the population is, by definitional necessity, above the S^L-threshold, individual actors, falling in a specific S^L–part, perceive themselves usually relatively deprived. Thus, the available literature on the importance of relative deprivation [Olson/Hafer, 1996 or Walker/Pettigrew, 1984] can be added as further evidence for the proposed S^L–part-stress linkages.
- Fourth, while stress reactions vary in length, intensity and emotional involvement, the basic physiological reaction patterns are unspecific with respect to the sources of stress. In other words, one does not find a "bad boss-stress reaction", confined to a specific region in the neuro-immune system in contrast to a "loud noise-stress reaction", affecting other parts of the neuro-immune system. Thus, a multi-dimensional array of essential living conditions across the contexts or settings of actors and across their cognitive-emotional organization can be interpreted as a summary of all relevant potential stressors whose scope and degree of completeness is limited by the restrictions inherent in conventional survey research only.
- Fifth, stressors and stress reaction are clearly not invariant to the actual number of stressors since stress reactions are functionally related, probably in a complex and non-linear manner, to the overall number of stressors. This, in turn, provides additional support why a survey analysis should focus on the aggregation of dimensions because these aggregate values should be interpretable in terms of a net value for the overall number of socio-economic stressors.

In this way, a third bridge can be built which leads from survey research to biomedical and health research and back and which should lead to a much deeper understanding of the complex interactions between daily routines at the workplace or at home and on patterns of health conditions.

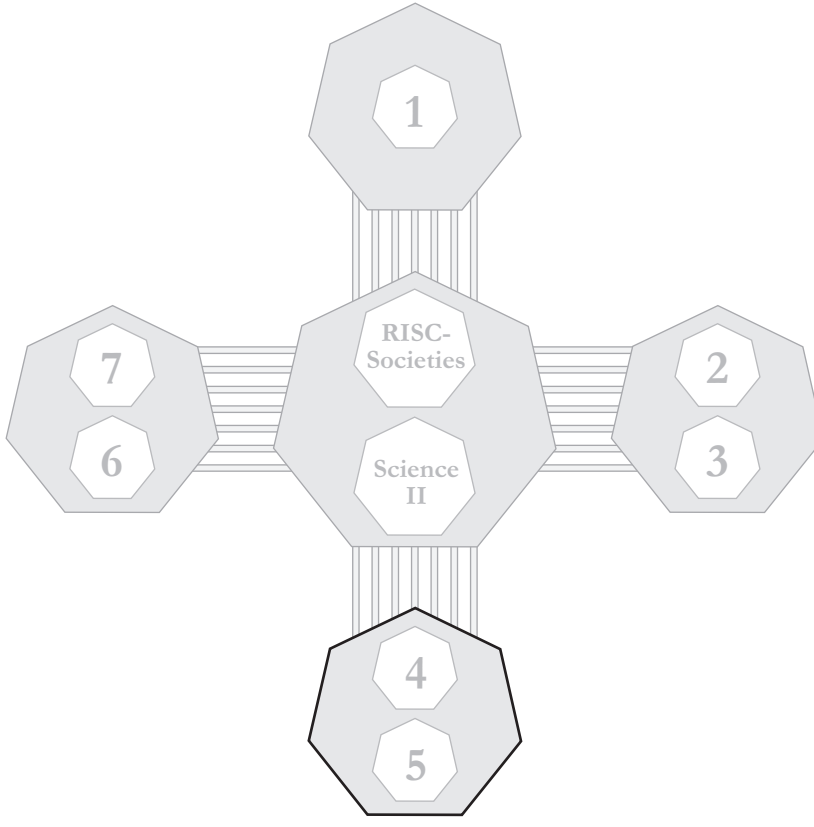
3.7 Further Outlooks

At this point, the question arises whether these three bridges from the neuro-cognitive sciences to survey research should be viewed as artificial constructs with zero consequences, as a happy coincidence or as a preliminary set of successful examples with many more to come. Towards the end of this article two strong arguments can be put forward that one should be able to identify many more recombinations across survey research, the neuro-cognitive sciences and the life sciences in the future. These two basic arguments do not even depend on the secular changes from Science I to Science II, but refer to the underlying technological support systems and environments.

- First, in a sharp contrast to the laboratories for most parts of the 20th century, one can observe a revolution in cyber-research infrastructures which started only in the last two decades and which will provide, inter alia, a huge potential for data-integration and model recombinations across practically all scientific disciplines. The cyber-research infrastructures which are currently built across various fields of science are, in principle, accessible from every point of the scientific landscapes. Thus, a massive integrative support system is currently in construction which, even in the case of a chronic under-utilization, provides a permanent incentive to explore new and inter- or transdisciplinary ways of data or theory integration.
- Second, one can also see an upward trajectory of the information and communication technologies (ICT) from its low levels of numerical operations to considerably higher levels of complex task integrations. Along this path the ICT-segment produces recombinant and increasingly intelligent machines which move along the drift of cognitive holism which has been described in the fourth section of this article. As a consequence, a rich class of machine-based, but cognitive-holistic actor models will be developed in the near future which can be used as reference points for survey research, too.

And with this brief technological outlook the current article on the impact of new building blocks in the background knowledge for survey research can and will be concluded.

Part III
New Designs for Survey Research in the Age of Science II



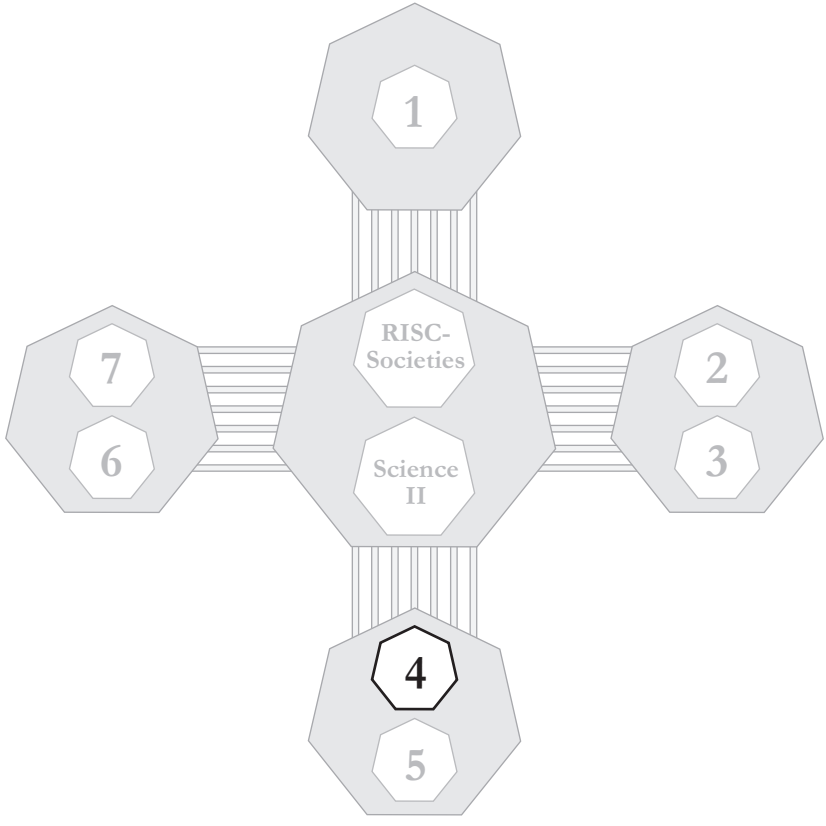
Introduction to Part III

The third part of the book continues to highlight the new relations between Science II and empirical survey research and introduces two new groups of research designs for the production of empirical survey data on the one hand and for the secondary analysis of survey data on the other hand.

- The first article of Part III stresses the importance of pattern formations and pattern recognition in survey research. With the help of a large number of examples it is shown that both the methods of pattern recognitions as well as of pattern formations can be used in order to achieve complex data structures for survey data.
- The second article points to new possibilities for secondary comparative analyses of survey data which were classified as "morphological approach". Usually, comparative analyses are strongly restricted by the non-availability of strictly comparative data or by the data quality of comparative data, due to differences in samplings, in the mode of survey measurements, etc. The article proposes new ways for comparative analyses in the case of strictly incomparable data which, however, are similar with respect to their general domains. In this case it is suggested to build a common or identical complex data-model which, despite the underlying differences in the variables of the complex data-model, can be compared directly. Using data from the European Social Survey (ESS) and splitting these data in two groups it can be shown that a new complex data-model like a stratification model can serve as a common basis for comparative analyses.

Thus, Part III offers new design groups both for survey measurements and observations as well as for comparative secondary analyses which are both strongly embedded in the new cognitive environments of Science II and which should become of significantly higher importance in the future.

4 Visual Survey Research with Pattern Formations and Pattern Recognitions



Over the last decades one of the biggest challenges for empirical survey designs has come from qualitative social research and from its insistence on the autonomy of respondents and on the need to bring their views, perspectives or hidden dimensions and desires into full daylight. Empirical survey designs so far operate in a rather restricted code, allowing respondents only to choose among a small set of categorical options or a small set of values on four point, five point seven point or ten point scales. In this debate, the present article makes a central claim that respondents can choose a third way beyond the restricted code of quantitative surveys and the story-telling mode of qualitative designs. This third way operates on the production or on the recognition of visual patterns where respondents are in full control of the response-process and where they can produce complex visual patterns which, however, lend themselves to rigorous quantitative analyses.
The next two sections in this article will go deeper into the prevalent asymmetries inherent in the survey field work as well as into the technological advances for orchestrating the field work of surveys.

4.1 The Asymmetrical Configuration of Survey Interactions

Turning to the first issue of asymmetries in survey designs, the last decades have witnessed a wave of new approaches for exploring the social worlds under the heading of qualitative social research.[1] Leaving aside the problem of the relative merits of quantitative or qualitative designs and methods, the new domains of qualitative social research offer also a new way of interacting with individuals or social groups. By and large, these new qualitative approaches for data generation and data analysis view their respondents in an entirely different way to the procedures of standardized surveys. Qualitative interactions and methods try to maintain an open and flexible access to respondents, stress their autonomy and want to bring to surface not only specific episodes and perspectives by individuals or social groups, but more general biographical structures or styles of narration as well. In a significant number of instances, qualitative and quantitative research produce incoherent or even contradictory results, which, in turn, call for more complex ways of combination and integration like the so-called method of triangulation.
Aside from a new wave of qualitative research, the quantitative data themselves which are generated in traditional survey research have been a constant focus of discussion and interpretation. From the 1920s and 1930s onwards, attitudes and

1 On the widening and deepening field of qualitative research, see Flick/Kardorff/Steinke, 2005, Helferich, 2005 or Lamnek, 2005.

questionnaire-designs for identifying attitudes gradually occupied the center of the analytical stage, culminating in Gordon W. Allport's "The concept of attitude is probably the most distinctive and indispensable concept in contemporary American social psychology" [Allport, 1937:3] in 1937.

Accompanying the successful diffusion of comparative survey research, one finds, however, an alternative perspective which sees itself diametrically opposed to the dominant survey designs and to the hegemony of standardized empirical research. In the formative years of survey and attitude research Richard T. LaPiere has shown beyond reasonable doubt, but also with no lasting success, that attitudes and actions are separated by an unbridgeable gap. His assessment from 1934 seems as valid and controversial now as it was then.

> The questionnaire is cheap, easy and mechanical. The study of human behavior is time-consuming, intellectually fatiguing and depends for its success on the ability of the investigator ... Yet it would seem far more worthwhile to make a shrewd guess regarding that which is essential than to accurately measure that which is likely to prove quite irrelevant. [La Piere, 1934:237]

Aside from the scientific domain itself, survey research has come under implicit attack by the respondents of surveys, too, on two major fronts.

First, in the course of societal differentiations and of migration processes, it becomes more and more difficult to include special groups in a representative survey sample. For example, migrant persons with severe language problems in their new environments, younger and highly mobile persons, very old persons living in retirement homes, these are just three societal groups which are practically excluded from a survey data set. Due to the increasing mobility and due to individualization processes it can be expected that representative surveys become more and more difficult to implement.

Second, respondents turn out to be less and less willing to follow the ordinary procedures of a survey interview. Response rates for telephone or face to face surveys are declining continuously and respondents tend to defect especially in the case of telephone interviews.[2]

It seems worthwhile to investigate this issue of a growing survey apathy or, alternatively, of survey irrelevance in closer detail. The method for this in-depth analysis can be qualified as a variant of an ordinary language investigation and seeks to establish implicit or explicit rules, structures and constraints in the language game called survey questioning.[3]

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2 In terms of quality control, telephone interviews are considered to have the lowest values for reliability or validity. See, for example, Saris/Gallhofer, 2007.

3 On the process or on the language game of questioning, see, for example, Groenendijk/Strokhof, 1997.

In general, survey interactions, whether by telephone or face to face,[4] belong to a large class of question and answer-interactions which have found their way into different societal domains or systems and play their indispensable and non-substitutable roles.

A very broad division separates question and answer interactions into a continuum of symmetric and asymmetric instances.

- Symmetric interactions come close to Jürgen Habermas' ideal speech situation[5] where each participant has an equal chance of asking and of answering and where role reversals are a necessary part of the symmetry arrangement.
- In asymmetric interactions the roles of the questioning part is usually fixed and no role reversals are allowed. Additionally, one observes a clear power asymmetry between the actors responsible for the questioning from the persons undertaking the answering parts.[6] Here, all important strategic moves are reserved for the questioning part and the responding part has to adapt to these requirements.

Symmetric questioning and answer routines have been part of the conversations in civil society contexts and have become deeply embedded in virtual worlds where forums, chats and other forms of on-line discussions use this open and equally accessible format. Moreover, new forms of opinion expression on a wide variety of issues and topics like blogs, facebook groups, twitter and the like diffuse rapidly within the cyber-sphere. Here as well, symmetric forms of expressing one's opinion and reacting to it have become the dominant mode. Moreover, blogs can be linked to each other, leading to new virtual communities and the like.

Typical contexts for asymmetric and power loaded question and answer-interactions can be found, *inter alia*, in national legal systems, in national systems of security, in national education systems or in the national systems of tertiary education and of professional learning.[7] The recurrent use of the word national is not used accidentally because these question-answer interactions emerged in the course of the state building processes in the domain of an

4 In the subsequent discussion, self-administered surveys are not being considered since they do not involve other actors outside the respondent her- or himself.

5 See, for example, Habermas, 1981 and 1984.

6 With respect to power, Max Weber's definition of power can be used as a useful reference point. See Weber 1980.

7 National systems of broad domains like education, security, innovation or health comprise, from a cross-national perspective, a heterogeneous set of ensembles with a multiplicity of different actors and with characteristic forms of bindings or bondings between actors. For a theoretical summary, see Hollingsworth/Müller/Hollingsworth, 2002.

observing and of a caring state [Abraham de Swan]. In Western societies these asymmetric interaction forms were built on earlier models of control in military or in religious contexts.

Turning to these asymmetric question and answer interactions more closely, it becomes noteworthy that aside from their power asymmetry they usually operate under special constraints, especially under a constraint of subjective truth or truthfulness.

With respect to the question and answer interactions in surveys it goes (almost) without saying that they belong to the asymmetric cluster. Survey questioning and answering allows for no role reversals and operates, as its *differentia specifica*, with a very restricted number of options for answering. Thus, survey interactions are characterized by a practical necessity to select a specific pre-defined answer from a menu of admissible answers.[8] Moreover, the small number of admissible answers is rather uncommon to most respondents since they are required to use numbers and scales or different degrees of agreement or disagreement. Survey interactions operate on a weak constraint of truth in the sense of honesty, truthfulness or accuracy since these features simply are expected to be fulfilled within survey interactions. Surveys usually are free of legal or criminal sanctions except for exceptional instances of fraud on part of the interviewers.[9]

In recent years, the ways of expressing opinions has increased substantially in the Western world, especially following the revolution in information and communication technologies (ICT). Currently, the virtual web-communities with unrestricted forms of expressions and the potential for freely formed self-expressions abound. Thus, from the cognitive horizons of respondents, survey interactions become more and more outdated and, from the repertoire of everyday expressions, rather marginalized.

4.2 Economic Pressures and Technological Advances in Survey Research

A second element which currently weakens comparative survey research comes directly from the fields of the already mentioned ICT-technologies and their economic repercussions. In particular, the rapid diffusion of a new wave of

8 In this respect, surveys are similar to multiple choice tests which operate on the basis of a pre-given set of opinions plus the necessity to choose one of them.

9 A national census can be an exception to this condition which, at least in some countries, have criminal sanctions both for interviewers and respondents.

information and communication technologies (ICT)[10] brought about a dual effect. On the one hand, the new ICT-technologies lowered the entrance barriers for new firms in the field of market and opinion research. On the other hand, the new ICT-technologies do not only offer new modes for the production of survey data, they also provide solutions for alternative ways of organizing surveys.

The first point is easy to describe. Through advances in ICT-technologies, the costs for setting up small and medium-sized telephone laboratories has decreased dramatically. More specifically, rapidly decreasing hardware costs for laptops or PCs, computer aided software for surveys plus statistical software packages and, finally, decreasing telephone costs or the emergence of call-centers have led to a situation where new firms with small amounts of funds can easily enter into the field of market and opinion research. Moreover, due to the increased competition, the prices for conducting surveys are declining rapidly as well. This, in turn, led to a considerable widening of surveys outside the classical fields of market research or the social sciences. Currently, both print and audiovisual media use surveys for elections and for opinions on widely debated political issues extensively.

The characteristic constraints and consequences of these technological advances and economic developments are not widely discussed. Usually, survey research operates under increasingly strong economic pressures and limitations. Within these new configurations, the critical element in surveys becomes time. Thus, surveys normally are generated under critical time constraints since interviewers are not full-time employed and their income usually depends on the number of successful interviews. Thus, the survey interactions become more and more reduced and individuals who cannot be contacted immediately are replaced by the next available person in the sample. In this way, the quality of survey data decreases substantially and it comes as no surprise that the data quality of telephone interviews is considered as the lowest among all possible modes.[11]

Turning to another aspect, these new information and communication technologies enable and support a new mode for survey research, namely online or e-surveys.[12] Here, the degree of autonomy of respondents is increased substantially because there are usually no time-constraints and, dependent on the technical implementation, respondents can go back to review their previous replies.

These new technological advances allow, moreover, better and better simulations of face to face questionnaires, with voices talking to respondents or with virtual cards which mimic more and more components of face to face interactions.

10 More systematically, see Müller 2008a.

11 For a summary on the issue of modes and data quality, see Saris/Gallhofer, 2007.

12 For a summary, see, e,g., Couper, 2000 or Dillman, 2000.

This new technological potential increases, on the other hand, the development of new types of online-surveys which, for example, follow the path of deliberative surveys.[13] Here, respondents receive to each question a substantial amount of background information which can be used prior to answering a single survey item.[14] These designs organize surveys as a learning process but run into an interesting trade-off between high representativeness/low deliberation and low representativeness/high deliberation.

To sum up, the measurement processes in surveys are undertaken currently under heavy economic pressures and that means under strong time constraints. Additionally, the measurement processes through telephone interviews are organized in a way that leaves less and less room for reflective answering and for more symmetric forms of interactions, reducing, thus, the data qualities of surveys considerably. Additionally, new modes[15] of online-surveys widen the possibilities of survey research well beyond the conventional designs and open up a new and rapidly expanding trajectory of non-standard survey research.

The next sections of this article will focus on new directions in the design of surveys and on new frontiers in the analyses of survey data.

4.3 The Centrality of Pattern Recognition and Pattern Formation in the Age of Science II

After this short review of the wider socio-economic changes which threaten the conventional survey designs the next step will lead to an entirely different area which, however, has been covered extensively in the previous articles. This particular domain concerns the long-term shift in overall science landscapes which has been summarized under the label of a shift from Science I to Science II. Among the many basic differences between Science I and Science II one can find the differentiation into laws (Science I) and patterns (Science II).

For this distinction one can refer to a nearly unknown article by Friedrich A. Hayek who published a highly interesting and relevant paper with the title "The Theory of Complex Phenomena" [Hayek, 1967, 1972]. In this article Hayek develops a typology of complex phenomena and processes which are strictly separated from simple phenomena and simple processes.

13 On deliberative surveys, see, *e.g.*, Luskin, R.C., J.S. Fishkin, R. Jowell, 2002 or, for a more general background, Carson/Hartz-Karp, 2005 or Booth, 2006.

14 On deliberative polling, see, also Sturgis/Roberts/Allum, 2005.

15 On the issue of survey modes in general, see *e.g.*, Pruchno/Hayden, 2000.

Table 4.1 specifies many of Friedrich A. Hayek's distinctions and connects them with the separations between Science I and Science II. As can be seen, the two equivalences

$$\text{Simple Phenomena} \equiv \text{Science I}$$
$$\text{Complex Phenomena} \equiv \text{Science II}$$

hold completely.

Thus, the central cognitive concepts for Science II lie in patterns, pattern recognition, pattern forecasting and, one might add, pattern production or, alternatively, pattern formation. Complex phenomena alias Science II are pattern-centered in contrast to a focus on laws and on the specification of laws which dominated the analysis of simple phenomena.

TABLE 4.1 **Friedrich A. Hayek's Main Distinctions between Simple (Science I) and Complex Phenomena (Science II)**

Dimensions	Science I	Science II
Degree of Complexity	Low	High
Measure of Complexity	Small Number of Variables	Large Number of Variables
Binding between Variables	Causality	A-Causal
Specification Scheme	Laws	Patterns
Mode of Analysis	Covering Law Model	Pattern Recognition
Forecasting	Law-Based	Pattern-Forecasting
Paradigmatic Field of Science	Classical Physics	Evolutionary Biology and the Sciences of Complexity

With the new focus on patterns the next question is whether survey designs could be specified in which patterns, pattern recognition and pattern formation play a leading role. The next sections will outline several novel ways that could transform conventional survey designs into pattern-based ones.

4.4 Introducing Visual Surveys through Pattern Recognition

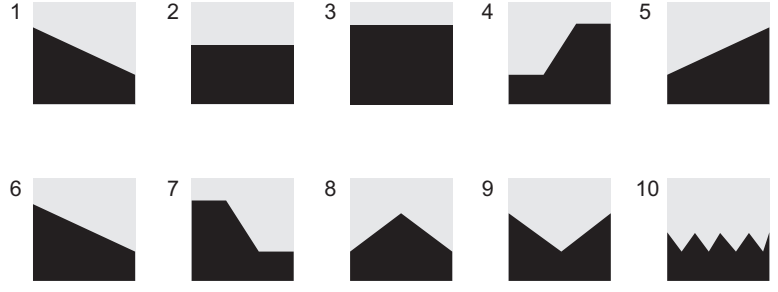
With respect to new survey designs, one of the core differences between Science I and Science II was the dichotomy between general and universal laws on the one hand and pattern recognition and pattern formation on the other hand. A

new survey design which is based on this distinction moves the verbal responses from categories and numbers to the domain of pattern recognition and pattern production.

In essence, these surveys are composed of measurement and scaling designs which produce two types of outputs. The first output group consists of a series of patterns where the task of respondents lies in the selection of a single, most appropriate pattern. The second output group is composed of visual tasks which end up in a specific pattern, generated by the respondents themselves.[16]

Four examples should be sufficient to demonstrate this type of visual survey. The first example deals with a pattern recognition task and is exemplified by Figure 4.1. Here, one sees a collection of visual patterns which represent one's life course so far. The task of respondents is twofold. Either they select one of the pre-given patterns or they can produce a new one.

FIGURE 4.1 **Measurement Method as Pattern Recognition I**



This specific item has been used in several large Austrian social surveys and has been also used in the German welfare survey.

The second example comes from a survey on the status of the cognitive sciences in Austria. Respondents were asked which of the visual patterns comes closest to the long-term development of the cognitive sciences in Austria and in the international environment.

16 For an overview, see Müller, 2004.

FIGURE 4.2 **Measurement Method as Pattern Recognition II: Development of Scientific Fields**

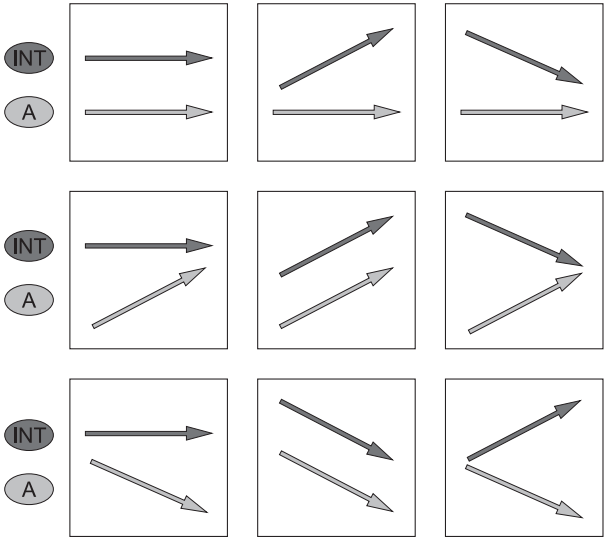
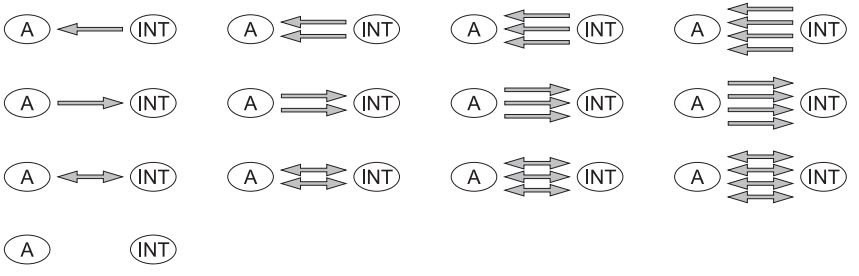


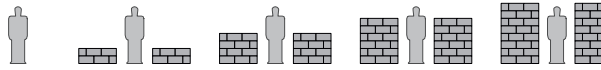
FIGURE 4.3 **Measurement Method as Pattern Recognition III: Patterns of Influence between Austria and the International Environment**



The third example is taken, once again, from the cognitive science survey. Here, respondents were asked on the type and of the strength of interactions between cognitive science in Austria and the international environment.

The fourth example is taken from an Austrian innovation survey where respondents were asked about their perception of barriers for co-operations between scientific institutes.

FIGURE 4.4 **Measurement Method as Pattern Recognition IV: Perceived Barriers**

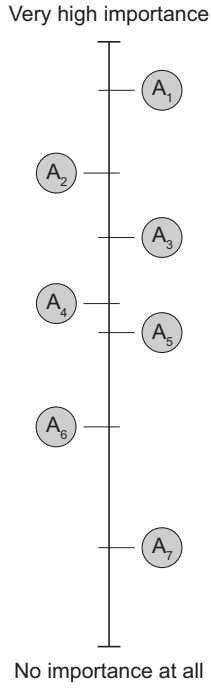


The examples 4.1 to 4.3 are interesting because they can be hardly approximated with verbal responses. In principle, the patterns in Figure 4.1 can be produced verbally as well, but the sequence of verbal items would be rather complicated to read and the selection process would be extremely difficult to perform. The fourth example could be approximated very easily with a verbal scale like very high, high, medium, low and no barriers. However, even in this case the visual input in terms of barriers creates a much richer consensual domain between respondents on barriers and their relative strengths.

4.5 Visual Surveys through Pattern Production

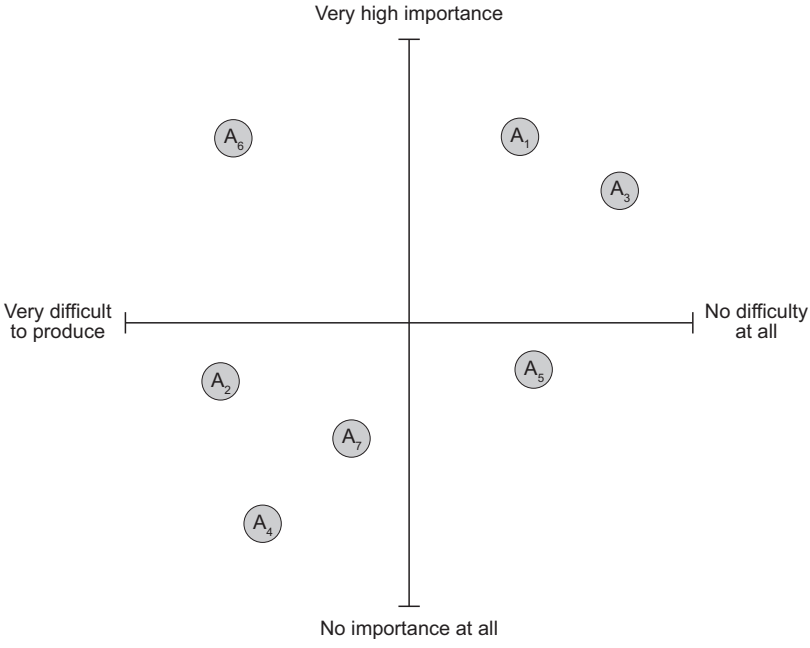
The second and, most probably, more important large domain for visual survey designs lies in the field of pattern production where respondents are asked to create a visual arrangement, albeit in a well-defined manner. Figure 4.5, for example, exhibits an elementary form of pattern production where respondents are required to evaluate seven different domains and rate their overall importance for them. In sharp contrast to the sequential mode of questioning in traditional surveys, this pattern producing task generates a configuration where each new alternative A_2, A_3, A_4 ... and A_7 is placed within a self-specified context of an already existing reference point (A_1). A self-generated configuration like the one in Figure 4.5 provides an abundance of structural and also of quantitative information on the relative strength of each of the seven alternatives.

