MEMETIC ENGINEERING AND TRANSPARENCY
POTENTIAL AND DESIGN OF ENVIRONMENTS FOR LARGE
SCALE CREATIVE COLLABORATION VIA NETWORKS IN
ARCHITECTURAL EDUCATION

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Memetic Engineering And Transparency

Potential and Design of Environments for Large Scale Creative Collaboration Via Networks in Architectural Education

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Abstract

This dissertation is about online education in architecture and about information architecture for networked collaboration. It makes the case for a social understanding of creativity, for a close relationship between learning and sharing of ideas and for the application of architectural principles when dealing with information. The main focus and basis of the thesis is the description and evaluation of four case studies: four different types of classes about Computer Aided Architectural Design carried out with large groups of architecture students at ETH Zürich between 1996 and 1999.

Potential of creative collaboration and memetic engineering

The first goal of this study is to document and analyze the design and outcome of these classes and to compare them with earlier teaching projects done in the same context. The case studies were teaching projects for which extensive database driven web environments were developed. These developments were made to improve the quality of the teaching by enabling more peer-to-peer interaction between the students. The main difference to the earlier projects is that the case studies can also be described as environments for creative collaboration via networks. Creative collaboration is defined as the joint effort of a group of equals, both in terms of their expertise as in their assigned roles in the process. The dissertation describes, discusses and evaluates the various implications of this type of collaboration for design education.

To describe the peer-to-peer exchanges that took place in these collaborative projects, the relatively new theory of memetics is introduced. Memetics provides new insights into the construction of collective intelligence and was an important factor in the conception of the online environments. They are designed to both optimally facilitate and monitor memetic processes. In this sense the networked environments can be considered as case studies in memetic engineering.

The analysis of the case studies shows that the different types of memetic engineering, which they enable, can indeed lead to powerful creative processes. Such environments for creative collaboration are therefore of interest for the rapidly growing fields of computer supported teaching and online education. The reliability and widespread commercial use of products developed in an open source fashion suggest that this type of memetic engineering also has possibilities that go beyond the academic realm of research and learning.

Design of transparent online environments

The second goal of this work is to determine the essential characteristics of the online environments that were developed for these projects and to ask whether a set of principles can be derived from them that could guide the future development of such environments. The hypothesis put forward is that transparency is one of the key prerequisites in enabling large
scale creative collaboration in architectural education and that, with the help of the case studies, it is possible to define by way of example, what the nature of this transparency is or must be. Based on the findings, the information architecture of such online environments can be called transparent if it

- supports **multiple simultaneous readings** of the same information
- supports **outworld views** that allow to visually analyze relationships between data
- states **authorship or source** of any data
- allows **custom filtering** of information
- minimizes **centralized editorial control**

These guidelines are developed with references to architectural theory, which is straightforward, given the many architectural metaphors used to describe the online world. It is hoped that thereby a contribution has been made to the formation of a theory of information architecture itself.

Potential von kreativer Zusammenarbeit und ‘Memetic Engineering’

Das erste Ziel der Arbeit ist es, die Gestaltung und die Resultate dieser Lehrveranstaltungen umfassend zu dokumentieren und zu analysieren. Dafür werden sie mit früheren Veranstaltungen verglichen, die im selben Umfeld stattgefunden haben. Das Hauptaugenmerk liegt aber auf der Auswertung der eigentlichen Besonderheit dieser Projekte, den datenbankgestützten Web-basierten Arbeitsumgebungen, die für sie entwickelt wurden. Diese Entwicklungen wurden gemacht, um die Qualität der Lehre zu verbessern, indem sie mehr direkten Austausch der Studenten untereinander ermöglichten. Im Unterschied zu den früheren Kursen können die Fallstudien als Umgebungen für kreative, vernetzte Zusammenarbeit beschrieben werden. Kreative Zusammenarbeit ist definiert als die gemeinsame Anstrengung einer Gruppe gleichwertiger Individuen - gleichwertig sowohl was Ihren Ausbildungs- oder Wissensstand, als auch was ihre Rolle in der Gruppe angeht. Die Dissertation beschreibt, diskutiert und evaluiert die verschiedenen Implikationen, welche diese Form der vernetzten Zusammenarbeit für die Architekturausbildung haben kann.