FIGURE 4.5 **Visual Survey Designs as Pattern Formations I: One-Dimensional Patterns**



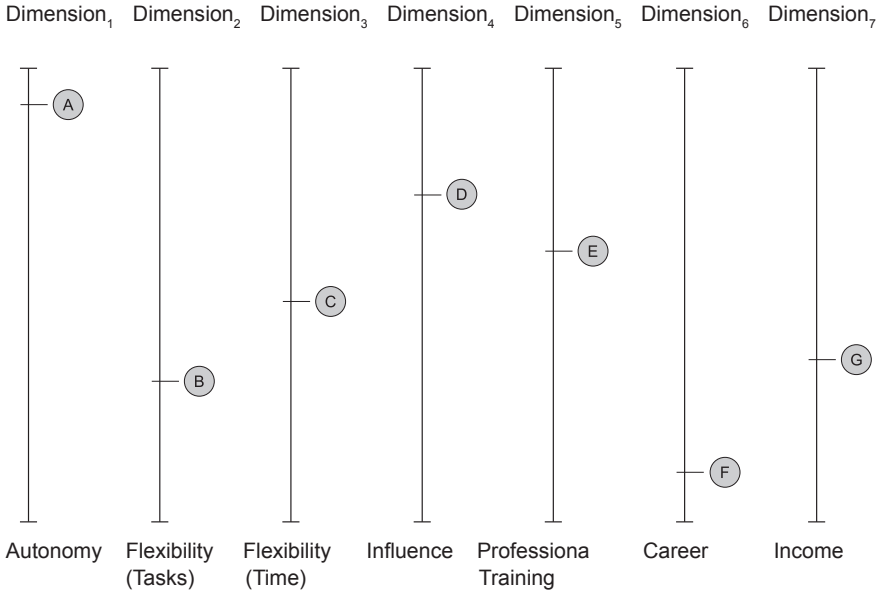
The example above can be widened to a two-dimensional configuration which combines two different dimensions. Take the following example of an individual task-distributions at the workplace where the first dimension rates the importance of tasks and the second dimension the efforts needed to accomplish this task. The seven tasks can be ordered from input tasks like the organization of the necessary input materials to output tasks like the transfer to the next production unit.

FIGURE 4.6 **Visual Survey Designs as Pattern Formations II: Two-Dimensional Patterns**



The next group of visual productions is more demanding in nature because it uses an N-dimensional configuration. Figure 4.7 shows an example with seven different dimensions on working conditions where respondents are required to perform a single assessment for each of the seven dimensions.

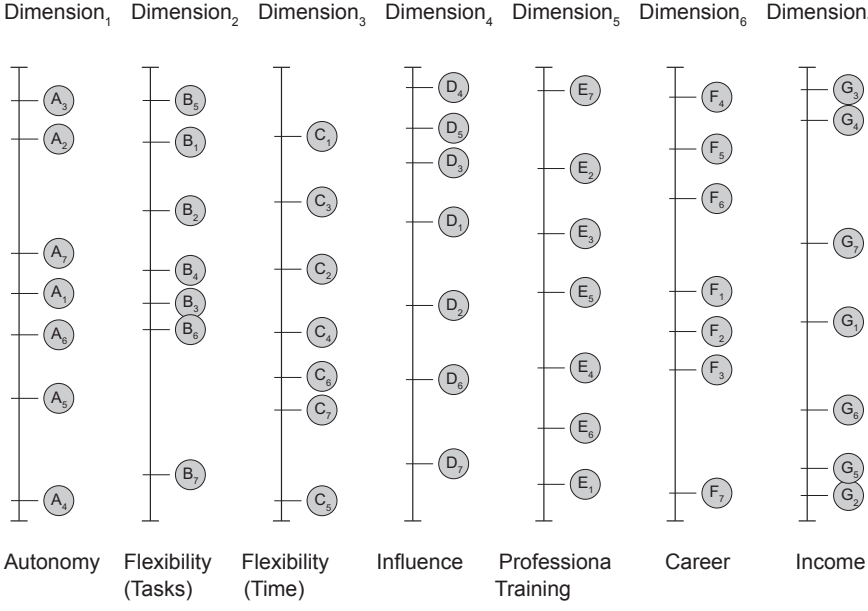
FIGURE 4.7 **Visual Survey Designs as Pattern Formations III: N-Dimensional Patterns**



Obviously, respondents can also produce rather complex visual patterns. Figure 4.8 can be seen, in principle, as a combination of the pattern in Figure 4.5 and in Figure 4.7. Here, each dimension contains a set of sub-dimensions and respondents are required to provide their assessments for each of these seven sub-dimensions. The resulting pattern of Figure 4.8 becomes relatively complex and offers an abundance of context-sensitive data. The context sensitivity arises because respondents create their patterns in full view of what they have been created so far. Moreover, the answers across the seven main dimensions turn out to be strongly comparable since respondents will try to produce a pattern that fits not only vertically within a main dimension but also horizontally across the seven main dimensions.

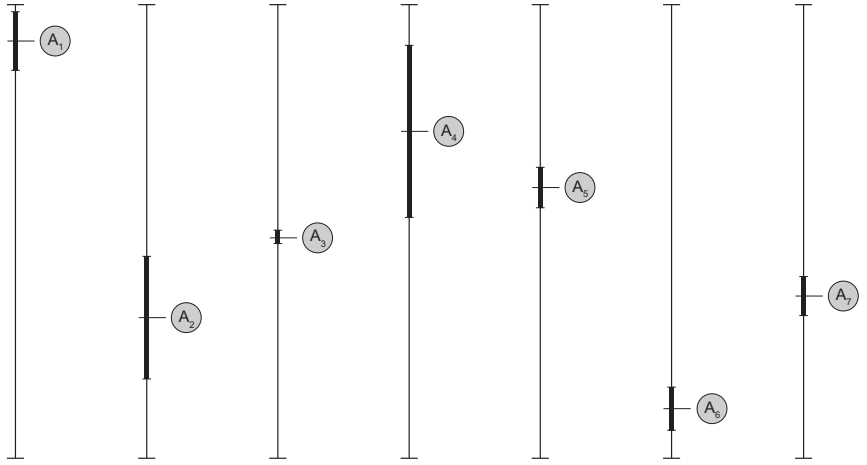
The patterns so far can be arranged by asking respondents to choose an indifference interval instead of selecting a specific point on a scale. For example, Figure 4.5 can be redesigned so that respondents choose seven indifference domains for the seven alternatives A_1 to A_7. These intervals can be of different length and can provide interesting insights into the fuzzy network of relations of particular respondents. Moreover, indifference domains within a survey sample of across survey samples offer a new prospect for deeper analyses of survey scales.

FIGURE 4.8 **Visual Survey Designs as Pattern Formations IV: Complex N-Dimensional Patterns**



With Figure 4.9 the small set of patterns in visual surveys can be concluded. The purpose of the last two sections was to show that visual questionnaire designs can be performed in a very comprehensive manner. The subsequent part of the article will demonstrate that visual survey designs should be chosen form a methodological point of view for a specific very broad category of survey questions.

FIGURE 4.9 **Visual Survey Designs as Pattern Formations V: Patterns with Intervals**



4.6 Towards Visual Survey Designs for Under-Learned Items in Questionnaires

The upshot of the sections on pattern recognition and pattern production lies in a proposal for a radical redesign of surveys into two main components. For this division a conceptual differentiation must be re-introduced which was prominently used in the second article of this issue, namely the distinction between over-learned and under-learned responses. Survey measurements are in complete accordance with over-learned responses as once can see from Table 4.2. Table 4.3 summarizes the typology of under-learned responses and adds, once again, the conventional survey measurements as the third column.

As one can see from Table 4.3, the survey measurements used for under-learned responses stands in a striking contrast to the logic of under-learned responses.

From Tables 4.2 and 4.3 one is confronted with basically two broad alternatives.

- The first alternative is to drop under-learned responses from survey questionnaires altogether and to restrict surveys to over-learned responses. Along this path, surveys like the European Social Survey (ESS) would be required to eliminate roughly two thirds of their item-batteries and would need replacements with over-learned item batteries.
- The second alternative consists in adapted types of measurements which correspond more closely to the logic of under-learned responses. This

trajectory leads to new survey designs which are conducted as online-surveys and which are able to utilize the full potential of the new information and communication technologies.

TABLE 4.2 **Over-Learned Responses and their Measurements in Surveys**

Dimensions	Over-learned Responses	Measurements
Response	Single Response	Single Measurement
Response across Time	Stable across Time	Single Measurement
Inputs	Full Input	Full Input Assumption
Memory	Long-Term Memory	------
Production	Recall	Fixed Measurement
Type of Task	Non-Creative	Non-creative Measurement
Context	Context-free	Context-free Measurement
Path-Dependency	Path-Independent	Path-Independent Measurement
State-Dependency	State-Independent	State-Independent Measurement
Consistency	Global Consistency	Consistent Measurements
Errors by Respondents	Errors by Respondents Possible	Error Measurements and Error Designs
Bias	No Biases	No Bias Measurement Needed
Complexity	Trivial Configuration	Trivial Measurement

Obviously, visual surveys follow along the second path because they provide alternative ways for measurements which are much closer to the logic of under-learned responses. Visual surveys can be conducted, in principle, as face to face interaction, they are practically impossible to administer as telephone surveys and they can be fully employed in the case of online-surveys. Visual surveys consist of three parts, namely

- Part I of over-learned responses on the socio-demographic background of respondents and of over-learned responses in other survey domains as well
- Part II of item-batteries which are based on the pattern recognition capacities of respondents
- Part III of item batteries which use require a pattern production by respondents.

TABLE 4.3 **Under-Learned Responses and their Measurements in Surveys**

Dimensions	Under-learned Responses	Measurements
Response	Multiple Responses Possible	Single Measurement
Response across Time	Highly Volatile, Unstable	Single Measurement
Inputs	Highly Selective of Inputs	Full Input Assumption
Memory	Short-Term Memory	------
Production	Just in Time Productions	Fixed Measurement
Type of Task	Creative	Non-creative Measurement
Context	Context-Sensitive	Context-free Measurement
Path-Dependency	Path-Dependent	Path-Independent Measurement
State-Dependency	State-Dependent	State-Independent Measurement
Consistency	Global Inconsistency	Consistent Measurements
Errors by Respondents	No Errors by Respondents Possible	Error Measurements and Error Designs
Bias	Multiple Biases	Single Bias Measurements
Complexity	Non-Trivial Configuration	Trivial Measurement

In principle, visual surveys can be administered as face to face surveys although the face to face design needs rather complex encoding operations for the part with pattern productions. Especially in the case of two-dimensional, three-dimensional or n-dimensional patterns the encoding process requires a considerable amount of time and encoding errors occur rather frequently. Normally, the online version is best suited for these new visual surveys because here the encoding of patterns generated by respondents can be performed automatically.

Visual online-surveys offer a new type of survey measurements which are much closer to the logic of under-learned responses. Table 4.4 summarizes the close relationship between under-learned responses and their visual measurements. As can be seen from Table 4.4, visual measurements offer a series of genuine comparative advantages in relation to today's measurement operations. These distinctive advantages of the visual pathway of survey measurements can be listed in the short summary below.

TABLE 4.4 **Under-Learned Responses and their Visual Measurements in Surveys**

Dimensions	Under-learned Responses	Visual Measurements
Response	Multiple Responses Possible	Interval Measurement Possible
Response across Time	Highly Volatile, Unstable	Recursive Measurements Possible
Inputs	Highly Selective of Inputs	Full Input Assumption Justifiable
Memory	Short-Term Memory	------
Production	Just in Time Productions	Flexible Measurements
Type of Task	Creative	Creative Measurements
Context	Context-Sensitive	Context-Sensitive Measurement
Path-Dependency	Path-Dependent	Path-Dependent Measurement
State-Dependency	State-Dependent	State-Dependent Measurement Possible
Consistency	Global Inconsistency	Measurements for Inconsistency Possible
Errors by Respondents	No Errors by Respondents Possible	No Error Measurements and Error Designs
Bias	Multiple Biases	Multiple Bias Measurements Possible
Complexity	Non-Trivial Configuration	Trivial Measurement

First, visual online-surveys can be performed in a recursive manner and need not be restricted to single measurements only. Respondents can be required to go through the pattern production part of the survey and, if appropriate, through the pattern recognition part as well and they are free to change the patterns which have been created in the first round. Possibly, this re-iteration can be performed for a second or a third time so that the patterns can converge to their inherent *Eigenforms*.

Second, visual surveys are able to take the current state of respondents into account by asking them a detailed visual item battery on their current internal states. These under-learned visual state descriptions should become an important element in the analysis of survey data.

Third, visual survey questionnaires which are based on under-learned responses should place special emphasis on the overall inconsistencies in the under-learned belief-systems of respondents. Thus, visual survey questionnaires should ask

pairs of contradictory dimensions like life satisfaction and the degree of overall concerns, work satisfaction and, for example, work monotony, optimism and pessimism and the like. Examples from Austria show that these contradictory dimensions are not organized in an exclusive or, but rather in an and-mode. Respondents turn out to be both optimistic and pessimistic or satisfied with their life and seriously concerned about it at the same time.

Fourth, the visual measurements are usually context-sensitive. Any item-battery, for example which asks for a ranking of alternatives is produced iteratively and each new visual choice changes the visual space for the subsequent choices. Moreover, these visual choices exhibit an implicit network of relations for single respondents which can become a highly interesting unit of analysis in a deeper analysis of survey data.

Fifth, visual measurements offer interesting ways for addressing multiple biases or, more appropriately, multiple context sensitive characteristics inherent in surveys. Online-surveys can be organized by using, for example, two, three or even more different sub-group designs where the sub-groups differ by the sequence of items or by the visual designs. One could even consider the possibility of having a sub-group perform a conventional survey where the visual part is completely administered as a conventional language-based survey. In this way, essential insights can be gained on the comparative strengths and, if any, on the weaknesses of visual surveys when compared to the traditional survey measurements.

Sixth, visual measurements can be undertaken as interval measurements where respondents are able to select a specific range of values to which they are indifferent. Once again, these intervals, if analyzed systematically across surveys, should lead to new insights into the structure of survey scales.

Seventh, visual measurements can be encoded into quantitative data by using linear scales. But this is not the only possible form of transforming a visual pattern into quantitative data. One could also use logarithmic scales and it should become an extremely interesting empirical question whether linear or logarithmic data transformations offer more fruitful and interesting ways for the subsequent data analysis.

4.7 Further Outlooks

According to our experience with a small number of visual surveys so far, shifting from verbal responses to pattern formation and pattern recognition could and should become an interesting new way for survey questionnaire designs. In our assessment, visual or pattern-based surveys especially for the large amount of

under-learned survey items could capture the complexities of the cognitive architectures of respondents in a much better way than the Science I-based measurement methods with their restricted scales and pre-arranged verbal responses.

Visual surveys which are based on the distinction between over-learned and under-learned responses were not used in the early days of survey research where face to face interactions were the predominant mode of data collection. During this period the conventional measurement methods and theories prevailed and visual elements or visual measurements were not considered as a serious or even as a remotely interesting approach when compared to the dominant form of survey behaviorism.

During the mode of telephone surveys visual forms of questionnaires were nearly impossible to organize and the costs for visual survey designs would have been extra-ordinarily high. After all, visual surveys would require that each potential respondent receives a visual survey questionnaire which after the end of a successful telephone interview is sent back to the fieldwork agency, encoded appropriately, etc.

But with the emergence of online surveys visual surveys are relatively easy to implement and, most importantly, the transformation of visual patterns which were produced by respondents into appropriate quantitative data can be undertaken in an automatic manner. Thus, online surveys offer an ideal environment for visual surveys in unprecedented ways especially because respondents are able to produce rather complex conceptual networks of preference relations, of relevance relations and the like.[17]

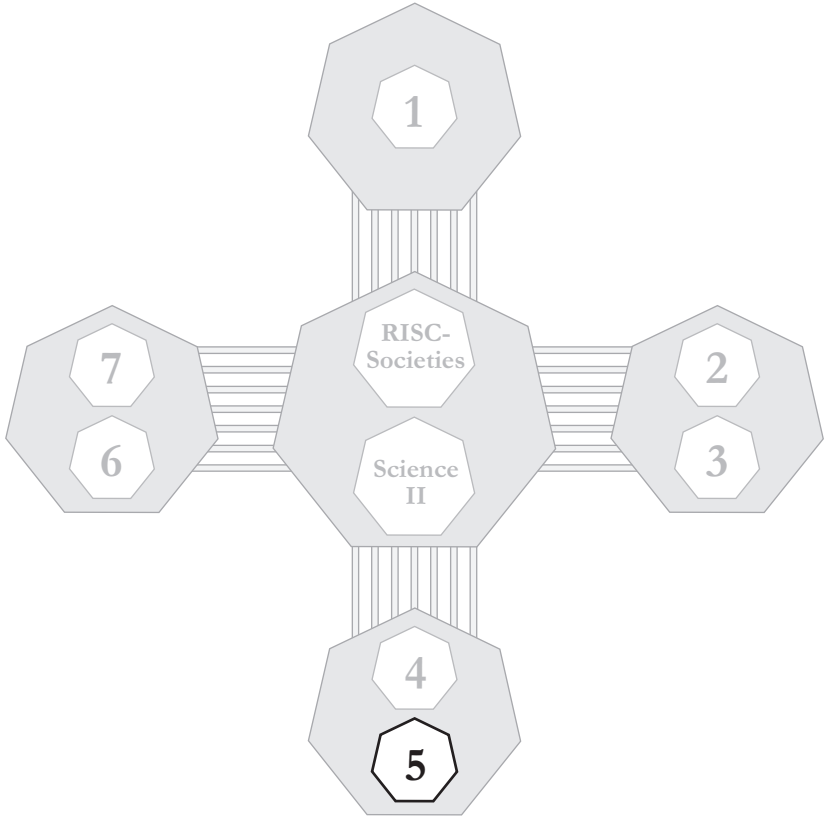
It will depend on the international survey community whether this new potential for survey data collection is and will be used more frequently than in the past. It is hoped that the two basic principles for online survey questionnaire designs, namely

- Over-learned items: language-based formats
- Under-learned items: visual forms (pattern recognition and pattern production)

will find more and more acceptance in the years to come.

17 For a more general background on the new research environments between researchers and respondents, see also Müller, 2008.

5 New Forms of Secondary Data-Analyses



Currently, large quantities of survey data sets remain idle and outside the available data bases for comparative analyses. These datasets have been produced and analyzed within a single region only and, so far, were not reproduced in other regional units as well. Due to the absence of functionally identical datasets in other regional units these data sets were of no use for comparative research. And because of the non-availability of comparable data sets from other regional units the potential for comparative analysis was severely hampered as well because a single data set without historical reference data sets or comparative data across other regional units lacks vital context information which is required for any deeper analysis of survey data within a specific space-time frame.
Subsequently, these surveys which have been designed and assembled for the purpose of analyzing a single population only will be characterized as atomic survey-datasets. Similarly, molecular datasets could be introduced as chains composed of identically generated datasets across regions like in the case of international survey programs [SHARE, ISSP, European Value Surveys, etc.]. Mutatis mutandis, the same arguments and strategies could be used for panel datasets as well. Essentially, atomic survey or panel datasets are, due to the missing links to similar survey or panel datasets in other areas, lost for comparative research, so the traditional story goes. Consequently, the subsequent article will place its emphasis on different atomic survey datasets and on their potential for comparative analysis.
At this point, the article will introduce a new morphological approach which tries, based to create bridges between these different atomic survey datasets. In other words, atomic survey data sets can be brought into the arena of comparative research. With a common class of data transformations which can be labelled as formation and as aggregation, the morphological approach generates a set of morphological constructs $\{MC_i\}$ which, despite the heterogeneity of the underlying atomic survey datasets, can be used for comparative analyses. Towards the end of this article, several different designs within the new morphological road to comparative research will be described in greater detail. But the main thrust of this paper lies in a high-risk test of the morphological approach in order to establish its viability for comparative research.

5.1 The Traditional Limits for Comparative Research

So far, atomic survey datasets, *i.e.*, directly incomparable micro-data between regions, were thought to be the strongest argument for the generation of comparable cross-regional survey programs like the European Social Survey (ESS), SHARE or Eurobarometer. Usually, comparative research has reaches

its insurmountable limits if confronted with different questions from different surveys in different countries. As an example, take the following two questions from Table 5.1.

TABLE 5.1 **Two Different Questions from Different Surveys in Two Different Countries**

Question Q_k from Survey A in country C_1 $[Q_k,(A, C_1)]$:	Start one's own business
QuestionI from Survey B in country C_2 $[Q_l (B, C_2)]$:	Satisfaction with the way things are handled at workplace

Normally, the outcomes for $Q_k,(A, C_1)$ cannot be compared with the results for $Q_l,(B, C_2)$. Assume, that for $Q_k,(A, C_1)$ two thirds of the female population, in contrast to only one third of the male group, have big difficulties in starting one's own business whereas three quarters of the female group are rather satisfied with their workplace, compared with only 50% of the male respondents. Any inference from $Q_l,(A, C_1)$ in country C_1 with respect to the potential results for $Q_l,(B, C_2)$ – and vice versa – would be ill-founded and, due to the absence of directly comparable data, would constitute a wild speculation without any empirical foundations.[1]

At this point, the morphological approach begins with its operations in creating links or bridges. But quite obviously, the morphological approach is not a magical procedure which can be used for any kind of heterogeneous datasets irrespective of the degree of data incomparability. After all, data on media consumption in country C_1 will provide no comparative clues on the health status of the population in country C_2.

Thus, the morphological approach rests itself on two assumptions which, *a fortiori*, are needed for the traditional ways of comparative research, too.

The first assumption is one of at least second-best or *satisficing* practices and requires that the atomic surveys which have been conducted, fulfil the usual quality requirements for surveys in a sufficiently professional manner. In other words, the atomic survey datasets used for morphological analyses should be free of serious deficits, biases and errors with respect to sampling, interviewer accuracy, etc.

The second assumption is content-oriented and requires a small number of shared domains between the selected atomic surveys. These shared domains are to be understood in a very general way and are fulfilled in all those instances

1 The result can be generalized from the Q_k/Q_l case to the general Q_i/Q_j case where i and j run through the entire set of survey questions.

where a uniform classification scheme CS can be built for each of the selected atomic surveys. What is needed, thus, for the morphological approach, are different atomic surveys on two, three or more shared domains like health, political attitudes or working conditions and the like.
The third assumption is related to the dichotomy between under-learned and over-learned responses in surveys.[2] Over-learned responses turn out to be context-insensitive and are reproduced in very similar or identical fashion. Under-learned responses are highly volatile, produced in a just in time mode and exhibit a distinctive non-classical logic.[3] Essentially, the focus for comparative analysis with atomic data-sets should be concentrated on under-learned responses like the usual self-evaluations or subjective assessments.
Violating even these three conditions simply means abstaining from any type of comparative data-analysis, morphological, traditional or otherwise.

5.2 The Basic Steps in the Morphological Approach

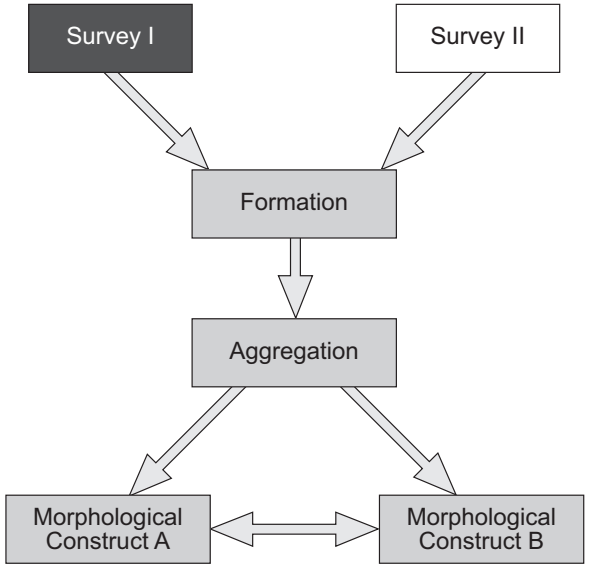
Figure 5.1 presents an overview for the morphological road to comparative research. The morphological approach starts with two or more different atomic surveys A, B ... in different regional units like cities or countries. Here, the variables, items and scales between the surveys A, B ... are usually heterogeneous, except for socio-demographic variables like age, gender or household size. Heterogeneity between surveys means that survey-questions are focused on different dimensions within a broader domain, that questions are phrased in significantly different ways within the same dimension and that the scales used for these questions differ substantially, too. Under normal circumstances, comparative research has come to an end in cases of strong survey heterogeneity.[4] However, the morphological approach starts with a set of atomic surveys A, B ... and creates a sub-set of shared domains which can be described in a homogeneous fashion by a single classification scheme CS. This classification scheme with a small list of shared domains like aging, housing, quality of life and the like forms the basis for the morphological approach.

2 On this distinction, see especially Müller/Toš, 2009.

3 For a summary on the non-classical logic of under-learned responses, see, once again, Müller/Toš, 2009.

4 To repeat, once more, the morphological approach, as any other alternative, must come to an insurmountable barrier, once a survey on eating habits in country C1 is to be compared with a different survey on professional training in country C2.

FIGURE 5.1 **Morphological Designs**



Following Figure 5.1, the essential steps in the morphologiocal approach are called formation and aggregation. Formation means a dual selection process.

- The first selection is made with respect to a number of elementary forms which have been assembled in Figure 5.2.
- The second selection concerns the number of dimensions used, given that the selction of elementary forms has been accomplished. Figure 5.3 highlights the distribution of forms with four dimension in each of the common domains.

More specifically, the formation process involves, first, the specification of a classification scheme CS for a group of atomic survey data sets. This classification scheme CS leads to a specific number N of homogeneous themes or domains which are shared by all atomic survey data-sets under consideration. Usually, a CS for atomic data sets includes broad domains (*e.g.*, social capital, partnership and family, etc.) which have been covered by a number of different questions or item-batteries in each of the atomic surveys.

FIGURE 5.2 **Elementary Forms of Shared Domains between Atomic Survey Data Sets**

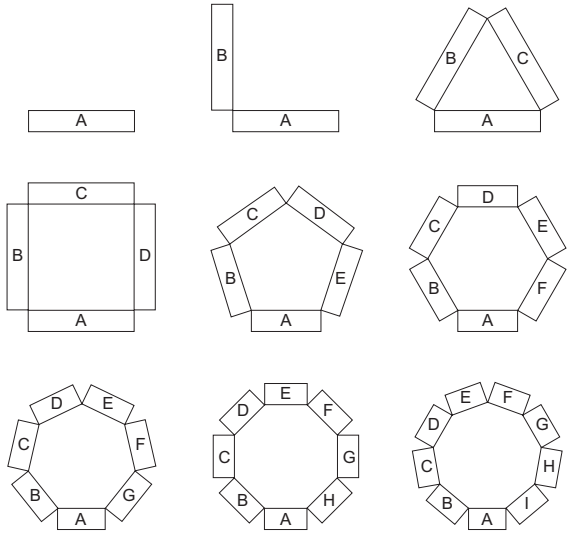
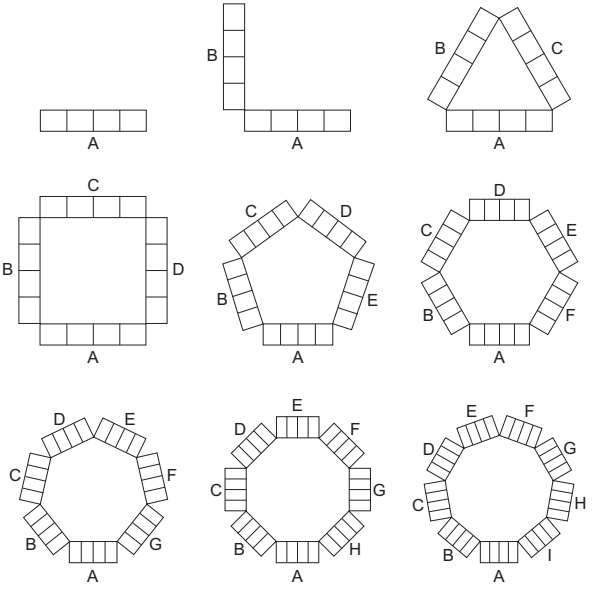


FIGURE 5.3 **Elementary Forms $F_{i,4}$ with I = 1, 2, 3 …, 9 Shared Domains and Four Dimensions**



The specification of a number of shared domains leads to the selection of a corresponding elementary form. Elementary forms F_i (i = 1, 2, 3 ...) are based on the combination of unit rectangles where each unit rectangle represents a single shared domain between atomic survey data sets. These unit rectangles can be combined to elementary geometric constructs like triangles, squares, pentagons, hexagons, heptagons and the like. Figure 5.2 summarizes these elementary geometric forms F_i from a single area up to a configuration of a nonagon with nine broad common domains among a set of atomic surveys.

Obviously, the next step consists in the selection of a common number of variables or dimensions $F_{i,d}$ (d= 1,2,3,....) which are needed for the subsequent creation of morphological constructs. Normally, several variables or dimensions are available for each of these shared domains. Depending on the selected atomic surveys the usual number of dimensions will be three, four or five and, probably seldom, higher. Numbers beyond seven or eight depend on the availability of suitable survey questions and lower numbers lead to difficulties for the morphological approach itself or to the purpose of comparative research altogether. Figure 5.3 demonstrates the variety of elementary forms for $F_{i,4}$ (I = 1,2, ...,9) with four dimensions and similar diagrams could be produced for three, five or more dimensions as well.

In terms of data operations, formation means a data transformation from an atomic survey dataset with different scales to a sub-data set with a specific number of shared domains, a specific number of dimensions for each of these domains, and, most importantly, homogeneous scales across all dimensions and domains.

Following Figure 5.1, the next step in the morphological approach, after formation, is called aggregation which is directed towards a morphological construct MC_i for each of the atomic data sets. These morphological constructs become, then, the basis for comparative investigations. Thus, based on a morphological construct for each atomic survey data set under consideration, the comparative analysis can be focused on the structure of the morphological constructs $MC^{A,B}$... and, due to the availability of an identical set of variables for all atomic surveys, on the socio-demographic profiles of this morphological consruct.

In terms of data operations, aggregation is focused, first, on the integration of dimensions and domains and, second, on the creation of a horizontal or vertical stratification of the sub-dataset which, then, forms the basis for comparative analyses.

Due to the necessary selection and construction of forms inherent in this approach the terms morphology and morpholical approach have become the main classifiers for this new road to comparative reserach. Subsequently,

a test design and a preliminary demonstration of the viability of this road to comparative research will be laid out in greater detail.

5.3 A Test-Design for the Morphological Approach

Within the present context, a test-design will be constructed which should help to demonstrate the usability and the relative robustness of the morphological approach. Following Figure 5.4, a single national survey will be selected and split into two different groups of questions A and B. It must be emphasized that the split is not one in populations as in split ballot designs, but a split in survey questions.[5] The rationale for focusing on a single survey only is rather straightforward: By concentrating on a single population, by using two different subsets of questions from one survey and by performing the morphological approach with an identical population one can easily compare the two resulting stratifications with respect to their population composition. In this way, two groups of results could be obtained.

- If the population is grouped in high numbers into the same categories by the formation and aggregation operations, despite two different sets of survey questions, then the morphological approach seems to be a viable path to follow.
- However, if the population is stratified across the two morphological constructs, following the necessary formation and aggregation operations, in a random manner, then the morphological approach should be abandoned altogether [See, once again, Figure 5.4].

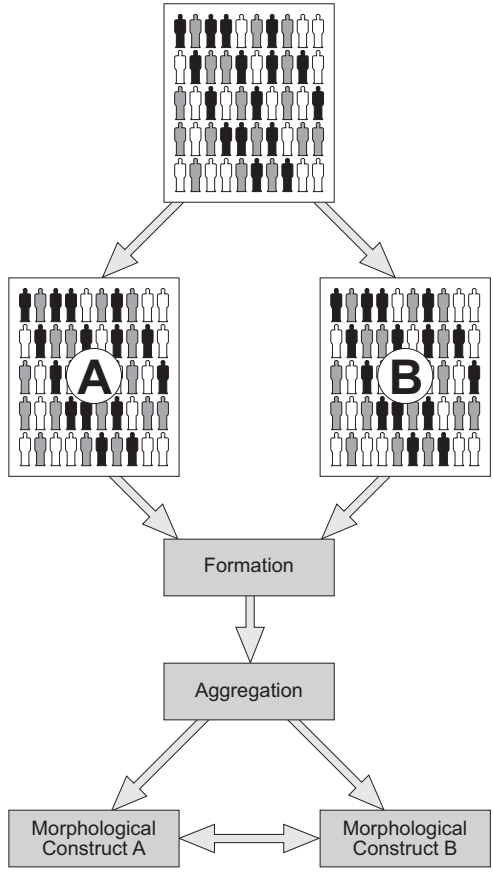
Turning to the test design in more detail, the starting point lies in the construction of a classification scheme CS which divides the survey into a small set of broad domains or general themes.

As usual, a zero hypothesis H_0 can be put forward which asserts the non-viability and the erroneous nature of the entire morphological approach.

H_0: The morphological constructs used for comparative analyses cannot be compared with each other in any meaningful way. The morphological data-constructs used for comparisons are, due to the absence of directly comparable data, artificial and spurious and lead to ill-founded results.

5 It should be added that the morphological approach builds on different sets of questions and not, as in the case of MTMM-designs (multi-trait multi-method) on slight variations of a single question. On MTMM in general, see Bagozzi/Yi, 1991, Bunting/Adamson, 2000 or Saris, 2003.

FIGURE 5.4 **A Test-Design for the Morphological Approach**

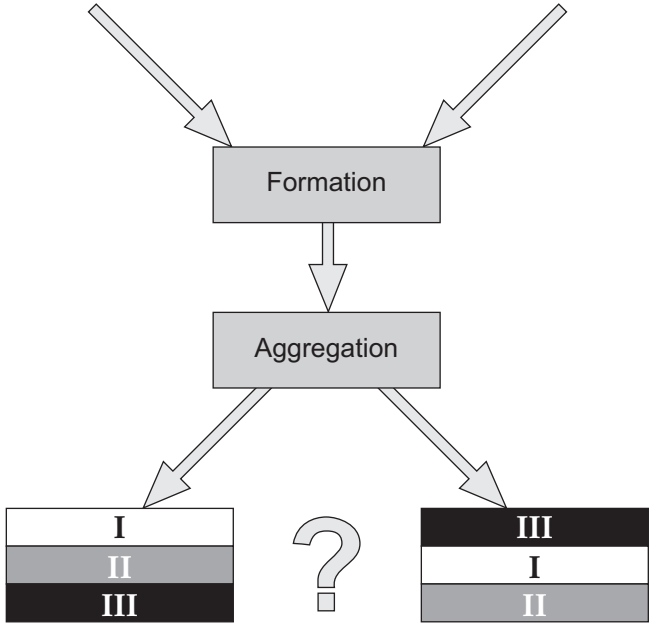


In order to refute H_0, the validity and the reliability of the morphological constructs MC must be shown in the following manner.

H_A: The morphological constructs used for comparative analyses can be compared with each other in many meaningful ways. The morphological data-constructs used for comparisons are, due to the absence of directly comparable data, both valid and reliable and comparisons lead to empirically well-founded results.

A perfect support of the H_0-hypothesis would consist in a series of comparisons between MC^A and MC^B in which each single categorization is misplaced. This configuration is shown in Figure 5.5 where one and the same population has been categorized in three layers or strata (low, medium, high).

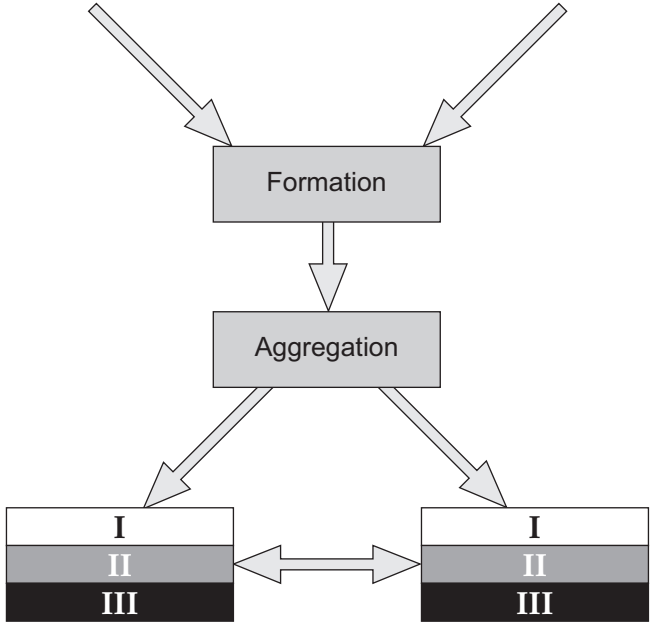
FIGURE 5.5 **A Perfect Failure for the Morphological Approach**



Due to the fact, that a single data set has been used, it can be determined how much the two constructs MC^A and MC^B differ from each other. As Figure 5.5 demonstrates this categorization has been undertaken in an entirely different way for the two morphological constructs MC^A and MC^B. Actually, not a single individual in MC^A is placed at the same level in MC^B. In the worst case of Figure 5.5, zero percent of the population have been categorized in an identical manner through the two morphological constructs MC^A and MC^B.

Contrary, the perfect support for H_A and for the morphological approach is depicted in Figure 5.6 where the two morphological constructs MC^A and MC^B produce an identical categorization for the entire population P. Here, all respondents within the morphological construct MC^A can be found at the identical levels in the morphological construct MC^B.

FIGURE 5.6 **An Optimal Result in Favor of the Morphological Design**



In the case of identical categorizations for an entire survey sample on the basis of two different sets of questions, one would have produced extremely strong empirical evidence for the construct validity of the morphological approach. In the next section, the numerical demarcations will be specified in greater detail which, quite obviously, must be situated somewhere between 0 (perfect misspecification) to 1 (perfect correspondence)

Finally, given that this approach produces valid and reliable categorizations for two different sets of questions within a single dataset, one can safely infer that this approach works also in the case of two different surveys with different sets of questions across different populations. And this inductive inference can be made, due to the present test-design with a single population, free of any ecological fallacies.

5.4 Setting up the Test

Using the Austrian data for the ESS as primary test dataset, a classification scheme CS with three broad domains has been specified. For each of these domains four variables or dimensions were available.[6] The classification scheme CS was composed of

- Social capital (trust in institutions, general trust)
- Working conditions
- Central actor-resources (income, education, life satisfaction, etc.).

Table 5.2 summarizes the two different groups of questions from the Austrian ESS questionnaire which were used for a differentiation into two different sub-surveys, namely into Survey A and into Survey B. The underlying elementary form $F_{3,4}$ is represented by the right element in the first row of Figure 5.3 which consists of three shared domains with four dimensions each.

The procedures with a classification scheme CS and different dimensions are neither particularly spectacular nor is it clear how a new road to comparative research can be based on these elementary forms or dimensions, specified so far. But until now, only the first step in the morphological procedure, the formation step, has been performed. What is still missing is the second step which has been qualified as aggregation procedure.

Thus, the crucial step for the morphological approach is the present one and it consists in a common transformation process which is depicted in Figure 5.7. Here, a common aggregation procedure for two elementary forms produces two morphological constructs MC^A and MC^B which, then, become the basis for comparative analyses between population A and population B.

6 For the test design any multiple thematic survey like, for example, the Austria Social Survey, conducted in 1986, 1993 and 2003, could have been chosen. The reason for selecting the European Social Survey was motivated by the fact that the ESS, due to its availability for twenty or so European countries, allows an identical replication of the morphological approach for the Austrian ESS data for the entire dataset as well.

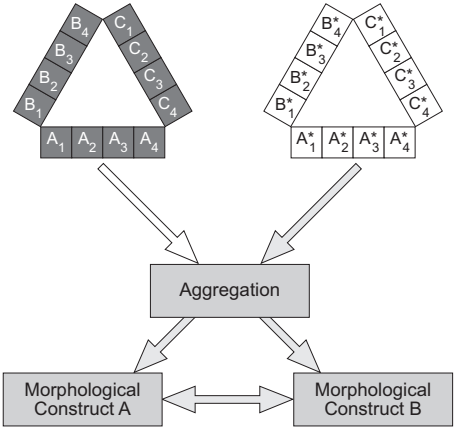
TABLE 5.2 **Sub-Survey A and Sub-Survey B from the European Social Survey (ESS)**

Survey A	Survey B
Trust in Institutions	
Trust in country's parliament	Trust in the legal system
Trust in the police	Trust in politicians
Most people can be trusted or you can't be too careful	Most people try to take advantage of you
Making mind up about political issues	Politicians in general care what people like me think
Working Conditions	
Allowed to be flexible in working hours	Allowed to decide how daily work is organized
Allowed to influence job environment	Allowed to influence decisions about work direction
Allowed to change work tasks	Get a similar or better job with another employer
Start own business	Satisfaction with the way things are handled at workplace
General Domain	
Household's total net income, all sources	Highest level of education
Borrow money to make ends meet, difficult	Feeling about household's income
or easy	nowadays
Life Satisfaction	Happiness
Father's highest level of education	Mother's highest level of education

To obtain the morphological constructs MC^A and MC^B, the following aggregation steps have to be undertaken.

First, each of the twelve dimensions in both data sets must be divided into three segments or strata, S^U, S^M and S^L. The criterion for separation is distribution-dependent where S^U occupies the upper third of the distribution, S^M the middle range and S^L the lower third of the distribution. Thus, single dimensions like flexibility in working hours or the feeling about the household's income may exhibit a distribution with a single peak, two peaks or several peaks. Independent of the shape of the distribution, the upper third of the distribution is classified as S^U, the middle third as S^M and the lower third as S^L.

FIGURE 5.7 **The Morphological Aggregation Procedure**



Second, a data transformation of the actual values in the dataset into the domain of -1, 0 and +1 must be performed. The transformation rules are straightforward: S^U equals 1, $S^M = 0$ and S^L becomes -1.

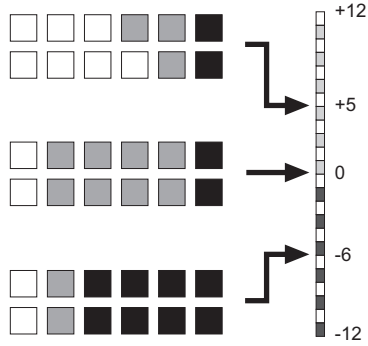
Third, at this point each respondent in the data set is characterized by a string of varying numbers of -1, 0 and +1. Consequently, an aggregation procedure is needed which generates a single number for each respondent in the dataset. Figure 5.8 exemplifies the corresponding aggregation procedure for the twelve dimensions. From Figure 5.8 one can see that the total number of S^L or the number of domains with a value of -1 are subtracted from the total number of S^U or the number of domains with a value of +1. Thus, a respondent with seven S^U-segments and two S^L-areas receives the overall value of 5 or a respondent with two S^U areas and eight S^L domains ends up with a value of -6.

Fourth, a new scale can be constructed which, due to the twelve dimensions selected for the data sets A and B, ranges from -12 to +12. +12 corresponds to a homogeneous distribution of +1 only and -12 marks the opposite sequence of a string of -1 only. Thus, each respondent, due to the selection of twelve dimensions, is located at one of the discrete points in the scale between -12 and +12.

Fifth, the resulting distribution, due to these data transformations, must be a normal distribution with $\mu = 0$ and $\sigma = 1$. This distribution is separated, once again, into three layers, namely into G^U, G^M and G^L. G^U comprises the upper third of the population, G^M the middle layer and G^L the lower third of the population distribution.

Sixth, the separation of the two populations A and B into three layers G^{AU}, G^{AM} and G^{AL} and G^{BU}, G^{BM} and G^{BL} leads to the morphological constructs MC^A and MC^B.

FIGURE 5.8 **A Transformation of the Data for Three Respondents with Twelve Dimensions into a Vertical Inequality Scale from -12 to +12**



S_U: White Squares S^M: Gray Squares S^L: Black Squares

Seventh, the two morphological constructs MC^A and MC^B can then be compared with respect to their socio-demographic composition like gender and age distribution or other socio-demographic categories which are usually available in an identical fashion across surveys.
In this way, two morphological constructs MC^A and MC^B have been generated which are based on sub-surveys from the ESS and, due to the overall test design, on the same survey population.

5.5 The Test-Results for the Morphological Approach

The final step in establishing the morphological approach as a viable new path for comparative research consists in a comparison between the two morphological constructs MC^A and MC^B. Since the ESS has been split into two sets of questions with an in identical population for each ESS-sub-class the crucial criterion lies, quite obviously, in the retention rate r for the groups G^U, G^M and G^L. The retention rate r measures the number of identically classified instances in the survey population P and focuses on the similarities or dissimilarities in the composition of G^{AU}, G^{AM} and G^{AL} on the one hand and of G^{BU}, G^{BM} and G^{BL} on the other hand. Three a priori generalizations on the viability of the morphological procedure can be formulated right away.

- First, the higher the retention rate between the two group stratifications of the morphological constructs MC^A and MC^B, the higher the construct validity of MC^A and MC^B and, thus, of the morphological approach.
- Second, the higher the number of successful test instances with split surveys and single populations, the higher the reliability of the morphological procedure.
- Third, the higher the construct validity and the reliability, the more the morphological approach can be applied to instances with two, three or more different surveys either across time or across regional units.

The retention rate r can be formally introduced as

$$r = \frac{(\Sigma n_i)}{(\Sigma n_i + \Sigma n_k)}$$

where the expression in the numerator sums up the common instances between survey A and B and the denominator is composed of the sum of common elements plus the sum of misclassified respondents.[7]

The expected value for the retention rate r for a purely random classification method of an initial configuration of three groups $[g_1, g_2, g_3]$ into a new schema with three groups $[g_{1^*}, g_{2^*}, g_{3^*}]$ is, quite obviously $r = 1/3$.[8]

A priori, the following assessments can be undertaken with respect to the retention rate r from a value close to 0 up to a value very close to 1.

A value of $r \approx 0$ like in Figure 5.5 would exhibit an endemic misclassification of the morphological procedure altogether. In this case, the morphological procedure offers an unintended side-effect. Due to the non-random nature of a complete misspecification additional considerations could be devoted to the problem whether a configuration with a highly significant negative result could be transformed into one with highly significant positive results.

A value well below $r < 0.33$ would indicate a misclassification bias of the morphological approach. Since the expected value for a purely random classification procedure lies at $r = 0.33$, it can be safely assumed that a significantly lower value for the retention rate r implies a systematic bias inherent in the morphological constructions.

Values of $r > 0.33$ but below $r \leq 0.50$ would show that the morphological approach performs slightly better than a pure random classification but is of no

7 A retention rate can be calculated in two ways, namely first with the population of Survey A as origin and the population of Survey B as successor and, second, with population B as origin and A as successor.

8 Given a configuration of three groups g_1, g_2, g_3, one has a total of nine possibilities with three rank preserving specifications $[g_1|g_{1^*}; g_2|g_{2^*}; g_3|g_{3^*}]$ and six possible misspecifications.

use for comparative research since the failure rate is sufficiently large and the margin of errors is simply too wide.

The most interesting and relevant domain of the retention rate lies in the range $0.50 \leq r < 1$. Here, the morphological approach operates in a highly significant manner well beyond a pure random classification procedure. Moreover, the retention rate is sufficiently high to be qualified as pattern preserving. Pattern preservation can be defined as a data transformation $D \rightarrow D^*$ which keeps general data patterns like a rising or a falling trend, clusters or characteristic relations largely intact so that D^* exemplifies these patterns, albeit with some variations, as well. Especially interesting are retention rates near or above 0.67 because this would show that the morphological approach produces very powerful classification preserving results.

The value of $r = 1$ or r sufficiently close to 1 would show that both morphological constructs, despite their different underlying dimensions and data-bases, yield the same results. In this case, the morphological approach would operate almost in a purely magical way because it would generate, despite an underlying heterogeneity, (almost) perfect homogeneity.

Before going into the issues of construct validity, reliability and retention rates, Table 5.3 presents a summary of the correlations between each pair of the dimensions used for Survey A and Survey B. This overview is useful because it demonstrates that the constitutive pairs of dimensions from Survey A and from Survey B are not correlated in a uniformly high manner. On the one hand, each of the three groups contains at least a pair of rather weakly correlated dimensions. Second, the correlations for the three groups themselves, specified as average correlation for all four pairs, differ significantly as well. The pairwise correlations in the domain of trust in institutions and in people turn out to be the highest (0.54) and they fall considerably in the area of working conditions (0.38).

Turning now to the decision problem of accepting H_0 or H_A, the following procedures and rules can be established.

TABLE 5.3 **Correlations between the Dimensions in Survey A and in Survey B (ESS)***

Survey A/Survey B (ESS)	
Domain I: Trust in Institutions and in People	
Trust in country's parliament/ Trust in the legal system	0.56
Trust in the police/ Trust in politicians	0.43
Most people can be trusted or you can't be too careful/ Most people try to take advantage of you	0.58
Making mind up about political issues / Politicians in general care what people like me think	0.60
Average Correlation for Domain I	0.54
Domain II: Working Conditions	
Allowed to be flexible in working hours/ Allowed to decide how daily work is organized	0.56
Allowed to influence job environment/ Allowed to influence decisions about work direction	0.62
Allowed to change work tasks/ Get a similar or better job with another employer	0.24
Start own business/ Satisfaction with the way things are handled at workplace	0.09
Average Correlation for Domain II	0.38
Domain III: General Resources	
Household's total net income, all sources/ Highest level of education	0.17
Borrow money to make ends meet, difficult or easy/ Feeling about household's income nowadays	0.41
Life Satisfaction/ Happiness	0.68
Father's highest level of education/ Mother's highest level of education	0.71
Average Correlation for Domain III	0.49
Average Correlation across Domains	0.47

*: The correlations have been calculated for the entire ESS-data set in Round 1 and not for the Austrian data.

With respect to the construct validity, two extreme cases can be distinguished. Assume a single dataset divided into two sub-sets A and B with n (n=1,2,..., N)

common domains and m (m=1,2,..., M) indicators or dimensions for each of the domains respectively where $n_{A,B}$ domains x $m_{A,B}$ dimensions are used as the empirical basis for comparisons. Assume, furthermore, a morphological formation and aggregation procedure that leads to two final morphological constructs MC^A and MC^B which separates the population of A and B in $o_{A,B}$ (o=2,3,..., O) categories each. Then, H_0 can be rejected if two independent tests on construct validity and reliability are passed.

Construct validity can be assumed in the case of $0.50 \leq r < 1$ simply because the retention rate lies within a domain far away from a random classification.

Turning to the reliability of the morphological approach, it can be assumed that the reliability increases inductively with the number of successful test applications. In the present context, reliability will be taken into account only in a weak way by applying the morphological test design for ESS data from Austria and for the entire ESS country group as well.

Table 5.4 offers a first overview on the results of the morphological procedures and on the overall retention rates. The retention rates have been calculated for the Austrian data set of the ESS as well as for the entire ESS-data set across all countries. In this way, the calculations both for a single country as well as for the entire set of ESS-countries should demonstrate that these retention rates are not the result of particularly happy circumstances within a single country, but demonstrate a general feature of the entire ESS-data set. Moreover, using ESS-data for Austria as well as for the entire group of ESS-countries provides at least a weak hint on the reliability of the morphological approach.

The most important result from Table 5.4 lies in the fact that the retention rates lie well in the critical and pattern-preserving range of $0.50 \leq r < 1$. As a rule of thumb, the retention rates come close to the value of $r \gg 0.67$ which means, essentially, that approximately two thirds of the population have been classified in a rank-preserving way.

A second essential outcome lies in the overall consistency of retention rates for a single broad domain or across the three shared domains. This result is particularly encouraging because it demonstrates the applicability of the morphological approach already for elementary forms of the variety $F_{1,4}$, $F_{1,5}$, $F_{1,6}$, ...

Finally, the third result points to the consistency between a single national survey and a large group of national surveys which offers at least a weak support for the reliability of the morphological approach.

TABLE 5.4 **Retention Rates for Survey A and Survey B (ESS) (in %)**

Retention Rates	Austria		Europe	
	A/B	B/A	A/B	B/A
Retention Rate for Domain I (Social Capital)				
Lower Group	57.5	65.3	70.6	66.2
Middle Group	39.8	44.1	46.0	46.7
Upper Group	74.8	59.3	64.5	68.3
Retention Rate for Domain II (Working Conditions)				
Lower Group	66.3	71.4	66.6	66.5
Middle Group	65.4	55.3	63.0	58.1
Upper Group	55.0	67.5	57.1	65.6
Retention Rate for Domain III (General Resources)				
Lower Group	59.3	42.2	80.2	41.0
Middle Group	48.0	47.6	47.8	33.9
Upper Group	54.2	67.0	33.2	86.0
Overall Retention Rate across Domains				
Lower Group	54.3	72.8	76.6	68.0
Middle Group	48.3	34.3	53.3	36.3
Upper Group	69.4	71.7	59.5	87.4
Average Retention Rate across Domains	57.3	59.6	63.1	63.9

In sum, with retention rates well around r ≈ 0.67 and, thus, a relatively high construct validity plus an *a priori* reliability of the morphological procedure due to the similarity between the Austrian and the European retention rates, H_0 can be safely rejected and H_A accepted. These results point to the overall viability of the morphological approach and for using morphological constructs as units of comparisons in the case of atomic data sets.

Moreover, using atomic surveys and splitting them into sub-atomic parts with identical populations should become the indispensable testing ground for exploring and eliminating potential weaknesses in the morphological construction processes. In principle, exploring the test-design with single populations should lead to two forms of potential cognitive gains.

On the one hand, this testing ground of split surveys and identical populations for each sub-survey should contribute, in the long run, to the development of positive and negative heuristic rules for the formation and aggregation procedures of the morphological approach. For example, the third common domain for the ESS with its focus on general resources turned out to be the one with the comparatively

lowest retention rates. Looking more closely on the selected dimensions and on the construction process, it was rather difficult to split the two education variables into three equal segments. Although the ESS did not offer another pair of dimensions in the shared domain of general resources, it becomes possible to identify the weak components in the formation and aggregation process. Thus, there is a positive learning curve inherent in the morphological approach which has not been unfolded and which stays currently almost in its initial configuration. On the other hand, performing the morphological approach for a single dataset should produce a lot of new explicit and implicit knowledge with respect to superfluous and redundant survey questions. High retention rates for two subsets of questions within a single survey implies that one of the subsets can be replaced by an entirely new domain and by a new set of questions and dimensions altogether.

5.6 Different Trajectories within the Morphological Road of Comparative Research

Having established, in principle, the overall viability of the morphological approach, one can specify a large number of different designs within the morphological framework. Specific research interests and research questions require different morphological constructs as well as different forms of comparative analyses morphological style.

At the outset, the morphological approach is capable to cope with a large variety of formal structures in terms of the underlying composition and of spatio-temporal levels.

On the one hand, the morphological approach can be applied to different populations, be they composed of persons, households, enterprises, cities, nations and the like.[9] In compositional terms, this framework is not restricted to specific elements like persons alone, but can be used for different segments of contemporary societies as well like non-government organizations, research institutes, internet communities, etc. as well.

On the other hand, this approach can be used for different spatio-temporal levels as well, ranging, spatially, from neighborhoods to cities, regions, countries, supra-national regions up to the global level and temporarily from daily variations, monthly changes, yearly developments up to the slow transformations of the *longue durée*.

9 It must be stressed that the morphological approach has been applied already to different sets of actors like firms, scientific institutes, state agencies and the like. As an example of a morphological analysis for scientific institutes, see Müller *et al*., 2002.

Different Morphological Constructs

Morphological constructs can be built in two different ways, namely, like it has been done in the test-deign, in a vertical way or in a horizontal manner. The selection of vertical or horizontal constructs depends, on the one hand, on the overall research question as well as on the goal of a comparative analysis and, on the other hand, on the available classification scheme CS and on the dimensions selected for the morphological construct. In some applications it might turn out that vertical (horizontal) constructs should be specified, but no appropriate CS with a small number of vertical (horizontal)dimensions can be found within the available surveys.

Vertical Constructs

Morphological constructs as vertical formations reflect, very generally, underlying distributions of socio-economic inequality. For vertical constructs, classification schemes should cover essential domains of societal inequalities and dimensions should be chosen in a way that their lower ends can be interpreted in one of the following ways: as socio-economic risks, as being in a highly under-privileged position, as very disadvantageous, as very marginalized and the like.[10] Here, the lower and higher ends of the various dimensions must constitute an inequality relation. For example, the dichotomy of very high socio-economic risks and very high socio-economic life chances can be viewed as one of the possible interpretations for the two end points of the scale.

In general, the road with vertical morphological constructs should be selected whenever the research interest is directed towards societal inequalities and towards vertical stratifications. Looking at Table 5.2, for instance, many, if not all, of the dimensions bear strong relations with societal inequality. For instance, income, level of education, but also different forms of autonomy at the workplace can be seen as important aspects of societal inequality. Similarly, a high level of trust in institutions or in one's social environment can be viewed as an individual resource whereas low levels of trust exclude a person from many routines and practices and can be viewed as a lack of social capital. Due to the selection of dimensions in Table 5.2 with clear relations to societal inequality, the road with vertical morphological constructs has been chosen.

More specifically, the vertical formation procedure consists in a data transformation for each of the selected dimensions from the existing variety of different scales

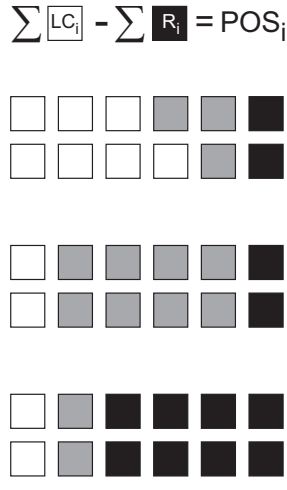
10 Likewise, the upper ends should be interpreted in a number of different ways, too, like socio-economic life chances, very over-privileged, very advantageous, very central and the like

and values to a single scale only. In principle, different options are available like a continuous scale between 0 and 1 or various discrete linear scales. The question of scaling will be discussed in greater detail in section "Non-Linear Scales".

In the test-design, a particularly useful transformation has been employed which was based on the underlying distribution in each of the dimensions and which consisted in a transformation of the distribution of a single variable or dimension into the domain of -1, 0 and +1. Here, a single dimension like the "health status" on a scale from 0 to 10 was transformed into the [-1, 0, +1]-scale in the following distribution-dependent way. The lower third of the distribution S^L received the value -1, the upper third S^U the value +1 and the middle segment S^M the value 0. Likewise, income, measured in income groups or levels of education, measured in years, were be transformed in the same way. The lower third of the distribution received the value -1, the upper third is encoded as +1 and the medium segment gets, once again, the value 0. Figure 5.9 demonstrates, once again, a possible distribution for three survey respondents, based on a classification scheme CS with a total of three shared domains and four dimensions each.

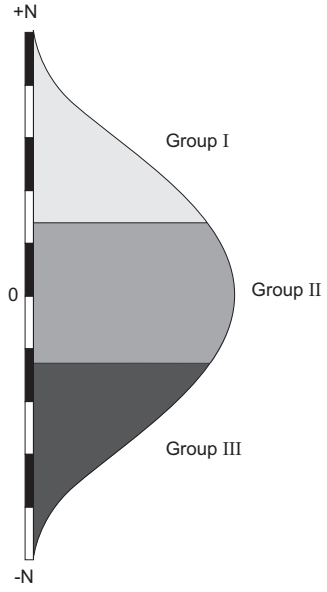
Due to the overall aggregation and to the summation of socio-economic life chances minus the number of socio-economic risk position each individual received a single value in the domain of –N to +N where N stands for the total number of dimensions. For example, in the test example, each respondent could be characterized by a single value in the domain from – 12 to +12.

FIGURE 5.9 **A Data-Transformation for Three Survey Respondents with Twelve Dimensions into the Domain of -1, 0 and +1**



White Squares: Life Chances Gray Squares: Medium Black Squares: Risks
POS_i; Position of respondent i LC: Life chances of i R: Socio-economic risks of i

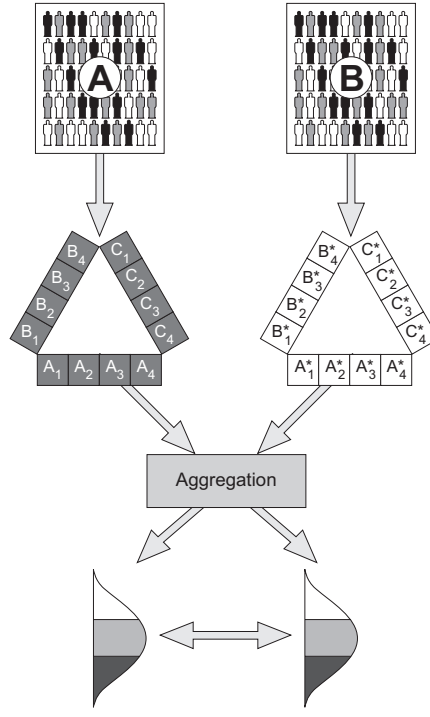
FIGURE 5.10 **The Vertical Morphological Aggregation Procedure**



Due to the aggregation process, the overall outcome is a normal distribution which can be separated, once again, in three groups, namely into G^U, an upper group, G^M, a medium group and G^L, a lower group [see also Figure 5.10].
In terms of comparative analysis with two atomic surveys, the minimal instance for a morphological design with vertical dimensions and scales consists of two morphological constructs MC^A and MC^B which serve as units of comparative analysis [see also Figure 5.11].
Additionally, this type of aggregation offers an interesting way for horizontal stratifications especially around the values of -1, 0 and +1, as can be seen from Figure 5.12.
Horizontally, the value 0 can be reached by twelve medium positions or by six risk-positions and six positions of socio-economic life chances. Again, empirical analyses have shown very interesting discrepancies between groups with a high number of medium positions versus groups with a relatively large number of positions of risks and life chances simultaneously.[11]
Finally, the morphological constructs can serve as units for comparative analysis in a number of ways.

11 For more details, see Müller/Link, 1997.

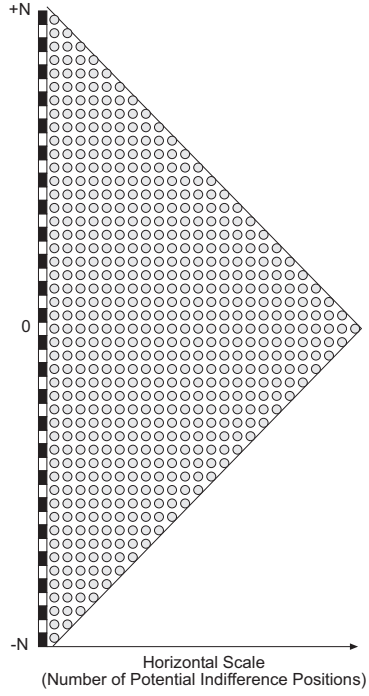
FIGURE 5.11 **Two Vertically Distributed Morphological Constructs A and B**



First, the morphological constructs MC_i can be compared with respect to their socio-economic attributes like gender distribution in each of the groups, their age distribution, their qualification levels, etc. In principle, the entire set of socio-demographic dimensions available across surveys can be used for comparative investigations.

Second, a new platform for comparisons is composed by the dimensions of the shared domains. It will become a fascinating research field in itself to determine the conditions and requirements for using a single dimension from Survey A as a predictor for the corresponding distribution in the survey population B. Differences in the socio-demographic composition between population A and B can be used as weights. The most challenging issue lies in the determination of degrees of semantic homogeneity between the dimensions which have been selected for the shared classification scheme CS. In the case of high semantic homogeneity like in the sets of questions on aspects of work satisfaction or trust in different institutions it might well be that the empirical distributions for the population A, with appropriate weightings, can be used for population B as well.

FIGURE 5.12 **Searching for Different Horizontal Configurations within a Vertical Morphological Construct**



In this sense, a powerful link can be created between atomic datasets which, so far, lay outside the domain of comparative research.

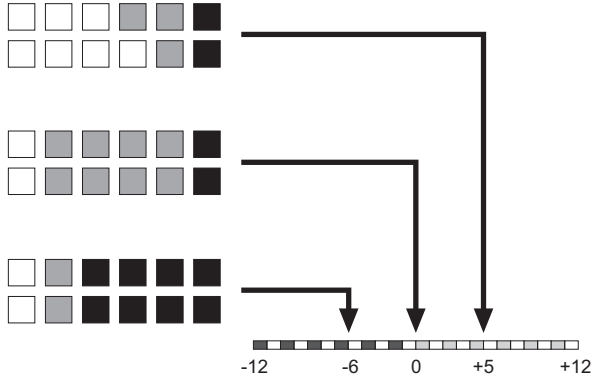
Horizontal Constructs

Morphological constructs can be built as horizontal configurations, too. Horizontal constructs correspond to different life-styles[12] or to different forms of life [Ludwig Wittgenstein] which should not be interpreted in terms of societal inequality but as horizontal stratifications. Take, for example, a classification scheme CS which consists of leisure activities, cultural and artistic preferences and of consumption styles. Moreover, the selected dimensions are composed of the frequency of visiting a theater or an exhibition of contemporary art or the importance of contemporary design in the purchase of consumer durables, etc. Here, the lower and the upper end-points of the selected dimensions

12 For an overview of life-style approaches, see Dangschat/Blasius 1994, Otte, 2004, Richter, 2005, Rössel, 2005 or Schwenk, 1996.

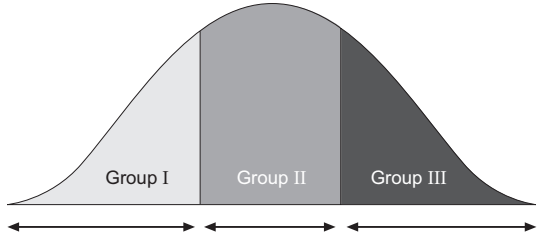
could be interpreted in a number of different ways like traditional versus innovative, simple versus complex, etc. In contrast to the vertical constructs with a homogeneous interpretation in terms of societal inequality, horizontal constructs and horizontal stratifications are much more heterogeneous and one has to be very explicit with respect to the classification scheme CS and the interpretation for the selected dimensions.
Figure 5.13 and Figure 5.14 exhibit the aggregation process using horizontal constructs.

FIGURE 5.13 **A Transformation of Three Data-Sets with Twelve Dimensions into a Horizontal Life-Style Scale from -12 to +12**



Quite obviously, horizontal constructs and horizontal group stratifications become the new units of comparative analysis where major comparative issues lie, once again, in the socio-demographic group composition of MC^A and MC^B and in the weighting and adjustments procedures for the comparability in the dimensions of the shared domains.

FIGURE 5.14 **A Normally Distributed Aggregated Morphological Construct on Socio-Economic Life-Styles**



Non-Linear Scales

So far, the underlying scales were linear and discrete. But Table 5.5 shows that a wide variety of scales could be used for the formation and aggregation procedures.

TABLE 5.5 **Different Types of Scales in the Morphological Approach**

	Linear	Non-Linear
Discrete	Type I	Type II
Continuous	Type III	Type IV

Overall life satisfaction, for example, if measured on a scale between zero and ten exhibits only a small number of respondents with values of five and smaller and, once again, a very small number in the highest category of ten. It is questionable whether the distance between 9 and 10 is the same as between, say, 6 and 7 or 0 and 1. Here, non-linear forms of scaling of Type II could be used as a substitute. In other instances, logarithmic scales could turn out as a useful way for scaling, especially in cases where the dimensions are scaled according to large quantities like the amount of household income, square meters for housing, or years spent in of education, etc.

Non-linear scales could give rise to wild vertical or horizontal constructs as well where the separations for different groups are not made on the basis of the overall population distribution, but on the scale-values, with very few instances in the upper range, a relatively small amount of cases in the middle range and the great majority in the lower group.

In this way, a wide variety of procedures – vertical, horizontal, different types of scales – become available for obtaining the morphological constructs MC_i.

Designs for Morphological Comparisons

Morphological constructs, if produced in a homogeneous and consistent manner for a number of different atomic surveys, become the new units of comparative analysis. Most importantly, a large number of different research designs can be created on the basis of morphological constructs as the subsequent explorations will demonstrate.

The first morphological design builds comparisons across time within a single region, using a set of different surveys $\{S_{i,t}\}$ where t lies in the interval from t_0, the initial period, to t_k, the final period. This design is particularly useful for the creation of time series on vertical formations like risk groups or on horizontal strata like different life style groups. This design is particularly relevant where only a small number of identical surveys is available within a single region and the available survey replications are many years apart from one another. Here, a number of alternative surveys for each of the missing years could be selected which could fill at least partially the gaps between the missing years.

The design for a single unit across time requires the usual steps in the morphological approach, namely the specification of an appropriate set of common or shared domains, the formation of dimensions and their aggregation along vertical or horizontal scales. In this way, time-series on the development of socio-economic risk groups, for example, can be created and can be analyzed in depth with respect to their changing socio-demographic composition, etc. Moreover, these time series can be compared with time series which result from a focus on the available identical surveys only and which use linear extrapolations for the missing years.

The second morphological research design creates comparisons with a larger number of spatial units, be it cities, regions or countries, for a single point in time. Here, different surveys with a significant number of shared or common domains are to be selected, first, and a classification scheme CS must be constructed. Then, the different formation and aggregation steps have to be performed, dependent on the overall comparative research interest, on the classification scheme CS and on the interpretation of the selected dimensions.

This instance is of particular interest in the case of cities and of sub-national regions which over the last years have accumulated a large number of atomic surveys which have been designed with very little consideration of comparative research interests. Here, the morphological approach offers a valuable instrument to link these atomic surveys and to create new units of comparison, either in vertical or in horizontal forms.

Finally, the third morphological research design is aimed towards comparisons with an increasing number of spatial units and time points. This approach is the most demanding one and requires a large number of atomic surveys and

a careful specification of a common classification scheme CS. However, the potential gains of this design, once it has been successfully implemented, are unusually high since it leads to comparisons of, say, socio-economic risk groups across a number of spatial units and across time.
Figure 5.15 summarizes the different research designs within the morphological perspective.

FIGURE 5.15 **The N x T Scope for Morphological Comparisons**

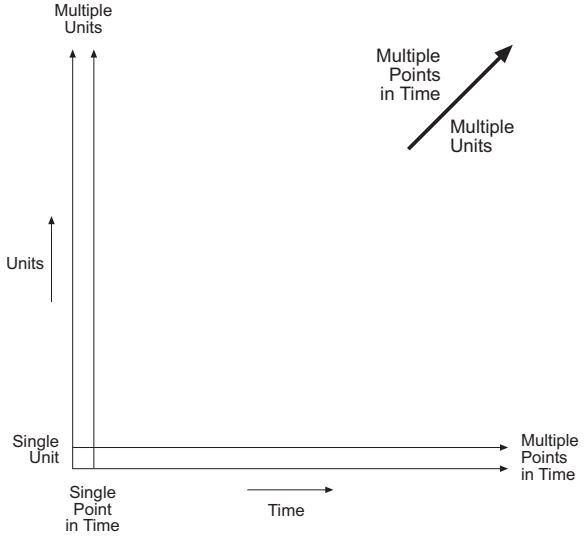
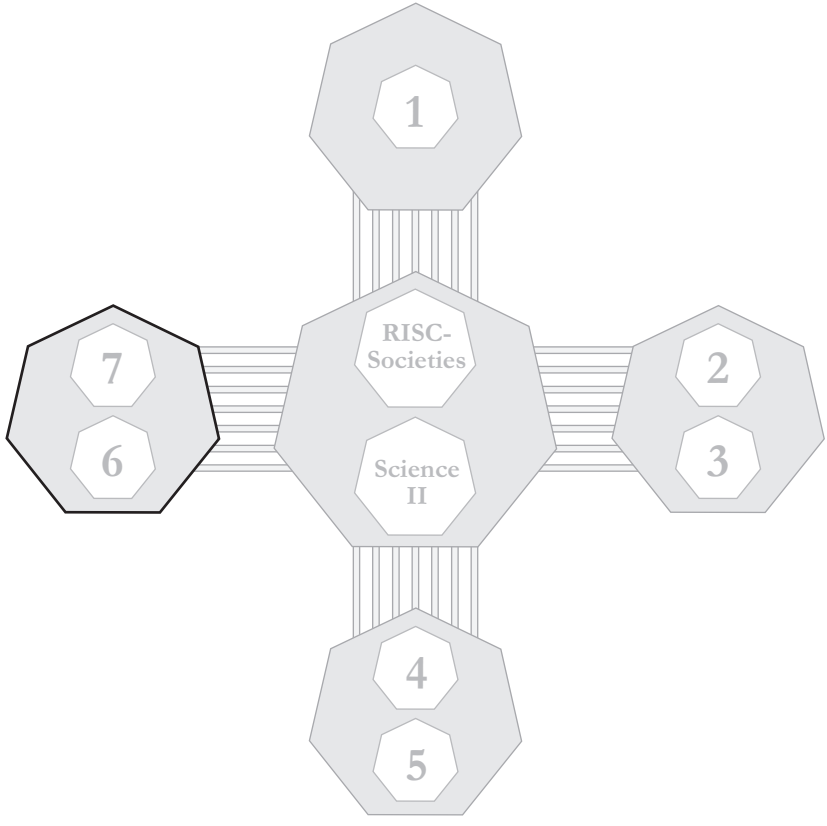


Figure 5.15 can be easily divided into four quadrants which correspond to different designs laid out so far. The first quadrant in the lower left area is occupied, essentially, by the test design of the morphological approach where one operates with a single unit, with identical populations and with a single point in time. The second quadrant in the lower right side is occupied by the design with single spatial units and multiple points of time. The third quadrant in the upper left side is reserved for the design with multiple units and a single point in time. Finally, the upper right hand quadrant uses multiple units with multiple points in time.

5.7 Further Outlooks

With Figure 5.15 an entirely new terrain for comparative analyses has been opened up which, so far, has not been utilized at all. Moreover, this new area for comparative research can build on the large quantities of data sets which are stored at national data archives for surveys or panels. Thus, the morphological approach should be especially useful for re-vitalizing large amounts of data which have been constantly neglected and ignored as a potential input for comparative research.

Part IV
Social Research within Contemporary RISC-Societies



Introduction to Part IV

The second central concept for this book is the notion of RISC-societies where the acronym RISC stands for rare incidents, strong consequences. Thus, rare incidents or rare events can be classified as the *differentia specifica* for RISC-societies which can be seen, therefore, as a collection of rare events. Typically, these rare events occur by necessity since they are an integral part of an overall distribution which is categorized as power law distribution and which is characterized by a very large number of minor or marginal events and a very small number of rare events. Moreover, each of these rare events is produced by a specific generative mechanism which accounts for the sequence of marginal, major and rare events.

Consequently, the framework of RISC-societies[1] emphasizes a composition of societies in terms of RISC-mechanisms and their corresponding power-law distributions. From an evolutionary point of view three different stages of RISC-societies are distinguished where the latest stage exhibits a coupling of societal and natural RISC-mechanisms. However, the framework of RISC-societies so far is mainly oriented on a macro-level and socio-economic risks from a micro-point of view are not discussed within the available RISC-research program.

The RISC-research program sees itself as a large-scale framework for the evolution of societies.

To be sure, the literature is full of potential candidates for generative mechanisms[2] of societal evolution like, to mention a few, functional differentiations into specific societal sub-domains or systems,[3] knowledge as a new wealth generating factor of production,[4] configurational and structuration dynamics[5], great ideas[6], the Schumpeterian entrepreneurs pursuing their recombinations

1 On the evolutionary framework of modern RISC-societies, see especially Kajfež-Bogataj/Müller/Svetlik/Toš, 2010,

2 Subsequently, the terms generative mechanism or, alternatively, generative engine will be used for the following configuration, namely for a process P and for an ensemble E which can be attributed with the production of P. The ensemble E could be a system, a network or any more complex configuration like a system of systems, a network of networks, a system of systems and networks, etc. In most societal instances, generative mechanisms or engines involve a dual level configuration between a set of micro-actors AMI , dynamically inter-linked within an ensemble E which, through its micro- and macro-dynamics, produces a macro-process PMA.

3 See, *e.g.*, Talcott Parsons, 1951, 1964 and 1994 or Niklas Luhmann, 1984 and 1997.

4 Along the knowledge line, see Daniel Bell, 1979a and 1979b, Peter F. Drucker, 1993, Richard R. Nelson, 1996 or Lester C. Thurow, 1996, 1999 and 2005.

5 See especially Anthony Giddens, 1984, 1991, 2000 and 2009.

6 As a recent example, see Richard Ogle, 2008.

of factors of production or innovations for short,[7] forces of production, revolutionizing both economic sub-structures and societal super-structures,[8] a technologically driven transition from low and medium risk production to high risk production processes with substantial ramification for individual life-courses,[9] urbanization,[10] a small set of crucial variables relevant for long-term sustainability[11] or a permanent interplay between systemic differentiations and life world developments.[12] So far, the problem of rare events remained outside the mainstream discussions on the driving (f)actors for societal development and growth.

Thus, the next steps will introduce the notion of RISC-processes (Rare Incidents, Strong Consequences) within an evolutionary theory landscape and build up a set of crucial components for an evolutionary RISC-based approach to societal unfoldings, differentiations and complexifications.

IV.1 RISC-Processes and RISC-Societies as the Missing Link in the Theories of Societal Evolution

Formally, a RISC-process is characterized by a specific distribution and an underlying distribution function where a very large number of minor or marginal events is linked with a very small number of very large-scale events. RISC-processes occur within societies as well as in their environment. Societal RISC-processes comprise areas like the global finance system with rare occurrences of severe global crises in 1893, 1929, 1987 and 2008 or the current global information and communication networks with a very large number of marginal and local network defects and rare incidents of major failures with widespread and disastrous consequences. Natural RISC-processes in the environment of societies can be found, for example, in earthquakes with very rare instances of

7 On the Schumpeter system, see, for example, Joseph A. Schumpeter, 1934, 1952, 1961, 1975, 1991, W. Brian Arthur, 2009 or Wolfgang Weidlich and Günter Haag, 1983.

8 Under this category fall all Marxist approaches that use the distinction between an economic production ensemble and a collection of societal systems which are strongly influenced by the economic production ensemble and which, in turn, have a limited capacity to influence or control this production ensemble.

9 See, for example, Beck, 1986, 1997, 1998a, 1998b, 2000, 2002 or 2007.

10 On urbanization see, for example, Florida, 2002 or 2005.

11 See, especially, Jarred Diamond with his five driving forces of environmental damages, climate changes, hostile neighbours, loss of trading partners, inappropriate reactions to change. [Diamond, 2005]

12 Of course, Jürgen Habermas is the most relevant source of reference in this area as can be seen from Jürgen Habermas, 1968, 1981 or 1984.

earthquakes with deep impact and catastrophic consequences and a very large number of very weak quakes.

In the words of Didier Sornette, RISC-processes exhibit a wild distribution and can be qualified, thus, as wild processes. In contrast, the bell shaped normal distribution can be described as a mild distribution and the underlying processes, consequently, as mild ones.

> What is the probability that someone has twice your height? Essentially zero! The height, weight and many other variables are distributed with 'mild' probability distribution functions with a well-defined typical value and relatively small variations around it. What is the probability that someone has twice your wealth? The answer of course depends somewhat on your wealth but in general there is a non-vanishing fraction of the population twice, ten times, or even one hundred times wealthier as you are. [Sornette, 2006:104]

Figure IV.1a and IV1b exhibit the typical distributions for RISC-processes, using two different scales (linear, dual logarithmic).

FIGURE IV.1 **Two Distributions of a RISC-Process**

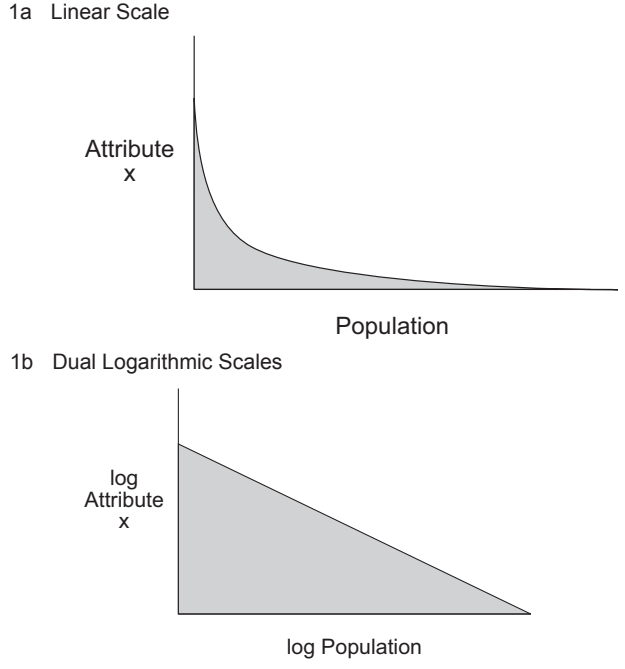


Table IV.1 offers a short overview on the ubiquity of RISC-processes with respect to natural or social domains and with respect to different scientific disciplines involved.

TABLE IV.1 **RISC-Processes Across Different Scientific Disciplines**

RISC-Process/ Scientific Discipline	Distribution-Characteristics	
	Rare Incidents, Strong Consequences	**Very Frequent Incidents, Weak Consequences**
	Natural Science Domains	
Sandpiles/ Physics	very small number of very big avalanches	very large number of very small avalanches
Earthquakes/ Earth sciences	very small number of earthquakes with very strong effects	very large number of earthquakes with very small effects
Solar flares/ Astronomy	very small number of very strong outbursts	very large number of small outbursts
Forest fires/ Environmental sciences	very small number of fires with very large scale consequences	very large number of fires with very local effects
Viruses and epidemics/ Medical Research	very small number of new viruses with very large scale effects	very large number of new viruses with no or marginal effects
Ecological systems/ Environmental sciences or	very small number of breakdowns with very large-scale effects	very large number of vanished species with no marginal effects
The brain/ Neuro-cognitive sciences	very small number of neurons with a very high number of links	very large number of neurons with a very low number of connections
	Social Science Fields	
Language/ Linguistics	very small number of words with a very large number of occurrences (in books, plays, etc.)	very large number of words with a very small number of occurrences (in books, plays, etc.)
Scientific quotations/ Science studies	very small number of articles, quoted with very high frequency or very high impact	large number of articles with no quotations or zero-impact
Scientific breakthroughs/ Science studies	very small number of institutes with a very large number of scientific breakthroughs	very large number of institutes with no scientific breakthroughs
Innovations/ Science-technology society	very small number of innovations with far reaching effects and very strong repercussions strong repercussions	very large number of innovations with near- zero effects or rRe-percussions

Financial markets/ Finance	very small number of crashes with very strong effects	very large number of fluctuations with very small consequences
Wealth and income/ Economics	very small number of very high income or wealth	very large number of persons or households with small or medium income
Power grid/ Energy sciences	very small number of accidents/failures with very widespread consequences	very large number of minor accidents/failures with no or marginal effects
Migration and settlement/ Sociology, demography	very small number of very large cities within a nation	very large number of small settlements

Another interesting aspect of the overall RISC-framework lies in the micro-operators or actors and in their relevant operations which constitute or produce a RISC-process. As can be seen from Table IV.2, operators and operations comprise very heterogeneous sets, ranging from simple operators like a grain of sand to complex ones like firms, organizations or scientific institutes and from simple operations like dropping/falling down to very complex ones like doing research work, publishing or quoting articles. It is important to note that the focus on operators and operations does not assume a reference model of behaviour/action or a set of maximization or minimization rules. Operators and operations can be specified freely and can include trivial and non-trivial operation schemes.[13]

From Tables IV.1 and IV.2 it becomes clear that RISC-processes can be characterized as self-organizing since all the examples in Tables IV.1 or IV.2 have no units for effective steering and control. No malevolent or benevolent controller or demon is in sight for arranging, following Table IV.2, the succession of sand avalanches, the order of magnitude of earthquakes, the severity of forest fires, the diffusion degree of epidemics, the severity in the breakdown of ecological systems, the ordering of neural waves, the frequency order of words, the frequency distribution of scientific quotations, the orchestration of scientific breakthroughs across institutes, the rank-size distribution of firms or, finally, the severity of financial crises.

In other words, RISC-processes are mostly generated through the characteristic micro-operations of their micro-operators although one can identify control units in many of the examples in Table IV.2 where these control units remain well embedded and couched in an overall self-organization ensemble.

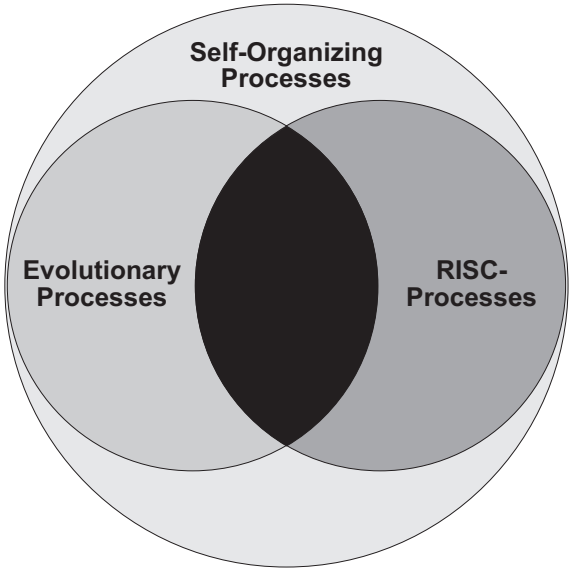
13 For a very interesting non-trivial operation scheme, see especially Soros, 1994, 2008.

TABLE IV.2 **Selected Examples for Micro-Operators and Micro-Operations in the Production of RISC-Processes**

	RISC-Building Blocks	
	RISC Micro-Operators	**RISC Micro-Operations**
Natural Science Domains		
Sandpiles	a single grain of sand	dropping down (on a specific spot)
Earthquakes	a tectonic plate	movements and interactions
Forest Fires	a tree, bush, etc.	inflaming, interactions with neighbouring trees
Viruses and epidemics	a single virus	replication, movement, interactions
Ecological systems	a species	reproduction, interactions
Cognitive systems	a neuron	signaling
Social Science Fields		
Language	a competent language user	bindings of language elements
Scientific quotations	a single scientist	quoting articles
Scientific breakthrougs	a scientific institute	research work and publishing
Innovations	a firm or an organization	changing the production process
Financial Markets	a single trader	selling and buying

Furthermore, while all RISC-processes can be classified as self-organizing, the relations between RISC-processes, self-organization and evolution are complex and can be captured with the help of Figure IV.2. While all evolutionary processes can be characterized as self-organizing, the converse relation does not hold since not all self-organization processes should be qualified, at the same time, as evolutionary ones. As an example, take the case of the dynamics of tectonic plates and the issue of earthquakes which, for obvious reasons, is to be qualified as a non-evolutionary self-organizing process. Similarly, all RISC-processes turn out to be self-organizing ones, but the reverse side does not hold either since not all self-organization processes are distributed in a RISC-like fashion. As an empirical example, take the size distribution in a species which is normally and, thus, mildly distributed. Finally, not all RISC-processes are to be qualified as evolutionary ones and not all evolutionary processes exhibit a RISC-distribution. Thus, Figure IV.2 summarizes the intricate relations between RISC-processes, evolution and self-organization.

FIGURE IV.2 **The Relations between RISC-Processes, Evolutionary Processes and Self-Organization Processes**



Additionally, RISC-processes are produced by generative mechanisms which can be divided into two broad clusters, namely into non-evolutionary and evolutionary mechanisms. In terms of demarcation criteria, an evolutionary mechanism requires an endogenous proliferation of novelty as well as a dualism in the micro-constitution of evolutionary actors. In biology, this dualism has a well-defined meaning,[14] since the observable properties, structures and processes of an organism as micro-actor belong to its phenotype and the sequence of nucleotides, forming the DNA of an organism are qualified as its genotype. [15] Moreover, the evolution of evolution in general exhibits a very illuminating RISC-characteristic as well because innovations or mutations in the history of life exhibit only a very small number of very profound changes and transitions and a very large number of marginal or minimal changes. The following table, compiled by John Maynard Smith and Eörs Szathmáry [1996:5], offers an overview on the very small number of big evolutionary jumps.

14 On this point, see, for example, Marcus W. Feldman 1988:43, John Maynard-Smith, 1974, 1982b or1989.

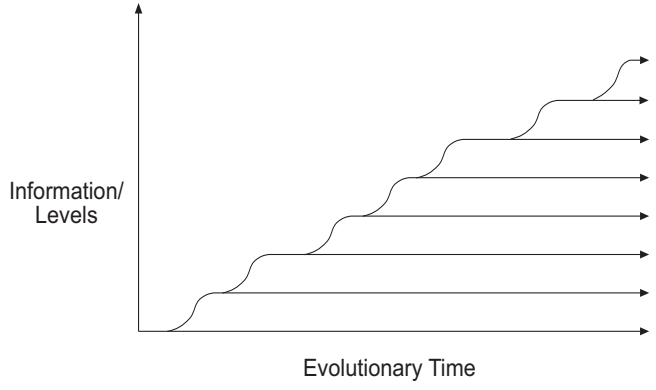
15 Due to this separation of domains, an interesting point could be made that any evolutionary theory from its very outset is co-evolutionary in nature. On this point, see especially Lynn Margulis, 1981, 1993 or 1998.

TABLE IV.3 **Very Large Scale Transitions in Evolutionary Time**

Previous State Transition	Phase	New State
Replicating molecules	→	populations of molecules in compartments
Unlinked replicators	→	chromosomes
RNA as gene and enzyme	→	DNA and protein (genetic code)
Prokaryotes	→	eukaryotes
Asexual clones	→	sexual populations
Protists	→	animals, plants and fungi (cell differentiation)
Solitary individuals	→	colonies
Primate societies	→	human societies (language)

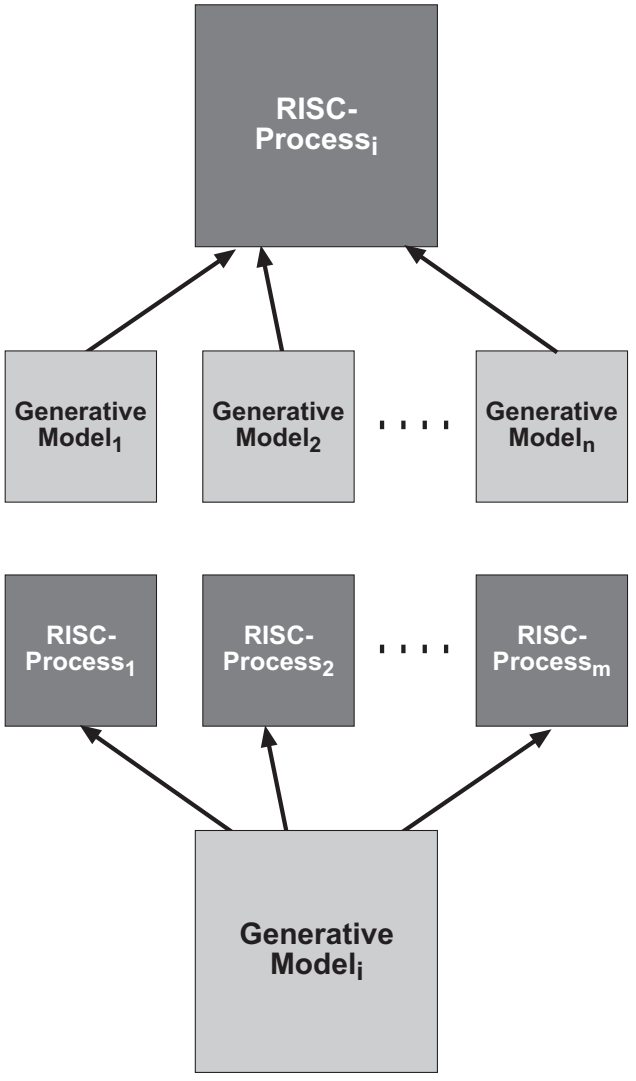
Moreover, it must be added that these new jumps and transitions were accompanied by a widening of the evolutionary landscape and not by a complete substitution, something which can be captured in Figure IV.3.

FIGURE IV.3 **The Pattern of Evolutionary Unfoldings**



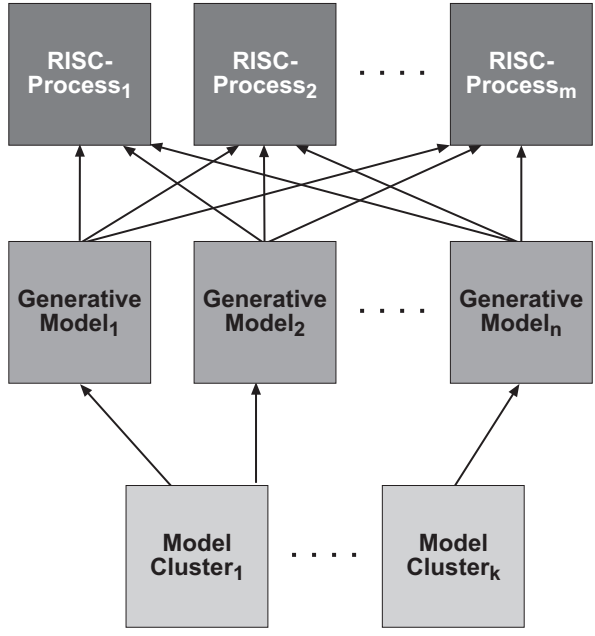
Focusing on the generative mechanisms of RISC-processes, the relations between RISC-processes and generative mechanisms are intricate and can best be described as a dual one:many-relationship. For each RISC-process one usually finds a non-empty set of generative mechanisms which can be used for empirical analysis. Likewise, each generative mechanism can be utilized in several different contexts and, thus, for a variety of different RISC-processes.

FIGURE IV.4 **The One-Many Relationships between RISC-Processes and Generative Mechanisms**



At the current point it must be posed as an open question whether the different generative mechanisms will converge to one or a small number of second-order mechanisms generating generating mechanisms. Thus, Figure IV.5 leaves it open whether the model cluster at the deep-structure will consist of one, two or several independent clusters of generating mechanisms of generating mechanisms.

FIGURE IV.5 **The Convergence towards Small Clusters of RISC-Mechanisms**



At this point it might be interesting to continue with a short discussion on the differences and similarities between the concept of RISC-processes and the focus on rare events with large-scale societal consequences on the one hand with the meanwhile well-recognized notion of risk-societies[16] on the other hand.

At the outset, RISC-societies, *i.e.*, societies with an ensemble of endogenous RISC-processes, differ from post-modern risk-societies in a fundamental manner, since risk-societies, following Ulrich Beck and others,[17] emerged as the latest phase of capitalist development only whereas RISC-societies and their evolution can be traced throughout the entire history of human societies. Figure IV.6 and Table IV.4 offer some guidelines on the special relations between contemporary risk-societies and RISC-societies.

16 As *locus classicus*, see Beck 1986.

17 On risks and risk-research, aside from Ulrich Beck's risk-society, see also John Adams, 1995, Gerhard Banse, 1996, Peter L. Bernstein 1996, Wolfgang Bonß, 1995, Pat Caplan, 2000, Ron S. Dembo and Andrew Freeman, 1998, Mary Douglas, 1992, Kevin Dowd, 2005, Baruch Fischhoff *et al*., 1981, Dan Gardner, 2008, John D. Graham and Jonathan B. Wiener, 1995, Nick Pidgeron, Roger E. Kasperson and Paul Slovic, 2003, James Reason, 1994, Paul Slovic, 2000 or Ben Wisner *et al*. 1994.

FIGURE IV.6 **The Relations between Risk-Societies and RISC-Processes**

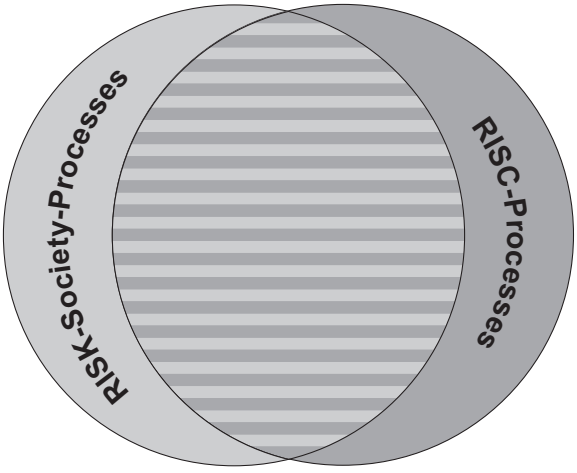


TABLE IV.4 **Shared Domains and Differences between Risk-Societies and RISC-Processes**

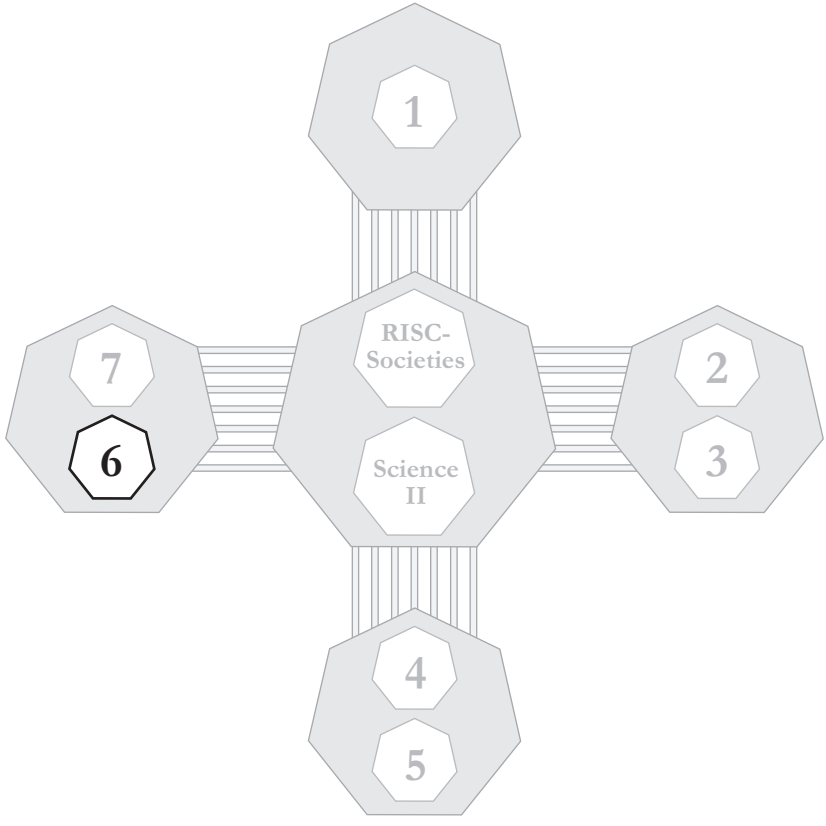
Shared Domains	RISC-Processes Independent of Risk-Societies	Aspects of Risk-Societies without RISC-Processes
Production processes and large-scale Innovations; Relations between production processes and the environment; Size distribution of firms; Income and wealth distribution; Financial markets; Migration and settlements, etc.	solar flares sandpiles tectonic formations brain mechanisms word-frequency distributions; scientific quotations complex networks (preferential attachments), etc.	processes of the individualization of life courses; drifts towards scientific self-reflexivity, etc. individualization of risks from systemic domains to private households or individuals, etc.

IV.2 The Two Articles in Part IV

It must be emphasized at the outset that the two articles are focused on topics which lie outside the domain of RISC-processes and generative RISC-mechanisms. However, these two articles provide crucial information on other relevant aspects of RISC-societies in general.

- The first article deals with a special general stratification pattern for RISC-societies. Here, the generative mechanism is the labour process itself and the central question is whether the labour process leads to a core/periphery differentiation between employed and unemployed persons or to a strong vertical separation already in the domain of employed persons which reflects itself also in marginal groups like unemployed persons. Somewhat surprisingly, the empirical answers to this issue point predominantly to a vertical stratification pattern already in the field of unemployment.
- The second article addresses the issue of social stratification which is based on a large number of indicators like living conditions, level of education, housing environments and the like. While RISC-processes are highly relevant for single dimensions like wealth or income, the second section of Part IV operates on the assumption that multi-dimensional stratification patterns should be analyzed with the help of normal distributions and not with the wild power-law distributions. Consequently, a new multi-dimensional stratification scheme is offered which, however, leads to a classification of three groups which constitute modern RISC-societies, namely groups with multiple life chances (the upper third of the overall distribution), intermediate groups (middle third) and groups with multiple risks (lower third of the distribution).

6 Modern RISC-Societies and Their Basic Organization: Core-Periphery or Vertically Stratified?*



*) Special thanks go to Richard Fuchsbichler from the Austrian Ministry of Labour, Social Affairs and Consumer Protection (BMASK) who was mainly responsible for the funding of this study.

It belongs to the conventional wisdom in social and economic research that inequality has increased substantially over the last three decades both at the national and at the global levels. However, significant increases in equality can have quite different effects, depending on the overall organization of contemporary societies. On the one hand, the societal periphery could increase in size and move further away from a diminishing societal core-domain. On the other hand, societies, due to increasing inequalities, could drift further and further apart in their upper and lower segments which leads to a crumbling of the middle stratum in between.

The present article will address the crucial issue of societal organization which despite its centrality is seldom posed or answered. The article will focus on labor processes as the central societal distributive engine for societal stratifications and will introduce a complex stratification scheme which produces two significantly different data patterns for the two different models of societal organization. Additionally, the article will bring empirical evidence from two recent surveys which were conducted in Slovenia and in Austria and which should be capable to support one of the two basic models of societal organization.

6.1 Two Models for the Basic Organization of Contemporary Societies

Modern societies can be described, in principle, in a variety of ways with respect to their composition in groups, classes, strata, clusters and the like. In accordance with the broad Marx-Weber tradition it will be assumed that labor processes can be considered as the main societal machinery for the distribution of life chances [Max Weber] as well as of socio-economic risks.

Labor Processes → Vertical Stratifications

But labor processes and their distributive capacities can operate in at least two different forms or models.

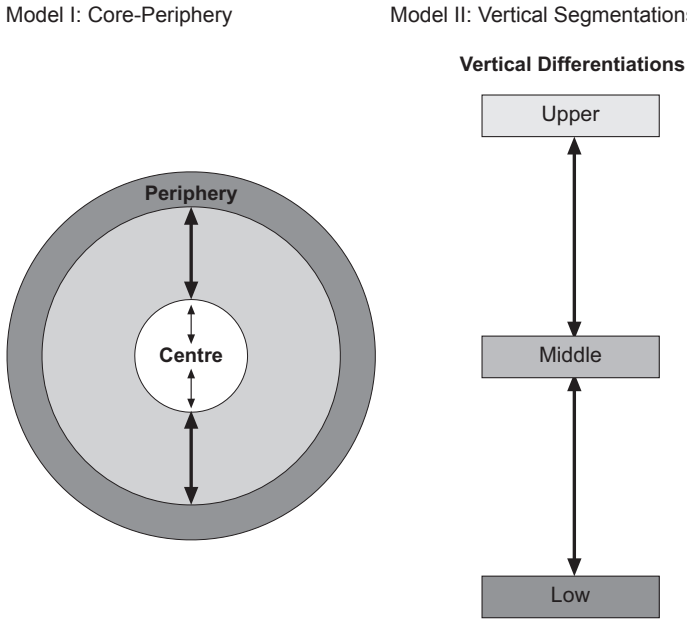
The first model emphasizes the emergence of more and more peripheral groups which, aside from unemployed persons, include marginally employed, peripherally self-employed, temporally employed and other groups which fall outside the realm of fulltime employment. Here, the main emphasis lies on a core-periphery segmentation and on a deep vertical split between the core of fulltime employment and other forms of employment, including unemployment. The center-periphery model presumes a core status for fulltime employment, relatively small differentiations within the core of fulltime employment and large vertical distances to peripheral groups like unemployed or marginally employed persons.

The second model of societal organization assumes that labor processes lead to a strong vertical separation into classes or strata. According to the second model the basic vertical divisions occur already within the domain of fulltime employment and other societal groups follow along these strong vertical divisions within the domain of fulltime employment. Thus, the vertical model postulates relatively large vertical differentiations within the sphere of fulltime employment and similar distributions for other societal groups.

It should be noted that both models have different implications for social policy issues. According to the first model, the main emphasis lies in a transfer of persons and groups from the periphery to the core and, thus, to a widening of the core-segment. Within the second model, the main attention is devoted to the lower strata of fulltime employment and to the lower strata of other societal groups as well as to a gradual reduction between upper and lower strata within the domain of fulltime employment.

Figure 6.1 presents a visual display of these two models of societal organization which stand in the center of the present article.

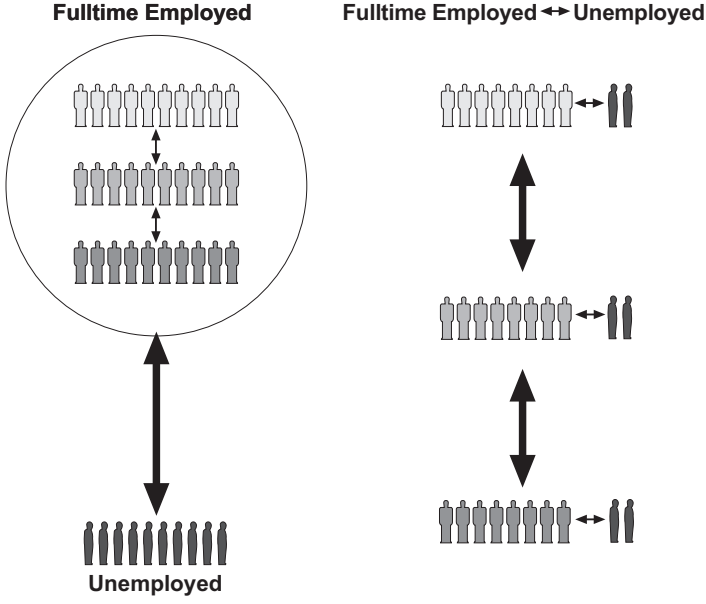
FIGURE 6.1 **Two Models of Societal Organization**



Taking two extreme groups within labor processes as reference examples, namely fulltime employed and unemployed persons, the two models exhibit the following characteristic features.

The core-periphery model places heavy emphasis on the deep split between the core domain of fulltime employment and unemployed groups. Thus, the first model expects strong divisions along the deep chasm between core and periphery. In sharp contrast, the vertical model sees the deep vertical differentiations within the domain of fulltime employment. Consequently, the group of unemployed persons is assumed to be strongly stratified as well and to follow closely the pattern of the fulltime employed group. Figure 6.2 presents these two models and their characteristic features.

FIGURE 6.2 **Two Models of Societal Organization for Fulltime Employed and Unemployed Groups**



At first sight, the core-periphery model looks far more plausible than the homogeneous vertical model. After all, unemployed persons have not only lost their job, but they experience financial restrictions and various forms of social exclusion as a consequence of their job losses. It seems highly implausible to assume that the group of unemployed persons has an upper stratum with relatively low differences to the upper stratum of fulltime employed persons.
Nevertheless, both models go along with significantly different empirical data patterns which largely depend on the current stratifications within the core domain of fulltime employment on the one hand and on the gaps between fulltime employment and marginal forms of employment, including unemployment, on the other hand.

6.2 The Missing Links between Labor Processes, Vertical Stratification and the Multi-Dimensionality of Living Conditions

Surprisingly, the currently available stratification schemes suffer from two characteristic deficits which can be summarized in the following way. Classical stratification schemes in the Marx-Weber tradition which are based on labor processes operate with a very small number of variables which, however, are not able to capture the multi-dimensionality of living conditions. Alternative stratification schemes which usually fall outside the sphere of labor processes emphasize horizontal differentiations and operate largely independent from vertical stratification schemes.

Labor Processes	→	Small Set of Key-Dimensions	→	Irrelevant for Multi-Dimensional Living Conditions
Multi-Dimensional Living Conditions	→	Life Styles	→	Irrelevant for Vertical Stratification Schemes

Within the Marx-Weber tradition, the Marxian frameworks on class formations and vertical stratifications try to account for multi-dimensional living conditions within their overall conceptual schemes. However, the traditional or post-traditional approaches in the Marxian tradition [for a comprehensive summary, see Grusky, 1994] share a fundamental shortcoming due to the clearly under-complex conceptual frameworks for reducing the complexities of current living conditions.[1] Referring to contemporary class-analyses as advanced by Pierre Bourdieu [1982, 1985] or by Eric Olin Wright [1997], the main argument rests basically on too little diversity in the underlying class-concepts, including Bourdieu's habitus formations. In essence, two main-dimensions in the case of Wright (relations to means of production (including power relations) and qualifications (expert/skilled/non-skilled)) or the three Bourdieu dimensions with economic, social and cultural capital do not reach the requisite dimensional variety necessary for mastering the highly heterogeneous life-courses of individuals or households.

Due to the under-critical conceptual apparatus, multi-dimensional living conditions would have to be included into a class-analysis framework as additional components. However, such a strategy runs counter to the conceptual core of class-analysis, especially in the case of Pierre Bourdieu. But for Eric Olin Wright too, the problem of integrating living conditions into class analysis means for

1 For an interesting summary and discussion see *e.g.*, Giddens, 1989:209pp.

him to study the effects of class formations on living conditions in a peculiar way for which Wright uses a seemingly compelling analogy from medical research.

> Class analysis is based on the conviction that class is a pervasive social cause and thus it is worth exploring its ramifications for many social phenomena ... Understood in this way, class analysis is what might be called an 'independent variable' specialty. It is a discipline like endocrinology in medicine. If you are an endocrinologist you are allowed to study a vast array of problems – sexuality, personality, growth, disease processes, etc. – in addition to the internal functioning of the endocrine system ... Endocrinology is monogamous in its explanatory variable – the hormone system – but promiscuous in its dependent variables. [Wright, 1997:1]

Though considerably weaker, this version has the distinctive disadvantage that a large amount of "independent variable specialties" are available, in principle. Take age groups, cohorts, gender, regional differentiations or life-styles, to mention just a few, then one could justify their relevance for socio-economic analysis in Wright's own terms, namely "that age (cohort, gender, life style, region) is a pervasive social cause and thus it is worth exploring its ramifications for many social phenomena." In the end, the socio-economic endocrine system turns out to be itself highly promiscuous.

To conclude, the two most advanced class approaches by Pierre Bourdieu and Erik Olin Wright are by their very structural organization unable to integrate multi-dimensional aspects of current living conditions, including, above all, the aspects of attitudes and self-assessments.

Turning to the shortcomings of the Weberian tradition in their current versions[2], these approaches offer vertical stratification schemes by distinguishing between different classes or status groups. Classes, on the one hand, are defined on the basis of the position and of the interests within a capitalist mode of production which determine, to use a central Weberian term, the life-chances of large groups of individuals. Status-groups, on the other hand, are conceptualized as specific communities, sometimes of an amorphous kind, where the distinctive elements are determined on the basis of a specific social estimation of honor and on particular life-styles which has become another core Weberian notion. Classes and status groups produce, according to Max Weber, different configurations, sometimes very intimately linked, probably more often than not, opposed to each other and at times in aggressive disharmony.

While the conceptual differentiation in Max-Weber's work can be considered as remarkably complex and multi-dimensional, the subsequent empirical research trajectories along Weberian lines suffer from the peculiar fact of being too highly

2 For a summary on the Weberian tradition, see *e.g.*, Blau/Duncan, 1967, Giddens 1973, Hodge, 1981, Parkin, 1979, Sørensen, 1991/1994 or Treiman 1977.

reduced in their conceptual complexities. The wide design spaces for Weberian classes and status groups have been severely under-utilized so far since the index constructions leading to status scales are either based on occupational ratings or on small sub-sets of socio-economic indicators on living conditions or life-styles.

Thus, the Weberian and Post-Weberian traditions have retained their emphasis on vertical stratification, but apparently at the expense of restricting the multi-dimensionality of life styles and the social order to a small number of key variables only. Consequently, the available Weberian or Post-Weberian platforms simply have become too narrow for linking them with additional domains like culture, risks or health-conditions.

Turning to stratification schemes outside the Marx-Weber tradition, one finds a new societal perspective which emphasizes risks and risk formations, and which rests largely on Ulrich Beck's "Risk Society" [Beck, 1986].[3] Ulrich Beck in his national Post-Chernobyl bestseller uses the pattern of a phase transition between two stages in modernity as a broad platform in which the notion of risks receives its proper attention. The initial stage is characterized, not surprisingly, as industrial or traditional capitalism. Using dialectical metaphors, Beck argues that industrial capitalism has an in-built logic which transcends its own boundaries and identities and which produces, thus, an endogenous drift towards a qualitatively different stage. Thus, driven by inner necessities, industrial capitalism is superseded by a new phase which has been labeled as risk society. Put briefly, risk societies have become the current stage in the capitalist evolution and a generalized logic of risk-production, in contrast to the logic of wealth production of the industrial phase, stands at its center. This new logic of risk production manifests itself most vividly in the effects of high technology production and services which constitute, aside from their undeniable advantages in terms of volume, price, diversity or quality, a permanent threat to individuals or households. Again using dialectical metaphors of inner necessities, production and services under the new risk regime generate, by inner necessity, a large number of pollutants or the potential of very large scale-accidents within very large scale technologies, highlighted by the two major accidents in atomic power plants in Three Mile Island and Chernobyl. Due to the complexities of production and service processes or of the energy and information substructures

3 For an interesting historical as well as contemporary summary on the concept of risk, see, aside from the Beck, 1986/1989/1993/1997/1998a/1998b/2000 or Beck/Giddens/Lash, 1994 also Bonß, 1995, for special versions see Baecker, 1988, Banse/Bechmann, 1996 or Japp, 2000.

involved, frequent occurrences of fatal accidents[4] and high tech-disasters become the order of the risk-day within a risk-society environment.

It would have been fascinating to integrate socio-economic risks into this profile of contemporary risk societies. In fact, Beck devotes the second part of his book on the growing individualization of life courses under the new regime of risk-societies. But despite the phase transition towards risk societies, socio-economic risks have not found their way into the Part II of the book. Rather, for Beck the question of social inequality and vertical stratification seems to undergo a transformation itself, namely a secular change from vertical to horizontal forms. At various points, Beck gives the impression that social inequalities belong basically to the domain in which they originated in the first place, namely to the phase of industrial capitalism. Most notably in the phrase "Poverty is hierarchical, smog is democratic" [Beck, 1986:51], Beck seems to suggest that vertical societal inequalities become more and more marginalized and de-centered whereas new horizontal ways of inequality like regional, local inequalities or group-specific risks which affect, for example, all employees in a special high-technology plant or even in an entire cluster alike, are gradually occupying the central positions within contemporary risk societies.

Similarly, current multi-dimensional approaches on living conditions [see especially Schulze, 1992] have become, by and large, horizontally stratified, loosing their vertical dimensions in the course if widening the relevant socio-economic dimensions. Thus, current life-style frameworks, while focusing on a broad range of living conditions and socio-cultural practices, have become by and large unable to arrange the resulting life style formations into a vertical ordering on different life styles

The subsequent discussion will have its focus mainly on Gerhard Schulze's book on „Erlebnisgesellschaft", 1992. Here, a representative sample of roughly 1000 persons from the city of Nuremberg has been selected and a large number of questions on cultural practices or on daily routines of information gathering have been asked. In the theoretical core of Schulze's work lies a universal social grammar [*Ibid*:243pp.] which, at least according to Schulze, is capable to detect and identify hidden homologies between inhomogeneous and seemingly contradictory or incoherent domains. At various places, Schulze speaks of a latent pattern which connects diverse surface appearances or of a universal pattern in the relation between actors and their environment or worlds [Schulze, 1992:36].

4 At various points, Beck seems to suggest, too, that the metamorphosis of modernity I into its self-reflexive stage of modernity II brings about a shift in Charles Perrow's, 1984 two dimensional diagram (with coupling and complexity as its vertical and horizontal dimensions) to the quadrant of dense coupling/high complexity.

Essentially, Schulze uses age and education as the basic socio-demographic dimensions in order to differentiate between five different milieus or lifestyles, namely between an entertainment-milieu (age low, education low), a harmonious milieu (age high, education low), a self-realization-milieu (age low, education high), an integrative milieu (age high, education medium) and a distinctive high-level milieu (age high, education high). Each of these five milieus is characterized by specific recombinations between dominant forms of style which are summarized under the headings of high culture, trivial culture or excitement/event culture.

Within the present context, the most important critical finding lies in the fact that the new life-style typologies which have been able to integrate large proportions of everyday routines and cultural practices, widely conceived, have lost the vertical dimension of inequalities almost completely. While these five life-styles can be arranged within a two-dimensional field, consisting of degrees of education on the one hand and age on the other hand, vertical distances and vertical inequalities have been largely reduced and replaced by horizontal disparities of self-contained clusters of socio-cultural practices. Additionally, classical problems of upward and downward mobility are substituted by new rites of passage, with age being a key determinant to change from one lifestyle-cluster to the next. Furthermore, problems of inter-generational inequality and mobility seem to have been reduced to marginal issues since the universal grammar sub specie Schulze reproduces these different clusters in the way it is supposed to reproduce them, namely universally. Finally, the potential space for socio-economic policies has been greatly reduced, too, since these self-sufficient clusters do not lend themselves easily to intervention or compensation.

Apparently, Schulze's analysis and many other life-style studies[5] are subject to a critical trade-off which can be summarized in the following manner. Relying on a small number of objective inequality indicators like income, education or status looses its linkages with overall self-assessments rapidly since many aspects and dimensions of cultural and everyday practices have not been included. Taking the diversified set of habits and routines in areas like information, housing, arts and culture, media or fashion into account, the resulting life styles have lost their connections with vertical dimensions and inequalities almost completely.

5 For other life-style studies, see for example Spellerberg, 1996, Schneider/Spellerberg, 1999 or for an interesting summary Matjan, 1998.

6.3 The Stratification Step: Constructing a Complex Configuration of Living Conditions

At this point the article is apparently bound to end with the uneasy conclusion that general problems of societal organization and differentiation cannot be pursued analytically as long as labor processes are assumed as the central engine for vertical societal stratifications. However, the significant weaknesses of available stratification schemes can also lead to an alternative approach which operates in two steps. In a first step a new vertical stratification scheme is introduced which accounts for the multi-dimensionality of living conditions and which produces, contrary to the horizontal life style models, a vertical stratification pattern for different societal groups. The second step focuses then on the research design itself and will be introduced in the subsequent section.
Turning to the new stratification scheme, the following result must be obtained:

Multi-Dimensional Living Conditions	→	Forms of Life	→	Vertical Stratification Scheme

Recently two surveys were conducted in Slovenia and in Austria which tries to integrate a large number of socio-economic dimensions on living conditions. The survey contained three major areas with three distinct sub-domains which can be classified as

- Life worlds (work, housing, social capital)
- Resources (income, qualifications, consumption)
- Cognitive-emotional states (perspectives on the future, self attributions, critical life vents).

For each of the domains and sub-domains a varying number of dimensions has been selected which were could be interpreted in terms of life chances or socio-economic risks. In particular, high personal income can be associated with life chances whereas relatively low incomes constitute a specific socio-economic risk. Approximately fifty different dimensions were used in order to arrive at a complex vertical stratification scheme.
Figure 6.3 shows the complex overall configurations with the three main domains, the three subdomains in each of the main areas as well as the number of dimensions in each sub-domain.
For each respondent in the survey an overall index was calculated which differed from 0 to 1. This overall index was sequentially computed by starting with the individual dimensions in each of the sub-domain and by finding an aggregate value for each of the three major areas. Finally, the three domain-specific indices were aggregated to an overall index for each of the survey respondents. Dependent

on the overall distribution of these indices a group-specific separation has been undertaken between

- an upper stratum (upper 33% of the population distribution, group with multiple life chances)
- an intermediate segment (middle group with 33% of the population)
- a lower segment (lower 33% of the population distribution, group with multiple socio-economic risks).[6]

FIGURE 6.3 **A Complex Stratification Scheme for the Multi-Dimensionality of Living Conditions**

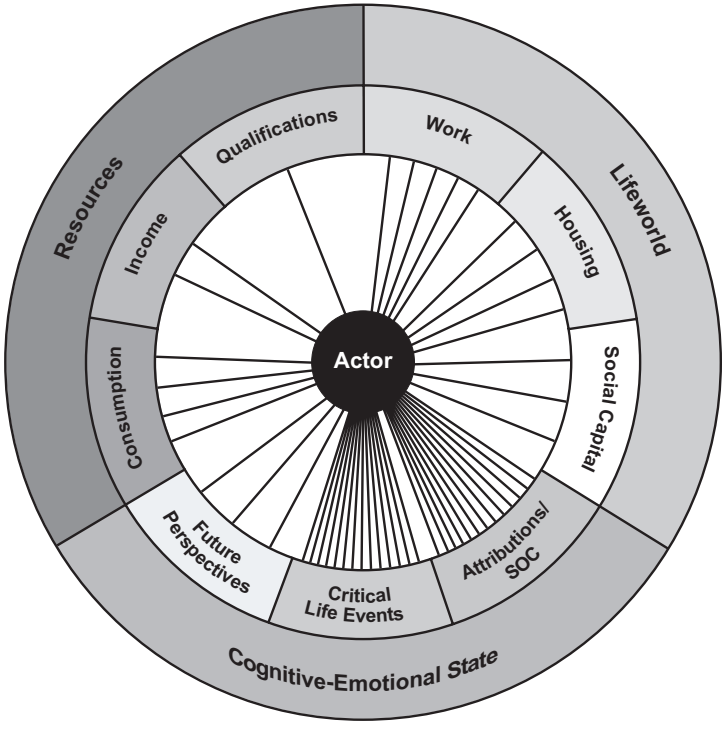
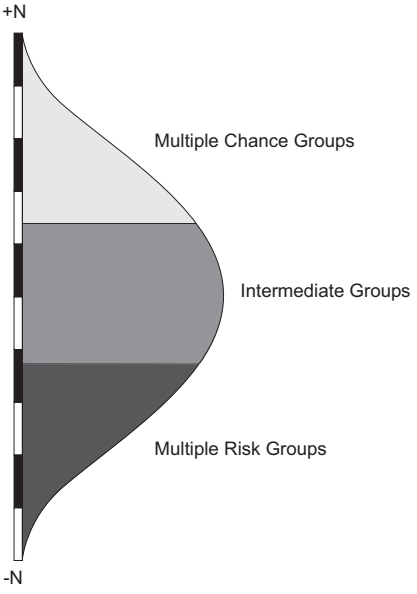


Figure 6.4 shows the new vertical stratification scheme which is based on roughly fifty dimensions across the three main survey domains of resources, cognitive-emotional states and life worlds.

6 For more details, see Toš/Müller, 2005, Toš/Müller, 2009 or Müller/Nemeth/Toš, 2002.

FIGURE 6.4 **A Multi-Dimensional Stratification Scheme**



6.4 The Design-Step: Focusing on Groups of Fulltime Employed and Unemployed Persons, Their Multi-Dimensional Living Conditions and Their Stratification Patterns

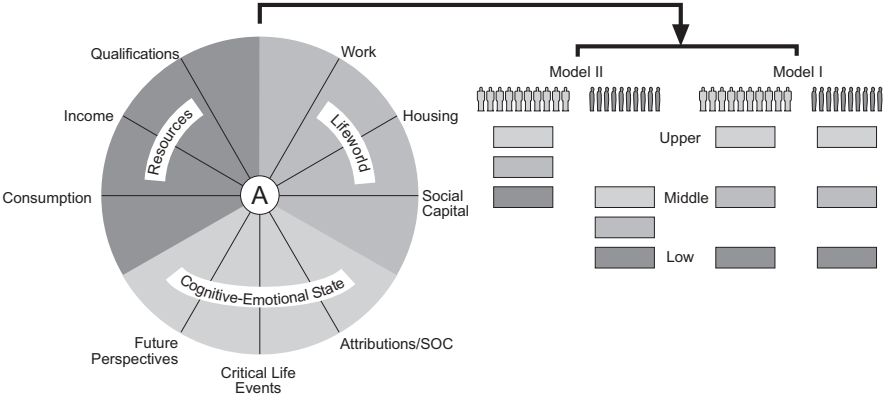
While the first step led to a new stratification scheme which was sufficiently diversified for a broad range of domains and dimensions of living conditions the second step operates with the research design itself which has its focus on two extreme groups with respect to their position in the labor process, namely on fulltime employed persons and on unemployed persons only.

Two Extreme Groups in the Labor Prvocess	→	Multi-Dimensional Vertical Stratification for Each Group	→	Different Data Patterns

In fact, the two surveys in Slovenia and in Austria were focused on samples of 400 fulltime employed and 400 unemployed persons. The survey questions and items were formulated in an identical manner for both extreme groups and the multi-dimensional vertical stratification scheme was applied to both groups respectively. With the help of the multi-dimensional vertical stratification scheme for both extreme groups it should be possible to produce a data pattern which either follows the core-periphery model or the homogeneous vertical stratification model.

Figure 6.5 presents an overview on different data configurations for these two models. The core-periphery model should exhibits deep vertical distances between the groups of fulltime employed and unemployed persons and weaker differences within the three segments of each group. The vertical stratification model should produce strong vertical differences within each group and relatively small horizontal differences between the different segments in each group. Phrased differently, the core-periphery model should show significant differences between the two groups whereas the homogeneous vertical model should emphasize the differences within each of the two extreme groups in the labor process.

FIGURE 6.5 **Two Different Stratification Patterns for Contemporary Societies**



In this manner the two models of societal stratification can be expressed in terms of different data patterns.

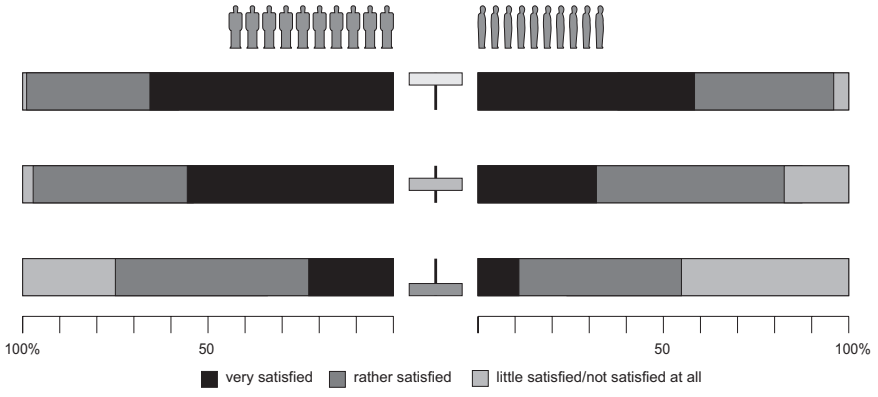
6.5 The Main Results from a Parallel Survey in Slovenia and Austria

Turning to the results of the surveys in Slovenia and in Austria more specifically the first general finding was that the general data patterns were highly similar for both countries. In both countries the vertical differences within each of the two extreme groups were by far stronger than the horizontal differences between the two groups.

Subsequently, several typical empirical results can be presented, starting with one of the central dimensions in survey research, namely with overall life satisfaction. As can be seen from Figures 6.6 and 6.7, the horizontal differences between the three groups with multiple life chances, the middle group and the group with multiple socio-economic risks are considerably smaller than the differentiation

within the fulltime employed and the unemployed persons. Interestingly, these differences turn out to be smaller in the Slovenian case, but even here the vertical differences within the unemployed and fulltime employed persons exceed the horizontal differences.

FIGURE 6.6 **Overall Life Satisfaction (Austria)**



Left side: Fulltime employed persons
Right side: Unemployed persons

Upper row: Group with Multiple life chances
Middle row: Middle Stratum
Lower row: Group with Socio-Economic Risks

FIGURE 6.7 **Overall Life Satisfaction (Slovenia)**

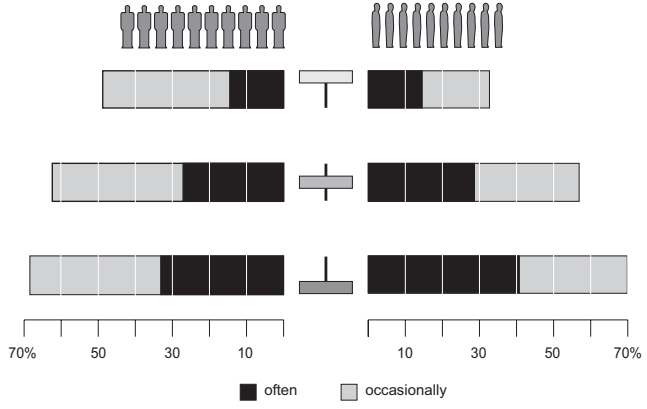
Left side: Fulltime employed persons
Right side: Unemployed persons

Upper row: Group with Multiple life chances
Middle row: Middle Stratum
Lower row: Group with Socio-Economic Risks

Apparently, even the central domain of life satisfaction differs significantly within the group of unemployed persons. Likewise, contrary to the assumptions

of the modern economic theory of happiness, the multiple risk group, despite its fulltime employment status, expresses significantly lower levels of life satisfaction than the upper or the medium stratum of unemployed persons.

FIGURE 6.8 **Stress in Everyday Life (Slovenia)**



Left side: Fulltime employed persons
Right side: Unemployed persons

Upper row: Group with Multiple life chances
Middle row: Middle Stratum
Lower row: Group with Socio-Economic Risks

Figure 6.8 presents a particularly revealing example, namely the feeling of stress across all six groups in Slovenia. The first remarkable result lies in the overall distribution with relatively low stress values for the upper strata and high values for the lower strata. Equally astonishing is the finding that the horizontal differences between fulltime and unemployed persons are almost negligible.

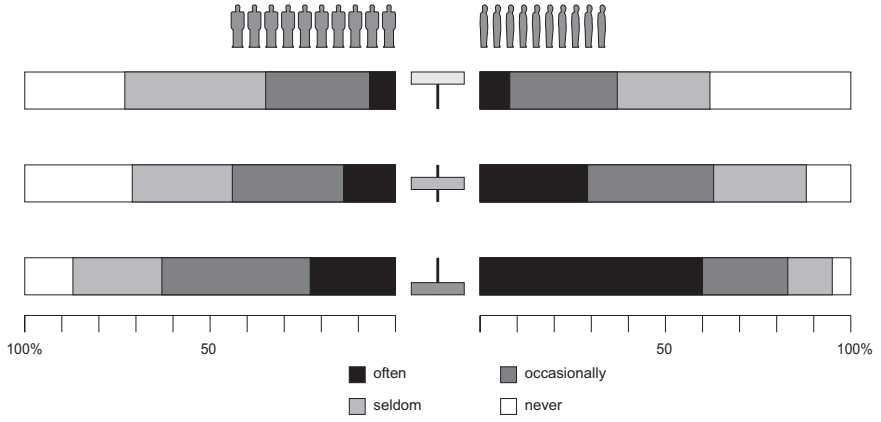
Figure 6.9 exhibits a typical result from a set of items on internal and external-attributions. Again, the vertical differences between the three groups are striking, compared to the relatively small horizontal differences.

Patterns like these were found practically across all major domains, sub-domains and dimensions. For example, a high satisfaction with one's former or current work produced in the Slovenian case the following values for the three groups of fulltime employed persons: 51% for the upper group with multiple life chances, 24% for the middle group and 20% for the group with multiple socio-economic risk. The corresponding values for the group of unemployed persons was 41% in the upper stratum, 36% in the middle group and 19% in the group with multiple socio-economic risks.

In fact, most of the sub-domains with their different dimensions gave support to the homogeneous vertical stratification model and rejected the core-periphery model. However, the big exception could be found in all the dimensions which

were directly linked with the income of persons. In the income-domain, but only in the income area, one could find support for the core-periphery model with deep horizontal differences between the corresponding strata of fulltime employed and unemployed persons.

FIGURE 6.9 **"Times are bad" (Austria)**



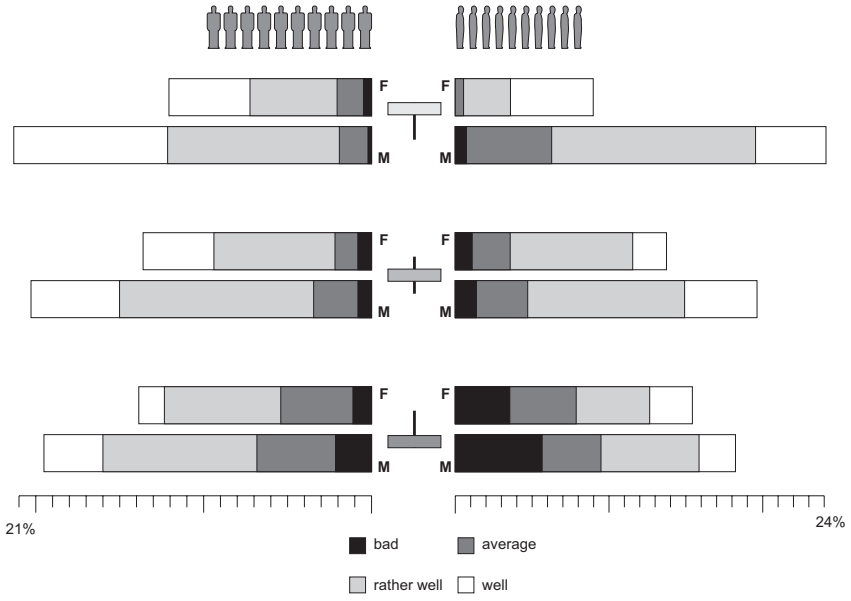
Left side: Fulltime employed persons
Right side: Unemployed persons

Upper row: Group with Multiple life chances
Middle row: Middle Stratum
Lower row: Group with Socio-Economic Risks

6.6 Closing the Gap from Social to Medical Research: Inequality, Stress and Health-Conditions

Another interesting general result could be found both in Slovenia and in Austria alike. In the health domain one can see significant differences between the lower strata of fulltime-employed and unemployed persons. The values for the multiple risk group of the unemployed persons were clearly worse than their counterparts from the multiple risk group of fulltime employed persons.
Figure 6.10 shows the self-reported state of health in Austria where one can see a strong difference between the two lower multiple risk groups especially with respect to bad health conditions.
This result can also be supported by Figure 6.11 which shows the distribution for different numbers of ailments. Again, the lower strata of multiple risk groups differ significantly since more than 30% of the unemployed group reports ten and mire ailments, compared to 13% in the multiple risk group of fulltime employed persons.

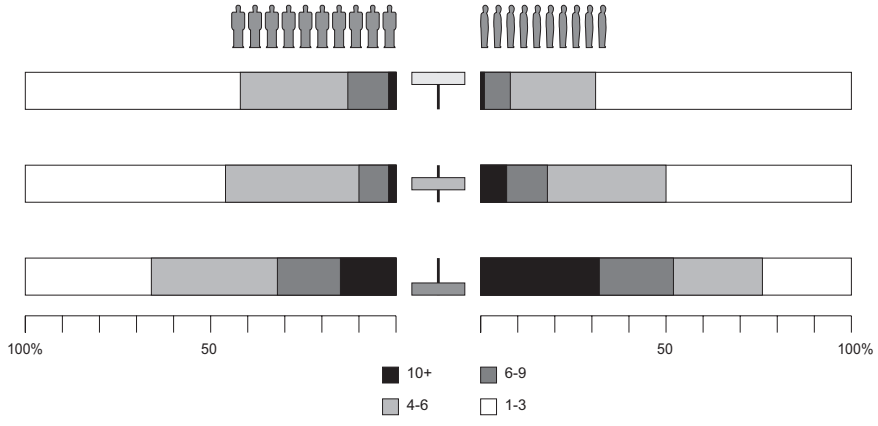
FIGURE 6.10 **General State of Health (Austria)**



Left side: Fulltime employed persons
Right side: Unemployed persons
F: Female M: Male

Upper row: Group with Multiple life chances
Middle row: Middle Stratum
Lower row: Group with Socio-Economic Risks

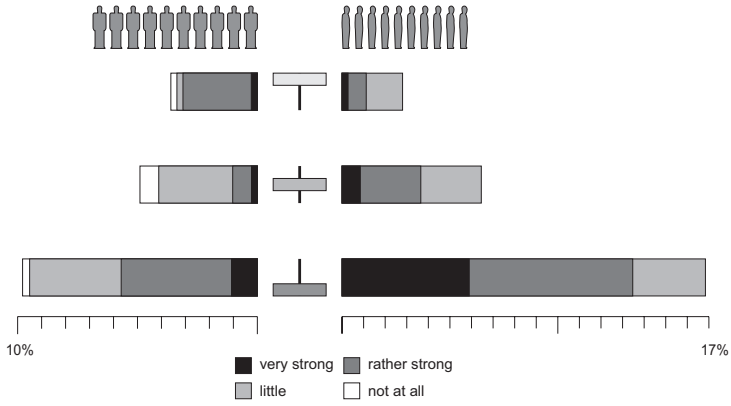
FIGURE 6.11 **Number of Ailments (Austria)**



Left side: Fulltime employed persons
Right side: Unemployed persons

Upper row: Group with Multiple life chances
Middle row: Middle Stratum
Lower row: Group with Socio-Economic Risks

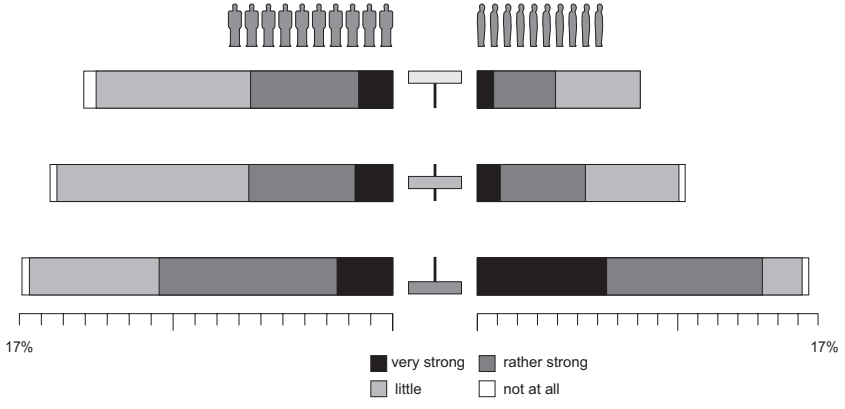
FIGURE 6.12 **Feeling Nervous (Austria)**



Left side: Fulltime employed persons
Right side: Unemployed persons

Upper row: Group with Multiple life chances
Middle row: Middle Stratum
Lower row: Group with Socio-Economic Risks

FIGURE 6.13 **Feeling Tired (Austria)**



Left side: Fulltime employed persons
Right side: Unemployed persons

Upper row: Group with Multiple life chances
Middle row: Middle Stratum
Lower row: Group with Socio-Economic Risks

The same result prevails in two rather psychological ailments, namely for feeling nervous and feeling tired as expressed in Figures 6.12 and 6.13.
These findings in the health domain suggest a new bridge which leads from social survey analysis to the areas of bio-medical health research. Through this bridge one can move from various domains of vertical socio-economic dimensions,

from socio-economic inequalities, from vertical stratification as well as the self-reported health status to a deeper language level and to a homogeneous vocabulary of stressors and of neuro-immunological processes. Initially, it is useful to start with a taxonomy of different types of stressors which can be found within the relevant body of literature [see, for example, Cooper, 1996, Horwitz/Scheid, 1999, or Sarafino, 2002]. Here, one is confronted with a heterogeneous set, comprised of sensory stressors (strong light, noise, sensory deprivation, etc.), block-stressors (preventing essential routines like eating, sleeping, social contacts, etc.), achievement stressors (tests, examinations, work-tasks, but also monotony at work, etc.), social stressors (large crowd of people, loneliness, isolation, etc.), environmental stressors (noise, pollution, toxic materials, etc.), decision-based stressors (goal conflicts, quick decisions, but also lack of decision-making, etc.) or future-based stressors (fear, anxiety of the future, etc.).

Seemingly, the heterogeneity of stressors is accompanied by a heterogeneity of stress reactions which vary in time (minutes, hours, days, weeks ...), in intensity or in emotions, associated with each stress reaction. Nevertheless, common to all these stress reactions is an attempt to reduce the discrepancy between the effects of stressors and internal target values. Moreover, all stress reactions involve the activation of the hypothalamus-pituitary-adrenal axis and produce comparatively high quantities of endocrine hormones, particularly corticosteroids, with cortisol as the most important one, and catecholamines. Likewise, all physiological reactions to stress manifest themselves in a broad range of measurable changes like a higher production of stress hormones, higher degrees of blood pressure, heart rate, respiration rate, galvanic skin responses or in larger amounts of free fat acids. The general pattern of stress responses possesses at least two main connections to the domain of sickness and ailments, namely through their direct effects on the cardiovascular system on the one hand and through their immediate impact on the immune system on the other hand.

With the short background on stress-research, it appears plausible to create a bridge from the current findings on the status of health to special classes of stressors like social, environmental, future-based or decision-based stressors. In order to move along this bridge, one needs a special subset of survey dimensions which are linked to societal inequality. In particular, the lower segments of dimensions like degree of education, income, but also working conditions, work autonomy or environmental constraints like pollution or traffic noise can be seen as external determinants of societal inequalities. From this perspective, the following subset-relation can be put forward:

$$\text{Lower Segments } S^{L} \text{ of Dimensions of Societal Inequalities} \subset \text{Stressors}$$

It is quite obvious that this subset-relationship needs a very detailed justification

which cannot be provided within the framework of the present article. However, five main arguments can be given, however, which should offer some plausibility for a sub-set relation between S^L, the lowest decile, lowest quarter up to the lower third in the different dimensions of societal inequalities and stressors.

- First, S^L-positions, which can be specified in a wide array of living and working conditions, are characterized, *inter alia*, by their relative permanence. Thus, many of the S^L–parts of socio-economic inequality dimensions like low, insufficient or deteriorating incomes or low degrees of qualifications are to be classified as long-lasting or, like in the case of low qualifications, as (nearly) permanent. Thus, being positioned in the S^L–parts normally acts as a continuous stressor and not as a single, rare or isolated occurrence.
- Second, there exists a remarkable symmetry between the language of societal inequality, in particular the focus on the lower parts of a distribution on the one hand and the physiological stress language on the other hand. In both cases, no equivalences can be found for the upper side of the inequality dimensions. Feeling unsafe in the public sphere does have a corollary in terms of stressors. But feeling very safe in the public domain does not constitute an alternative source for stressors. Likewise, a noisy environment at the workplace or at home implies at the same time an environmental stressor whereas a quiet atmosphere at work or at home cannot be associated with a different group of stressors. Thus, the lower segments of the distribution of inequality dimensions can be linked to stressors, whereas upper segments in the distribution imply, by and large, the absence of stressors.
- Third, the distribution-dependent specification for thresholds for the S^L–parts provides additional support for the subset relationship between the S^L–areas of dimensions of societal inequality and stressors. Since the majority of the population is, by definitional necessity, above the S^L-threshold, individual actors, falling in a specific S^L–part, perceive themselves usually relatively deprived. Thus, the available literature on the importance of relative deprivation [Olson/Hafer, 1996 or Walker/Pettigrew, 1984] can be added as further evidence for the proposed S^L–part-stress linkages.
- Fourth, while stress reactions vary in length, intensity and emotional involvement, the basic physiological reaction patterns are unspecific with respect to the sources of stress. In other words, one does not find a "bad boss-stress reaction", confined to a specific region in the neuro-immune system in contrast to a "loud noise-stress reaction", affecting other parts of the neuro-immune system. Thus, a multi-dimensional array of essential living conditions across the contexts or settings of actors and across their cognitive-emotional organization can be interpreted as a summary of all relevant potential stressors

whose scope and degree of completeness is limited by the restrictions inherent in conventional survey research only.

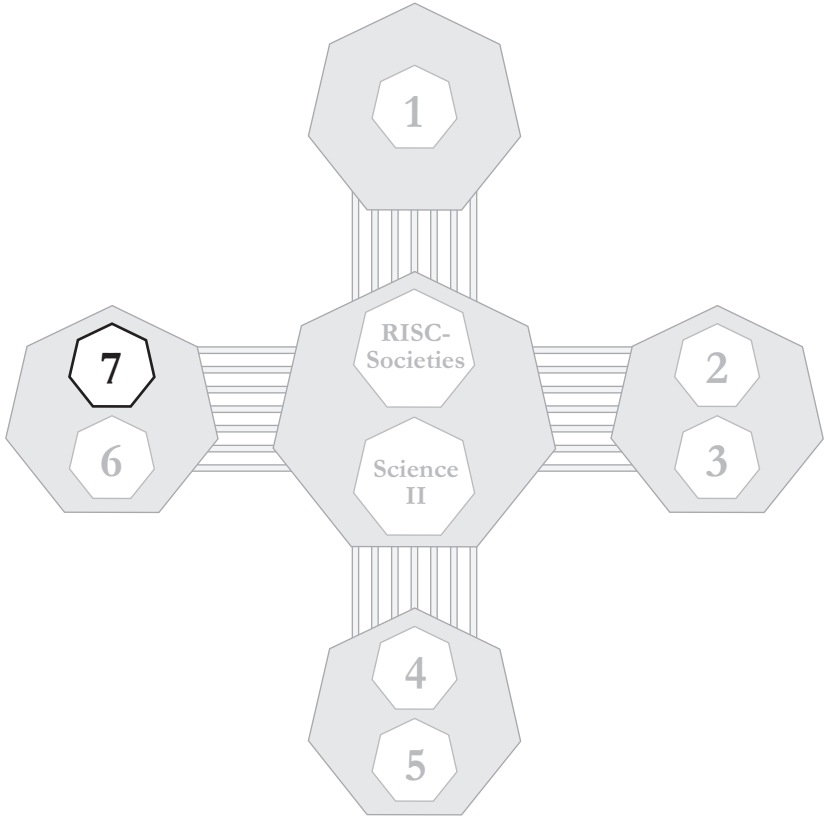
– Fifth, stressors and stress reaction are clearly not invariant to the actual number of stressors since stress reactions are functionally related, probably in a complex and non-linear manner, to the overall number of stressors. This, in turn, provides additional support why a survey analysis should focus on the aggregation of dimensions because these aggregate values should be interpretable in terms of a net value for the overall number of socio-economic stressors.

In this way, a bridge can be built to biomedical stress research which could offer a plausible hint on the specific data patterns found in the two surveys in Slovenia and in Austria. Unemployment as an additional permanent stressor operates especially within the multiple socio-economic risk groups which could account for the significant horizontal differences in the health domain. It is hoped that this suggestion could lead to a much deeper understanding of the complex interactions between daily routines at the workplace or at home and patterns of health conditions.

6.7 Further Outlooks

It should be emphasized that the empirical results from our study should have strong implications for social policies, broadly conceived. Due to the deep vertical differences already in the domain of fulltime employment much more emphasis should be devoted to the lower stratum with multiple-socio-economic risks which differs so strongly from the upper or the medium strata of the unemployed group. After all, bringing people back to work can also become a failed strategy if such a return to work implies an integration into the ranks and files of multiple socio-economic risk groups.

7 Inequality and Health Conditions in Modern RISC-Societies*



*) Special thanks go to Richard Fuchsbichler from the Austrian Ministry of Labour, Social Affairs and Consumer Protection (BMASK) who was mainly responsible for the funding of this study.

At first sight, unraveling the deep relations between stratification, social inequality and health seems superfluous since a large body of literature is already available which has uncovered significant relations on a cross-sectional as well as on an inter-temporal scale between different socio-economic strata, inequality and health conditions. Before entering into a new system of deep relations between these three domains it must be shown, therefore, that the currently available accounts suffer from systematic shortcomings and deficiencies and cover only the surface-relations between these three spheres.

7.1 Missing Links Everywhere

Following the primal scenario from systemantics [Gall, 2006:5], systems in general work poorly or not at all. Applied to the domain of the social sciences the primal scenario states that contemporary social sciences as a system work poorly or not at all and that they are not producing what they are supposed to produce, namely theoretically advanced frameworks for the complex relations between stratification, inequality and health in contemporary RISC-societies. In fact, the following two trade-offs can be observed:

- On the one hand, under-complex frameworks for stratification or social inequality are strongly connected with health research, but produce only weak impacts or correlations.
- On the other hand, complex frameworks of societal evolution are currently not linked with stratification, social inequality, let alone with health research and exhibit, therefore, no impact or correlations.

Starting with under-complex stratification schemes in the broad Marx-Weber tradition[1] one can generally observe that these approaches suffer from a characteristic deficit because they are based on the organization and structure of labor processes. Hence, they operate with a very small number of key-variables which, however, are not able to capture the multi-dimensionality of contemporary living conditions and daily routines.
Stratification schemes in the Marxian tradition[2] as advanced by Pierre Bourdieu [1982, 1985] or by Eric Olin Wright [1997] exhibit too little diversity in the underlying class-concepts, including Bourdieu's habitus formations. Moreover, both approaches have not been related to health research. Approaches in the

1 For an interesting summary and discussion see *e.g.*, Giddens, 1989:209pp.
2 For a comprehensive overview, see Grusky, 1994.

Weberian tradition[3] offer vertical stratification schemes by distinguishing different classes or status groups which can be used, subsequently, for socio-economic analyses of health. Nevertheless, these stratification schemes turn out to be under-complex in view of the heterogeneity of contemporary living conditions and life courses.

The second general under-complex field is focused on the relations between relative income, social inequality and health. Here, Richard G. Wilkinson's studies [Wilkinson, 1996, Wilkinson/Pickett, 2010] have become widely known. What makes Wilkinson's work highly valuable is, on the one hand, its wide regional scope by focusing on practically all advanced societies and, on the other hand, its insistence on a societal transfer process from a specific macro-societal state like a high level of social inequality to micro-levels like a significantly increased stress level for various societal groups to different types of chronic diseases or to high mortality rates. However, the major problem in Wilkinson's approach and in many similar studies lies in the focus on a single macro-societal dimension, namely on different levels of relative social inequalities. Other essential societal dimensions, systems or domains have been left out so that this line of research suffers from the verdict of under-complexity as well.

The third under-complex approach is centered on the combination of socio-demographic variables and health related life styles. This research field is most probably the worst offender in under-complexity since the main focus lies in a very narrow set of daily routines with respect to diet and nutrition, drug use, including smoking and alcohol, body weight or physical exercises and activities.[4] Life-styles can be decomposed with respect to gender, age groups, different education levels and the like. Usually, one finds apparently strong relations especially between education, life styles and health, but the whole field suffers from an enormous amount of under-complexity in the underlying factors of analysis.

Turning to the complex frameworks of life-styles [see especially Schulze, 1992] one is confronted with the general result that these frameworks[5] loose their vertical dimensions in the course of widening the relevant socio-economic dimensions altogether. Thus, current complex life-style frameworks, while focusing on a broad range of living conditions and socio-cultural practices, have become by and large unable to arrange the resulting life style formations into a vertical stratification scheme or in terms of social inequalities. Although

3 For a summary on the Weberian tradition, see *e.g.*, Blau/Duncan, 1967, Giddens 1973, Hodge, 1981, Parkin, 1979, Sørensen, 1991/1994 or Treiman 1977.

4 For an overview, see, *e.g.*, Egger/Binns/Rossner, 2010 or Rippe, 2012.

5 For other life-style studies, see for example Spellerberg, 1996, Schneider/Spellerberg, 1999 or for an interesting summary Matjan, 1998.

Schulze, for example, is very explicit in his deep search for a latent pattern which connects diverse surface appearances or of a universal pattern in the relation between actors and their environment or worlds [Schulze, 1992:36], the resulting life styles have cut their connections with vertical dimensions and inequalities altogether.

Turning to a fifth group of approaches, namely to risk- and RISC-frameworks, one finds,[6] starting with risk-perspectives, a new societal research program which emphasizes risks and risk formations, and which rests largely on Ulrich Beck's "Risk Society" [Beck, 1986].[7] Ulrich Beck in his national Post-Chernobyl bestseller uses the pattern of a phase transition between two stages in modernity as a broad platform in which the notion of risks receives its proper attention. Using dialectical metaphors, Beck argues that industrial capitalism has an in-built logic which transcends its own boundaries and identities and which produces, thus, an endogenous drift towards a qualitatively different stage.[8] It would have been fascinating to integrate a micro-concept of socio-economic risks into this profile of contemporary risk societies. But despite the phase transition towards risk societies, socio-economic risks have not found their way into Part II of Beck's book. Rather, for Beck the question of social inequality and vertical stratification seems to undergo a transformation itself, namely a secular change from vertical to horizontal forms.[9]

In contrast to risk-societies, the framework of RISC-societies[10] emphasizes a composition of societies in terms of RISC-mechanisms and their corresponding

6 One could add the complex Luhmann-framework on risks and risk-systems [Luhmann, 1986, 1988, 1990, 1991, 1993, 1997], but in Luhmann's case it is almost natural that no relations to stratification, social inequality or health can be established.

7 For an interesting historical as well as contemporary summary on the concept of risk, see, aside from the Beck, 1986/1989/1993/1997/1998a/1998b/2000 or Beck/Giddens/Lash, 1994 also Bonß, 1995, for special versions see Baecker, 1988, Banse/Bechmann, 1996 or Japp, 2000.

8 At various points, Beck seems to suggest, too, that the metamorphosis of modernity I into its self-reflexive stage of modernity II brings about a shift in Charles Perrow's, 1984 two dimensional diagram (with coupling and complexity as its vertical and horizontal dimensions) to the quadrant of dense coupling/high complexity.

9 At various points, Beck gives the impression that social inequalities belong basically to the domain in which they originated in the first place, namely to the phase of industrial capitalism. Most notably in the phrase "Poverty is hierarchical, smog is democratic" [Beck, 1986:51], Beck seems to suggest that vertical societal inequalities become more and more marginalized and de-centered whereas new horizontal ways of inequality like regional, local inequalities or group-specific risks which affect, for example, all employees in a special high-technology plant or even in an entire cluster alike, are gradually occupying the central positions within contemporary risk societies.

10 On the evolutionary framework of modern RISC-societies, see especially Kajfež-Bogataj/Müller/Svetlik/Toš, 2010,

power-law distributions. From an evolutionary point of view three different stages of RISC-societies are distinguished where the latest stage exhibits a coupling of societal and natural RISC-mechanisms. However, the framework of RISC-societies so far is mainly oriented on a macro-level and socio-economic risks from a micro-point of view are not discussed within the available RISC-research program.
Table 7.1 summarizes the current deficiencies in the fields of stratification, social inequality and health.

TABLE 7.1 **The Underdeveloped Status of Research on the Socio-Economic Conditions of Health**

Under-Complex Societal		
Stratification Schemes	→	Weak Relations with Health Domains
Under-Complex Schemes of Socio-Economic Inequality	→	Weak Relations with Health Domains
Under-Complex Life Style-Frameworks	→	Weak Relations with Health Domains
Complex Horizontal Life Styles	→	No Relations to Stratification, Social Inequality and Health Research
Complex Risk/RISC-Society Frameworks	→	No Relations with Stratification, Social Inequality and Health Research

7.2 A New Metric of Socio-Economic Risks and Life Chances

Taking the risk- or RISC-frameworks as reference domain, two new micro-concepts of socio-economic risks and, to borrow a term from Max Weber, of socio-economic life chances will be introduced. Initially, two general assumptions can be put forward.
Assumption I: While significant dimensions related to social inequality like income or wealth are distributed in a power-law fashion, this does not apply for cognitive-emotional dimensions like life satisfaction or happiness.
Assumption II: Societal stratification schemes for RISC-societies should be constructed with mild distributions[11] like the Gaussian distribution.
Although the second assumption seems counter-intuitive from a RISC-perspective, two strong arguments can be developed which support Assumption II. First, a stratification scheme based on power-law distributions would produce a separation where 80% of the population or more belong to the lower stratum and one or possibly two strata are reserved for 20% or less of the entire population.

11 On mild and wild distributions, see especially Sornette, 2006.

Second, the responses from numerous surveys indicate that respondents tend to see themselves firmly rooted in a middle-class or a middle-stratum and very few persons view themselves significantly above or below this very broad middle layer. In contemporary RISC-societies mildly distributed stratification schemes become, thus, embedded in a multiplicity of wildly distributed RISC-processes and mechanisms.

Thus, for the deep relations between stratification, social inequality and health one should search for a mild and normally distributed stratification scheme. Consequently, a new relational approach will be chosen which is based on the two complementary concepts of socio-economic risks and socio-economic life chances.[12] Additionally, the concepts of risks and life chances will be linked directly to a new metric and to a probability measure, establishing, thus, a comprehensive instrument for ex ante analyses as well.

The starting point for the subsequent definitions of socio-economic risks and life chances lies on socio-economic actors at micro- meso- or macro-levels and on their characteristic attributes. Actors are in no way restricted to individuals but may include small-scale firms, large-scale-organizations, transnational enterprises or even a state-apparatus or a globally operating NGO.[13] For reasons of simplicity, the subsequent discussion will focus on individual actors and not on organizations.[14] But the definitions for socio-economic risks and life chance for individual actors can be easily extended and generalized to include at least for broad arenas, namely individual actors, organizations, spatial units like cities, regions or nations and, finally, technological systems.

In contrast to the once dominant focus on labor-capital-relations, the main emphasis in the framework of socio-economic risks and life chances shifts to the daily routines of actors which include, quite naturally, their work routines, including household work, but which consist of other forms and areas of action and interaction as well. Following strongly established traditions within

12 For the concept of life chances, see, aside from the notion of life-chances within the Weberian framework, also Anthony Giddens and the "politics of life chances" [Giddens, 1997].

13 For a detailed analysis of regions with the new approach of socio-economic risks and life chances, see Müller/Link, 1999.

14 It must be emphasized though that the present risk/chance approach can be applied to different sets of actors as well like firms, scientific institutes, state agencies and the like. As an example of a risk-analysis for scientific institutes, see Müller *et al.*, 2002.

social psychology,[15] the cognitive sciences[16] or micro-sociology,[17] actors can be described by two main groups of attributes, namely

- by attributes and processes related to their internal cognitive and emotional organization and structure
- and by processes and characteristics of the contexts or the settings in which actors usually follow their routines and practices.

Within survey research, both domains have found their way into numerous questionnaires and item batteries. Essential dimensions for the first domain include coping capacities, the emotional constitution, life satisfaction, the pre-history of actors or critical life-events. For the contextual domain, important and relevant attributes comprise, inter alia, the quality of housing conditions, including the environment of one's home, the situation of the working place, the technical infrastructure at the working place or less tangible areas like social networks, political participation, broadly conceived, etc. Thus, the initial configuration for the subsequent introduction of socio-economic risks and life-chances is given by a comprehensive set of actor processes and attributes, summarizing, to use a phrase from Ludwig Wittgenstein, an entire form of life.
According to standard dictionaries, risks and life chances range over wide fields from gambling and decision theory to the realm of failures or favors. Following one of the Webster's definitions, the term "chance" is to be understood here in terms of an "opportunity", "a slight possibility of a favorable outcome" [Webster's, 1993:162] or "the more likely of possible outcomes" [*Ibid.*] whereas the risk concept is linked, again following Webster's, rather generally to the "possibility to loss or injury" [Webster's, 1993:881].
Generalizing this specific aspect of risks and life chances for the domain of actor processes and attributes, socio-economic risks will be linked to severe restrictions, losses, barriers, injuries in the action and interaction potential of actors and with unfavorable conditions in their overall contexts or settings whereas life chances are to be understood in terms of easy access, high participation, no barriers and of significantly high action or interaction potentials within highly favorable

15 For interesting overviews and approaches, see Palombo, 1999 or Ryckman 2000.

16 Within the cognitive science arena, one finds meanwhile numerous sub-fields and disciplinary niches covering the entire range of senso-motoric, emotional and cognitive routines as well their still puzzling interplay. For a diverse set of literature, see Calvin, 1996, Calvin/Bickerton, 2000, Campbell, 1984, Damasio, 1994, 2004, 2012, Deacon, 1997, Holland, 1995, Hofstadter, 1982, Hofstadter/Dennett, 1982, Hofstadter 1985, 1995, 1997, Lakoff/Nunez, 2000, Minsky, 1990, Norretanders, 1997, Pinker, 1997, Plotkin, 1997, Pollock, 1989, Ratey, 2001, Roth, 1999 or Sternberg/Wagner ,1994.

17 For micro-sociology see, for example, Goffman, 1980.

societal settings or contexts. In both instances, the concepts of socio-economic life chances and risks are to be utilized along the entire time axis, *i.e*., for risk-life chance-analyses in the past, the present and the future.
To be more specific, an assessment in terms of socio-economic risks or life chances can be undertaken for any socio-economic dimension if and only if four conditions are met simultaneously:

- First, the socio-economic dimensions under consideration must constitute important characteristics or processes of actors and their overall routines within their everyday contexts.
- Second, these essential socio-economic traits must be interpretable in a vertical fashion so that significantly below average or distinctively above average values correspond, quite generally, to the semantic regions of favorable (socio-economic life chance) and unfavorable (risk socio-economic risk) living conditions.
- Third, below average (risk) values must be closely associated with internal integration problems of actors or to environmental restrictions, limitations, barriers or detrimental shocks.
- Fourth, likewise, above average (life chance) values have to be connected with successful integration operations of actors or with environmental conditions of easy access, high resources, low or no barriers, no or marginal restrictions or no detrimental shocks.

Since socio-economic risks and life chances have been separated in a relational manner according to significantly below or above averages, an intermediate area around the average opens itself up quite naturally (insignificantly below or insignificantly above average) which for obvious reasons will be qualified as indifference region between socio-economic risks and life chances.[18] Tables 7.2 and 7.3 offer some basic characteristics for different risk- and life chance areas [Table 7.2] as well as several essential socio-economic dimensions and their corresponding values for risk, indifference or life chance positions [Table 7.3].
At this point, it might be useful to differentiate between the risk-life chance separation and the luck/bad luck (misfortune) dimension, offered by Nicholas Rescher. [Rescher, 1997] In Rescher's case, luck and bad luck (misfortune) are positive and negative evaluations based on random events, unpredictable and

18 Once again it must be emphasized that the new semantic domains for risk and chances are not confined to individuals only but can be extended to different actors across various levels like enterprises or state organizations or to spatial ensembles like regions, cities or nations and even to seemingly remote areas like computer programs, low, medium and high technologies or even to scientific articles and books whose essential attributes can be assessed in terms of their risk/chance profiles, too.

unknowable for the actors in question, whereas the risk-chance dimension, developed here, is based on an evaluation of any socio-economic attribute or process which are partly known to network actors and partly of an unforeseeable character only.

TABLE 7.2 **Main Characteristics of Socio-Economic Risks and Life Chances for Individual Actors**

	Socio-economic Domains of	
	Risks	**Life Chances**
Arena I (Internal, inside actors)	High Internal Adjustment Problems	Low Internal Adjustment Problems
	Low Degree of Self-Confidence or Self-Esteem Large Difficulties for Coping and Integration Many Shocks and Disturbances in the Past	High Degree of Self Confidence or Self Esteem Small Difficulties for Coping and Integration Few Shocks and Disturbances in the Past
Arena II (External, Settings)	High Barriers, High Restrictions Low Access Few Linkages to the Environment of Actors	Low Barriers Low Restrictions High Access Many Linkages to the Environment of Actors
	High Degree of Disturbances and Shocks Few Linkages from Outside	Low Degree of Disturbances and Shocks Many Linkages from Outside

Thus, traffic noise may be a constant disturbance to the household area of a specific actor whereas the sudden death of a family member falls under the random category. Additionally, both dimensions are entangled in a variety of strange loops [Douglas R. Hofstadter], where bad luck in a socio-economic situation, *e.g.* a traffic accident, may lead to injuries and bad health conditions which seriously hamper and restrict the day to day routines and give rise to new socio-economic risks like reduced social contacts. These newly acquired risks, in turn, bring about new socio-economic random configurations in which bad luck or good luck can operate again.

TABLE 7.3 **Selected Dimensions for Socio-Economic Risks and Life Chances**

Dimensions	Risks	Indifference	Life Chances
Income	Low	Medium	High
Qualifications	Low	Medium	High
Job Security	Low	Medium	High
Work-Stress	High	Medium	Low
Stress from Household Work	High	Medium	Low
Social Contacts	Low	Medium	High

Turning to the definitions for socio-economic risks and life chances across different socio-economic and cultural dimensions the following specifications can be provided.

- An actor A from a given population P is in a position of socio-economic risk in a specific internal or external dimension D_i (D_i: social, economic, cultural or other societal domains) iff one can assign (a) a comparatively high value for internal integration problems or a comparatively low value for internal adaptation capacities (Arena I) as well as (b) a comparatively high value for barriers, restrictions or outside disturbances for the interaction potential and a comparatively low value for actual action and interaction routines (Arena II) where the term comparatively has to be specified with respect to the overall distribution $\Lambda(P)$ and to a significantly below average position of A within $\Lambda(P)$.
- An actor A from a given population P is in a position of socio-economic indifference in a specific internal or external dimension D_i (D_i: social, economic, cultural or other societal domains) iff one can assign (a) a comparatively medium value for internal integration problems or a comparatively medium value for internal adaptation capacities (Arena I) as well as (b) a comparatively medium value for barriers, restrictions or outside disturbances for the interaction potential and a comparatively medium value for actual action and interaction routines (Arena II) where the term "comparatively" has to be specified with respect to the overall distribution $\Lambda(P)$ and to an average position of A within $\Lambda(P)$.
- An actor A from a given population P is in a position of high socio-economic life chances in a specific internal or external dimension D_i (D_i: social, economic, cultural or other societal domains) iff one can assign (a) a comparatively low value for internal integration problems and a comparatively high value for

internal adaptation capacities (Arena I) as well as (b) a comparatively low value for barriers, restrictions or outside disturbances for the interaction potential and a comparatively high value for actual action and interaction routines (Arena II) where the term "comparatively" has to be specified with respect to the overall distribution L(P) and to a significantly above average position of A within Λ(P).

Socio-economic risks and life chances, understood in the sense of significantly different degrees of barriers, disturbances or significant losses or gains with respect to the intra- and interaction potential of actors, have at least three distinctive advantage since these definitions can be utilized for other actors like small, medium or large-scale organizations,[19] for spatial ensembles like cities, regions or nations[20] or for small, medium and large-scale technological systems. Finally, the new risk and chance-based framework operates along the entire time-axis and is applicable for ex ante investigations as well.[21]

19 Basically, the same definition which has been proposed for individual actors can be used for defining risks and chances, or alternatively, opportunities for different types of organizations as well. [For a concrete example of an organizational risk-analysis, see Müller *et al*., 2002]

20 In the same manner, spatial units like a district in a city, a sub-national region or a nation can become the primary objects of this new risk-approach since the basic definitions for socio-economic risks and life chances for individual actors can be applied to spatial entities as well. It is legitimate to define a spatial unit like a city district at risk iff one can assign (a) a comparatively high value for internal integration problems or a comparatively low value for internal adaptation capacities (Arena I) as well as (b) a comparatively high value for barriers, restrictions or outside disturbances for the interaction potential and a comparatively low value for actual action and interaction routines (Arena II) where the term "comparatively" has to be specified with respect to the overall distribution Λ(P) and to a significantly below average position of A within Λ(P).

21 The general definitions for probabilities of socio-economic risks and life chances can be introduced in the following way.
An actor A from a population P is in a position of socio-economic risk in a specific internal or external dimension D_i (D_i: social, economic, cultural or other societal domains) *ex ante* iff one can assign (a) a high probability for internal integration problems and a low probability for internal adaptation capacities (domain I) as well as (b) a high probability for barriers, restrictions or outside disturbances and a low probability for low actual action and interaction routines (domain II) in the future.
An actor A from a population P is in a position of socio-economic indifference in a specific internal or external dimension D_i (D_i: social, economic, cultural or other societal domains) *ex ante* iff one can assign a medium probability (a) for internal integration problems or for internal adaptation capacities (domain I) as well as (b) for barriers, restrictions or outside disturbances and for actual action and interaction routines (domain II) in the future.
An actor A from a population P is in a position of high socio-economic life chances in a specific internal or external dimension D_i (D_i: social, economic, cultural or other societal domains) *ex ante* iff one can assign a low probability (a) for internal integration problems and

The next step towards a new metric of socio-economic risks and life chances requires the specification of broad arrangements of living conditions and routines and, thus, a multi-dimensional picture of post-industrial lives.[22] The important point here lies in the integration of a diversified and heterogeneous set of dimensions in which classical actor attributes like occupation, qualifications and income or objective living conditions like the available living space or household equipment are accompanied by a variety of seemingly soft dimensions like life satisfaction, coping capabilities, emotions, critical life events and the like. The main justifications for this move towards heterogenization lie in the subsequent four points.

- First, one can point to the well-documented result from many social surveys, indicating the at times surprising independence between subjective evaluations and emotional feelings on the one hand and the so-called objective realm of resources, qualifications or living conditions on the other hand. [Zapf, 1984, 1994]
- Second, one may point to an increasingly common anti-Cartesian mobilization [Damasio, 1994, 1999, 2012][23] with respect to the status of the "Cartesian Theatre" [Dennett, 1991] and to the age-long split between a dual realm of mental or spiritual matters on the one hand and physical objects or processes on the other hand. More and more it becomes clear that both worlds have to be integrated within a unified, though highly complex platform, placing subjective assessments, emotions or attitudes on an equal basis with objective measurements on living spaces, monetary transfers and the like.[24]

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a high probability for internal adaptation capacities (domain I) as well as (b) a low probability for barriers, restrictions or outside disturbances and a high probability for actual action and interaction routines (domain II) in the future.

22 Especially at this point, Anton Amann's verdict on the degenerate status of social indicator research should be taken into account as zero-hypothesis. "I am today convinced that the theoretical potential of the research on social indicators – which was also at the beginning of this movement – has been completely exhausted." [Amann, 1996:219]

23 Under the unifying slogan of Daniel C. Dennett's "We are almost all naturalists today". [Dennett, 1986:IX] the necessary "Anti-Cartesian mobilization" has to be undertaken in the seemingly remote fields of survey research as well where over the years and decades a large number of "Cartesian" dichotomies have been established and where the separation between objective and subjective measurements or between physical and psychological attributes has been firmly established.

24 On the surprisingly vital scenery and plays within the Non-Cartesian Theatre or, alternatively, within the "Living Globe Theatre", see the subsequent random selection of books which, all in all, may be considered as variations on the single theme of the Great Chain of Becoming which encompasses the domains of nature and society and which, moreover, can be described,

- Third, the inclusion of many different dimensions reflects, moreover, postmodern living conditions which according to standard accounts are characterized by growing heterogenization, disparity and a "neue Unübersichtlichkeit" [Jürgen Habermas] in terms of life style formations. Thus, the construction of a diversified set of dimensions should be able to capture this growing heterogeneity or offer, alternatively, a highly interesting empirical instance to refute this meanwhile common assumption of individualization. [See, for example, Beck, 1986, Beck/Beck-Gernsheim, 1994, Beck/Sopp, 1997]
- Fourth, the importance of including subjective assessments, feelings or areas like the subjective life satisfaction can be justified also with respect to the recent wave of constructivist approaches which stress the importance of self-constructions for the shapes and structures of realities, social and otherwise. Consequently, the subjective perceptions and assessments play a non-trivial role which has to be properly recognized in the selection of essential attributes for individual actors.

In Table 7.4, a typical post-modern configuration with many different dimensions has been built up within the context of a large social survey in Austria.[25] Three points in the construction of the dimensional scheme, underlying Table 7.4, are worth mentioning.

- First, the various dimensions for actors and their contexts should be constructed in a symmetrical fashion. In particular, the same overall number of dimensions should be reserved for the within organization of actors and for their contexts of action. In Table 7.4 this symmetry condition has been fulfilled, since actors and contexts have been separated into three groups respectively and each of these groups has been supplemented with four different dimensions.
- Second, actors can be characterized in numerous ways and partitionings. Thus, the subsequent main domains are to be understood as one among many potential descriptions and categorizations. Turning more specifically to the Austrian Social Survey, actors have been characterized at any point in time t by an internal cognitive-emotional architecture, by a prehistory from periods

studied and analyzed in terms of self-similar co-evolutionary principles. This list of recent publications reflecting the co-evolution between nature and society includes Burnham/Phelan, 2000, Changeux/Riceour, 2000, or Kauffman, 1990, 1993, 1995 and 2000.

25 For the subsequent explorations, the Austrian Social Survey will be used as a source for appropriate indicators since this representative survey (N = 2000), conducted twice in 1986 and 1993, entails a comparatively large number of living conditions and attitude formations. [See also Haller *et al*., 1996].

≤ t and, finally, by the interaction potential with their environments or settings where the interaction potential is dependent to a significant degree on the accumulated socio-economic resources. With respect to the contextual side, the action space has been divided into three principal contexts or settings. Since the separation between work and household belongs to the core-differentiation within modern capitalism, the three main settings qualify as household, work-place and, as a typical residual category, as civil arena, comprising all routines or habits which cannot be linked to work or household activities.[26] From a methodological point of view, it must be emphasized however, that these specifications are largely dependent on the available set of survey-dimensions. Different surveys will generate, by and large, different fields for the internal organization of actors and for their contexts. And finally, for any survey data set, various ways are open, in principle, for identifying key characteristics of actors.

- Third, for each of these 2 x 3 broad domains or dimensional groups of the actor scheme, four indicators have been selected for each of these six areas. Once again, the number of socio-economic dimensions selected depends largely on the available survey data as well as on the specific requirements and conditions for applying risk-chance evaluations. Consequently, a considerably richer survey data base might contain five or even six dimensions. Methodologically, no pre-fixed restrictions can and should be made in advance with respect to the exact number of dimensions. The only methodological requirement lies in the demand for largely independent socio-economic dimensions. Thus, dimensions with high and very high correlations within a specific group have to be avoided since this would create implicitly uneven weights between the dimensional groups selected.
- Fourth, due to the under-determinacy of finding a particular actor description, it is highly advisable to test various configurations for dimensional groups and specific dimensions and to choose a particular combination on the basis of its comparative advantages, using mostly conceptual criteria like a wide distribution across actor features and actor contexts, the adequacy of the risk-chance thresholds or the symmetry condition between actors and their environments but also empirical criteria like the correlations between the socio-economic dimensions within each dimensional group.

26 It should be added that the choice of the term "civil" has been motivated by the current interest in the shape and in the dynamics of civil societies and their role for overall societal development.

TABLE 7.4 **Twenty-four Dimensions for Socio-Economic Risks and Chances from the Austrian Social Survey**

Dimensions	Risk	Indifference	Life-Chance
Status	Low	Medium	High
Qualifications	Low	Medium	High
Future Potential	Low	Medium	High
Income	Low	Medium	High
Coping	Low	Medium	High
Life satisfaction	Low	Medium	High
Social Autonomy Transcendental	Low	Medium	High
Autonomy	Low	Medium	High
Status Difference with Father	High	Medium	Low
Difference in Qualifications with Parents	High	Medium	Low
Career Patterns	Downward	Medium	Upward
Critical Life Events	Many	Medium	Few/None
Work Stress	High	Medium	Low
Desirability of Work Place	Low	Medium	High
Job Security	Low	Medium	High
Unemployment	Frequent	Medium	None
Information	Low	Medium	High
Social Contacts	Low	Medium	High
Trust in Institutions	Low	Medium	High
Civil Environment	Low	Medium	High
Stress from Household Work	High	Medium	Low
Housing Environment	Low	Medium	High
Environmental Hazards	High	Medium	Low
Single Parent Status	Yes		No

Thus, a comprehensive multi-dimensional and symmetrical array must be constructed which captures essential aspects of the internal side of actors as well as of their day to day routines within their specific contexts or settings.

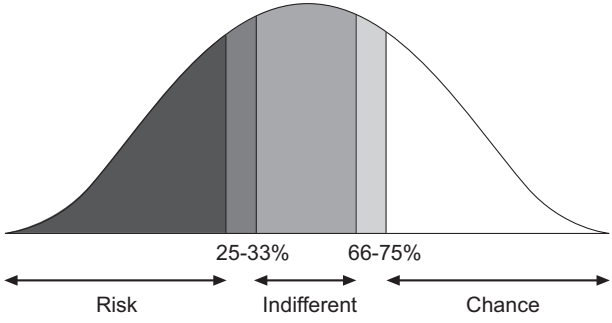
For the new metric of socio-economic risks and life chances an integration of socio-economic risks and life-chances into a broad framework of multi-dimensional living conditions has to be accomplished. Here, the specification tasks lies in the definition of critical threshold values for socio-economic risks and life chances. Thinking of dimensions like income, qualifications, the

frequency of unemployment episodes but also on social networks or the quality of the housing environment, it is intuitively appealing to restrict socio-economic risks to a small lower range (5–10%) within each of these dimensions and life chances to a narrow upper range (5–10%). However, Figure 7.1 points to the fact that a considerably broader range has been selected. Basically, three main groups of justifications can be provided for this specification move.

- First, a restriction to the small segments within the lowest and highest range generates a large number of unintended consequences for the study of socio-economic risk and life chance. To mention only two major consequences, all subsequent analyses would have to be based on a comparison of extreme groups only which cover only ten or less percent of the entire population and additional investigations beyond socio-economic risks and life chance would be required for the rest of the population which comprises an overwhelming majority of ninety percent or more of the population.
- Second, small segments of socio-economic risks and life chances would inhibit the study of risk-accumulation or the combination of two or more socio-economic risks to a significant extent. Since it is highly unlikely that five percent of the population accumulate all forms of socio-economic risks or life chances, groups with multiple risks or multiple life chances would move significantly below the five or ten percent range.
- Third, the notion of risk- or RISC-societies as a pervasive phenomenon of the contemporary state of societal evolution requires, so it seems, a broader range for socio-economic risks, too. Although a weak argument in itself, it adds up to the overall research direction of specifying considerably wider margins and ranges for socio-economic risks or life-chances.

Consequently, given an indicator like personal income, the lower third of the distribution should be qualified as a position of socio-economic risk, the domain from 33.3% – (66.7% as indifference position and the upper third as a position of socio-economic chance. In this way, an entire population gets separated, following Figure 7.1, into three broad groups where the socio-economic risk group comprises the lower segment (approximately 33% of a given population P), the group of socio-economic life chances is composed of the highest sector (roughly 33% of the population) and the indifference group lies within an intermediate range, comprising approximately 33% of a given population P.

FIGURE 7.1 **Specification for Socio-Economic Risks and Chances**



To complete the specification tasks, all socio-economic dimensions selected have to be given appropriate boundaries and thresholds for socio-economic risks and life chances. Thus, the dimensions for education, housing conditions, working conditions, on the civil environment (*e.g.*, social networks) on coping abilities or on life-satisfaction must be transformed into a distribution dependent risk-indifference- and chance-structure as well, specifying the thresholds for risks and chances in an entirely distribution-dependent manner within three segments of 33%, as depicted in Figure 7.1.

So far, the sought-for inclusion of risks and life-chances as well as the necessary specification and operationalization of critical threshold-values for socio-economic risks and life chances have been fulfilled.

Subsequently, a single vertical scale can be constructed from a multi-dimensional array of living conditions, recurrent routines or attitudes which have been completely transformed into values for socio-economic risks and life chances. Here, a new and holistic way for a multi-dimensional aggregation is needed which should meet the following two conditions.

- (C_1) First, the aggregation procedure must be able to include a multiplicity of socio-economic dimensions. This variety of socio-economic dimensions must be diversified enough to account for the relevant day to day routines of contemporary actors or, alternatively, for the diversity of post-industrial or, alternatively, of postmodern lives. (Condition of requisite variety)
- (C_2) Second, the aggregation procedures leading from a set of multiple dimensions to a measure of social inequality should be undertaken on the basis of a holistic aggregation procedure. (Condition of holistic aggregation)

In essence, two separate steps must be undertaken on the way to this new way of holistic aggregation.

- First, a radically postmodern strategy has been utilized since all the dimensions which have been included in the set of heterogeneous living conditions are assumed to be of equal weight. This heroic and obviously postmodern assumption of an equal weight condition reflects, inter alia, a growing literature on changing life-course plans towards more complex and multi-dimensional targets, including goals outside the area of labor. This multi-faceted picture is reflected in the symmetrical construction inherent in the indicator scheme of Table 7.4. Settings and actors, setting domains and actor domains, dimensions and indicators within a setting domain and dimensions and indicators within an actor domain have been constructed in a symmetric fashion, placing, implicitly, equal weights to actors and settings, equal weights to each of the actor (resources, prehistory, cognitive-emotional organization) or setting domains (work, housing, civil) and, finally, to each of the dimensions which have been selected for these actor or setting domains respectively. Thus, on a priori grounds, any position of socio-economic risk or of life chances can and will be considered of equal importance – and, thus, of equal weight.
- Second, the aggregation goal lies in the summation of the overall number of socio-economic risk positions irrespective of their origins and the overall number of life chance positions, once again irrespective of their origins. The new metric operates in the domain of [-1, 0, +1] by assigning the value -1 for a socio-economic risk position, 0 for an indifference position and +1 for a position of socio-economic life chances. Quite obviously, the possibility for simply adding all positions of socio-economic risks or life chances into a single number respectively, rests on the postmodern equal weight assumption. Due to these equal weights, socio-economic risk positions in areas like emotions, life satisfaction or social networks carry the same impact or weight as the classical dimensions for status and inequality like income, qualification or occupational status. It goes without saying that the equal weight condition for socio-economic risks has itself a highly risky status, too.

In this manner, each respondent in a survey can be assigned a single value, depending on the overall differences between the total sum of socio-economic chance positions and the total sum of socio-economic risk values. Thus, a new vertical scale can be generated which, despite the integration of multiple dimensions for living conditions, can be interpreted in terms of inequalities, socio-economic disparities or social exclusion[27] for that matter. In general, for a total number of N socio-economic, cultural, etc. dimensions, arranged in a symmetrical manner

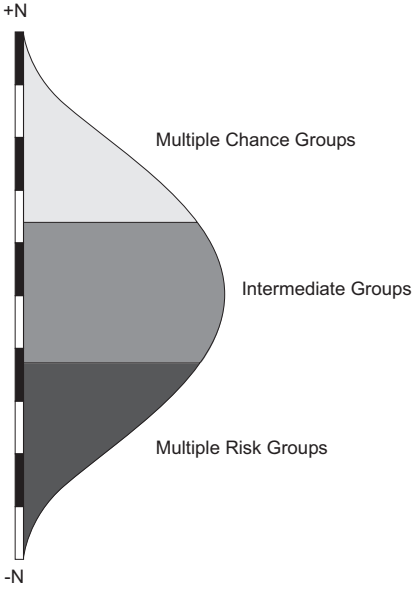
27 For the current discussion on exclusion, inequality and poverty, see *e.g.*, Bradshaw *et al.*, 1998, Levitas, 1998, Nolan/Whelan, 1996, Room, 1995, Silver, 1994, Townsend, 1979.

between internal and external dimensions, the new scale of social inequality ranges from – N to +N. – N is reserved for individuals with a maximum number of socio-economic risk positions (no indifference positions, no positions of life chances) and +N is occupied by individuals with socio-economic life chances across all dimensions (no indifference position, no risk position) In between, the new scale has 2(N – 1) different degrees. Due to the overall construction of socio-economic risks, life chances and aggregation procedures, the distribution pattern for a given population must result in a normal distribution with a mean-value around zero.
At this point, a new a new group specific separation can be introduced between

- an upper stratum with a group of multiple socio-economic life chances (upper third of the population distribution)
- an intermediate segment or a middle group with approximately one third of a population
- a lower segment with a group of multiple socio-economic risks(lower third of the population distribution).[28]

Figure 7.3 shows the new complex vertical stratification scheme which is based on a large set of internal and external dimensions which cover essential aspects of current postmodern lives.

FIGURE 7.3 **A Multi-Dimensional Stratification Scheme Based on Socio-Economic Risks and Life Chances**



28 For more details, see Toš/Müller, 2005, Toš/Müller, 2009 or Müller/Nemeth/Toš, 2002.

In this way, a new vertical scale and measure has been obtained which starts from a given population with a multidimensional configuration of micro-data with N dimensions, representing core aspects of living conditions, recurrent routines or attitudes and reflecting the heterogeneities of the postmodern condition. After specifying distribution-dependent threshold values for socio-economic risks and life chances and a symmetric aggregation procedure, a single value for each individual can be obtained which lies within a scale of – N up to +N and which can be interpreted as a measure of social inequality or, alternatively, of social exclusion or social inclusion.

7.3 Unraveling the Deep Relations between Stratification, Social Inequality and Health

So far, the key-factors for socio-economic effects on health conditions were centered around the two dimensions of education and income. Subsequently, two different international surveys will be used to show the significant differences between the conventional surface relations and the new deep relations between stratification, social inequality and health.

For a first general test a very large data set for 28 countries in Europe has been used which runs under the heading of "Quality of Life-Survey" and which has been collected by the European Foundation for the Improvement of Living and Working Conditions in Dublin.[29]

The Quality of Life Survey contains a relatively small set of relevant risk/life chance dimensions and, thus, a total of twelve different dimensions has been selected for the new inequality scale. Figure 7.4 as well as Table 7.5 summarize these twelve dimensions where six dimensions can be characterized as internal attributes of actors and the second group as attributes or routines in different settings or contexts.[30]

The thresholds for socio-economic risks and life chances have been specified for each of the 28 countries separately. Then two groups of correlation analyses

29 On the Quality of Life Survey, organized by the Dublin Foundation, see, European Foundation, 2004.

30 More specifically, the following dimensions and variables have been selected:
Internal Dimensions: Income (Q 65); sufficiency of income (Q 58 – Q 61); trust (Q 27 – Q 28); perceived quality of public services (Q 54a – Q 54e); stress (Q 13a – Q13c); cognitive coping (Q 30a – Q30e).
External Dimensions: Working hours (Q 7, Q 10); occupational work (Q 12a – Q 12g); social networks (Q 34 – Q 35); living space (Q 17); quality of home (Q 20 – Q 21); reachabilities (Q 53).

have been performed, namely correlations between life satisfaction and income, education as well as the new metric of socio-economic risks and life chances and the position on the new inequality scale and correlations between health and the three aforementioned dimensions of income, education and positions on the scale for multiple socio-economic risks or life chances.

The three hypotheses which will be tested can be phrased in the following form:

- (H_1) The correlations between the position on the scale for multiple socio-economic risks and life chances and subjective general assessments like the overall life satisfaction should turn out to be significantly higher when compared to traditional inequality measures like income, qualifications or status.
- (H_2) The same result should be obtained between the position on the scale of accumulated socio-economic risks or life chances and the general state of health.
- (H_3) H_1 and H_2 can be confirmed in roughly similar ways across Europe. Thus, no significant developmental or regional effects come into play.

FIGURE 7.4 **Central Features for Actors and their Living Conditions in the Quality of Life-Survey**

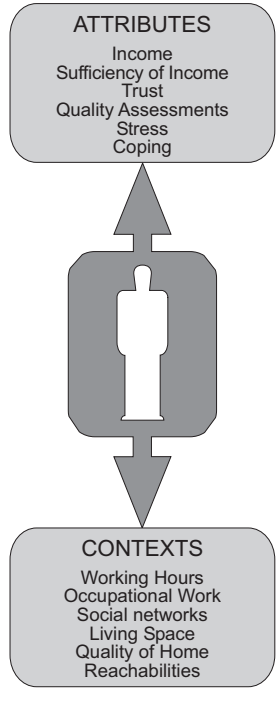


TABLE 7.5 **Twelve Dimensions for Socio-Economic Risks and Life Chances in the Quality of Life-Survey**

Dimensions	Risks	Indifference	Life Chances
Income	Low	Medium	High
Sufficiency of Income	Insufficient	Medium	Sufficient
Trust	Low	Medium	High
Quality Assessments	Low	Medium	High
Stress	High	Medium	Low
Coping	Low	Medium	High
Working Hours	Long	Medium	Short
Type of Work	Simple	Medium	Complex
Social Networks	Weak	Medium	Strong
Living Space	Small	Medium	Large
Quality of Home	Low	Medium	High
Reachability	Low	Medium	High

Figure 7.5 shows the results of the various correlation analyses and provides a strong support for all three hypotheses.

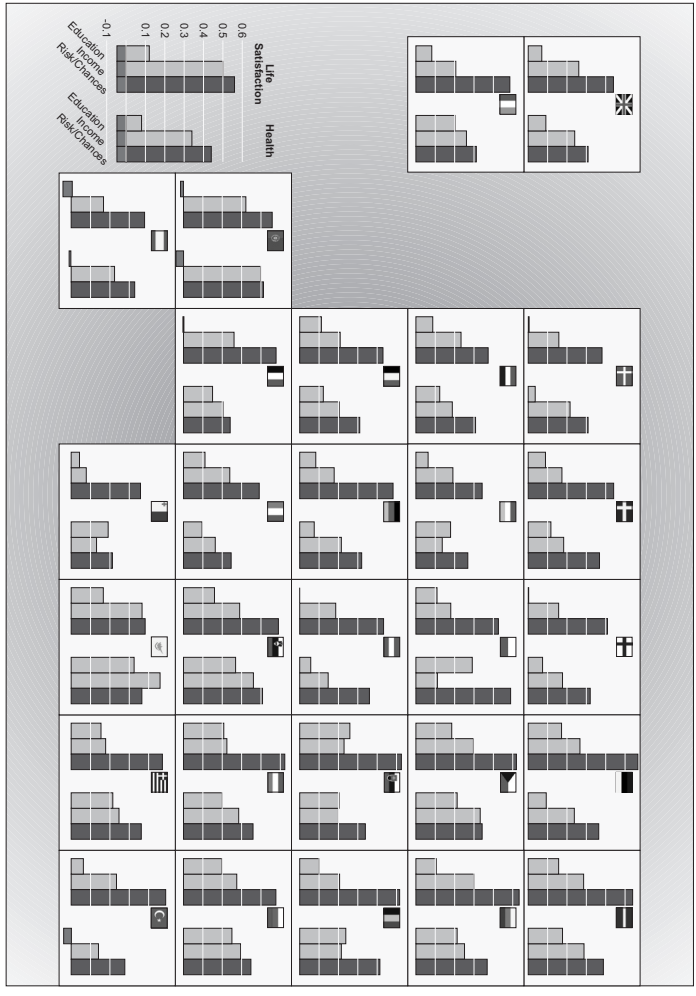
- First, Figure 7.5 exhibits an unusually clear pattern between the new metric of socio-economic risks and life chances and the overall quality of life evaluations. Compared to conventional dimensions like income or qualifications the new scale apparently captures an important systematic component in the general quality of life evaluations.
- Second, still according to Figure 7.5, much closer or deeper linkages can be recorded between the new positions of actors on the inequality scale and the status of subjective health.
- Third, both patterns are homogeneous across all 28 countries and no income or regional effects can be observed, *i.e.*, the relation is invariant with respect to the level of BIP p.c. across Europe or with respect to larger European regions like Scandinavia, Central and Eastern Europe or the Mediterranean.

These results suggest that a new and powerful metric on the constitution of contemporary risk societies has been achieved which establishes deep relations between living conditions, socio-economic risks or life chances, stratifications, social inequalities, life satisfaction and health.

It should become a valuable strategy to apply the new research perspective to the large quantities of available social health survey data both for highly developed as well as for developing regions and nations across Europe and to other socio-economic domains in which populations of actors and their

essential attributes become the key determinants for the evolution of risk societies.[31]

FIGURE 7.5 **The Deep Correlations between Risk/Life Chance Accumulation, Quality of Life Assessments and Health**



31 It should be added that this new risk- and life chance approach has been applied successfully to the organizational domain, in particular to a population of scientific institutes in Austria [see Müller *et al*., 2002]. Due to the importance of populations, the new framework can be easily recombined with the existing literature on organizational ecology [see, for example, Carroll/Hannan, 2000, Aldrich, 1999].

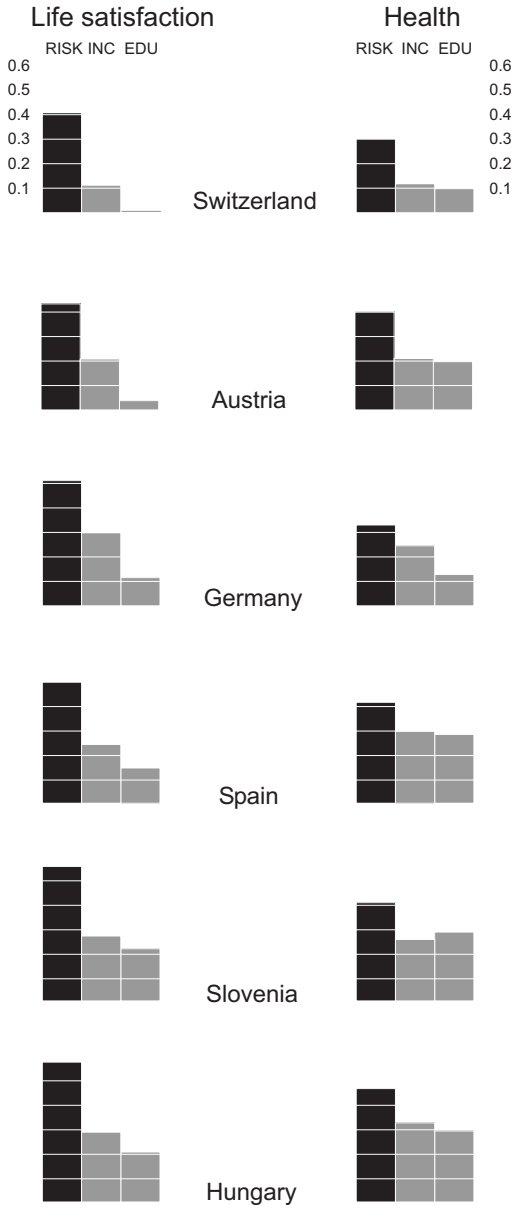
The second comparative data-set has been compiled under the auspices of Wolfgang Zapf at the Science Center Berlin and provides under the heading of Euromodule[32] a comprehensive picture of living conditions both in their external as well as in their internal dimensions in six countries, namely in Switzerland, Austria, Germany, Spain, Slovenia and Hungary.

Again, a preliminary plausibility test was performed for the new inequality scale and their resulting surface or deep relations with health or overall life satisfaction. It turned out that the risk/life chance-based scale exhibited a significantly positive correlation with qualifications. Low degrees of education were accompanied by a high accumulation of multiple risks and high degrees of education went hand in hand with high concentrations of multiple life chances. Moreover, the risk/life chance-based scale was significantly related with income. Low income levels were associated with high multiple risk values and high income standards with high values of multiple life chances. Additionally, the risk/life chance-based scale showed a clear gender asymmetry. In short, the female population was significantly over-represented in the multiple risk segment and under-represented in the group of multiple life-chances. Finally age was not related with the distribution of multiple risk-groups in a strong positive manner. This result is important due to the subsequent inclusion of health conditions. Since the state of health is very powerfully linked with increasing age, it would, thus, reduce the cognitive value of a high correlation between the new socio-economic risk/life chance scale and health substantially.

As a last step Figure 7.6 provides a clear graphical answer to the problem of surface or deep relations between the new metric of socio-economic risks and life chances and life satisfaction or health conditions. Again, Figure 7.6 shows that the new complex stratification approach is able to produce significantly higher correlations between social inequality and health, but also between social inequality and overall life satisfaction.

32 For a Euromodule-documentation, see Delhey/Böhnke/Habich/Zapf, 2001.

FIGURE 7.6 **The Deep Correlations between Socio-Economic Risks and Life Chances, Overall Life Satisfaction and Health**



7.4 Further Outlooks

With the new metric of socio-economic risks and life chances this article does not only offer a new alternative for complex stratification research under the conditions of modern RISC-societies, but unravels also deeper relations between stratification, social inequality and health which were outlined in the previous section already. This new approach is highly complex and heterogeneous in order to account for the diversity of contemporary living conditions, provides a new stratification scheme and a new scale of social inequality and is able to presents new and astonishing deep links between living conditions and attitudes on the one hand and the status of personal health on the other hand.

It is hoped that the new perspective for socio-economic risk and inequality formation under the conditions of modern RISC-societies is able to open up new cognitive ground for more complex and more refined analyses of contemporary stratification patterns and also for more adequate social policies, based on these patterns.

Sources

Five of the seven articles of this volume have been published previously with slight variations in the following journals: We want to thank the journals for the permission to reprint these papers.

Part II:

Müller, K.H., Toš, N. (2010), "Towards New Cognitive Foundations for Survey Research", in: *Teorija in Praksa 3* (vol. 47), 1316–1339.

Müller, K.H., Toš, N. (2012), "New Cognitive Environments for Survey Research in the Age of Science II", in: *Društvena Istraživanja. Journal for General Social Issues 2* (vol. 21), 315–340.

Part III:

Müller, K.H., Toš, N., Reautschnig, A. (2010), "Towards New Forms of Visual Surveys: Operating with Pattern Formations and Pattern Recognitions", in: *e-WISDOM 3*, 97–121.

Müller, K.H., Toš, N., Bischof, Ch. (2010), "Towards New Forms of Secondary Analyses for Survey Data", in: *e-WISDOM 3*, 61–95.

Part IV:

Müller, K.H., Toš, N. (2012), "The Organization of Modern Societies: Core-Periphery or Vertically Stratified?", in: *Teorija in Praksa 3* (vol. 49), 566–587

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This volume compiles a series of jointly produced articles by the two authors which are partly new and partly already published. Three general themes can be specified which lie at the heart of this book.

The first major theme focuses on an ongoing phase transition in the overall science landscapes from a traditional configuration under the name of Science I to an emergent ensemble under the heading of Science II. The second large topic discusses the impact of the transition from Science I to Science II for empirical social research, especially for survey research. The impact of Science II for survey research is being discussed especially with the help of data from the European Social Survey (ESS). The third focus of the book introduces the notion of RISC-societies (Rare Incidents, Strong Consequences) as a general evolutionary framework for societal analyses and the wider implications for empirical social research.

These three major issues seem even at second glance sufficiently interesting, diversified and relevant to be analyzed in a special volume.

Karl H. Müller, Niko Toš (2012), *Towards a New Kind of Social Science. Social Research in the Context of Science II and RISC-Societies* Vienna: edition echoraum (260 pages)

Towards a New Kind of Social Science is the result of a social science co-operation between Austria and its neighboring countries which runs under the title of EECO-LAB (Eastern European Co-operation on Labour). EECO-LAB is financed by the Austrian Federal Ministry of Labour, Social Affairs and Consumer Protection (BMASK) since 2003 and has become an important platform for comparative data, for data visualizations and for comparative analyses in Central, East and South-East Europe.