Die Analyse der Fallstudien zeigt, dass die verschiedenen Arten von „memetic engineering“, welche sie ermöglichen, tatsächlich zu mächtigen kreativen Prozessen führen können. Solche Umgebungen für kreative Zusammenarbeit sind deswegen für das schnell wachsende Gebiet der computerunterstützten vernetzten Lehre interessant. Die Zuverlässigkeit und weite Verbreitung von Software, die nach dem open-source Prinzip entwickelt wurde, zeigt aber auch, dass diese
Art des Memetic Engineering ein Potential hat, das über die akademischen Bereiche von Forschung und Lehre hinausgeht.

**Gestaltung von transparenten vernetzten Umgebungen**


- sie ermöglichen **mehrfache simultane Lesearten** der selben Information
- sie bieten sogenannte **Outworld views** an: Gesamtsichten, welche es erlauben, die Beziehungen zwischen Daten visuell zu analysieren
- sie geben für alle Daten **Quelle oder Autorenschaft** an
- sie erlauben das **benutzerbestimmte Filtern** von Information
- sie minimieren die **zentralisierte redaktionelle Kontrolle**

Diese Leitlinien wurden aus der Architekturtheoretie abgeleitet, was nicht ungewöhnlich ist, wenn man sich klar macht, wie viele Architekturmetaphern verwendet werden, um die vernetzte Welt zu beschreiben. Der Autor hofft, dass damit auch ein Beitrag zur Gründung einer eigenen Theorie der Informationsarchitektur entstanden ist.
Foreword

Don’t dissect a frog, build one!
(Negroponte, 1995, p. 198)

This dissertation was long in the making. It was left half-done (or what seemed three quarters done at the time) for almost five years until I now over the course of the last year finally got around to making the final push and finish it. As the work it describes lay quite a bit in the past when I first set out to write it in 2000, there is now a time span of almost twelve years between the time when we developed the first Phase(x) project in the fall of 1996 and the time when this dissertation was finally completed. This is an unusually long time, even more so given the topic it is describing: online environments for creative collaboration. In the online world, five years is considered at least a generation, technology-wise. Twelve years ago in Internet time is historic. Accounts of what the Internet was like, then, when Netscape was the dominant browser, when the big dotcom boom was only just taking off - such accounts are generally very dull. Which begs the question: How could a series of projects that were done with the technology of way back then, that were set in a completely different general environment, how could such projects still be of enough interest for even its author to muster the patience to write - let alone for anyone else to be expected to read about them?

This obviously is a rhetorical question, and the reader is prepared for the ‘surprise’: While one would expect these projects by now to be dull and outdated, they are not. Really! Or are they?

Let’s postpone answering this question for a moment. Things are not so simple. Back then the projects were quite revolutionary. The unusual media attention and the prizes they received were an indication that we were on to something. The new forms of collective authorship, of sharing ideas openly we were experimenting with, the way we were making these evolutionary processes visually understandable, all this got many people thinking. We had touched upon something essential, a large topic. The surprising thing, now, is that these projects, which we went about developing with tremendous energy and which were a technical accomplishment at the time, really weren’t so much about technology. What has allowed them to age gracefully despite their technical datedness is the fact that the topics they dealt with are now as present and important as ever. What’s more, the way we treated these topics then actually grows in stature in the quasi-historical perspective we can take now. Just like some silent movies still seem avant-garde to us today because of the fresh way their makers approached the young art of film-making, just so phase(x) and fake.space are as clear and direct about their subject matter as perhaps only pioneering projects can be. None of the many later projects I worked on afterwards have this quality. Why is that so?

Many of the functionalities the projects experimented with would nowadays be referred to as web 2.0 or social networking. They have long become everyday commodities. It would be a very lame argument to say that something is still interesting today because it used the type of person to person sharing before the likes of facebook, youtube or flickr became big. It is lame, because it misses the point that these social networking sites really only became interesting with the scale to which they grew.
If Phase(x) and fake.space are still interesting today, it is not because they used certain functionalities, but precisely because they experimented with the topics that were to become large phenomena in such a contained and pure way early on. The thesis refers to the case studies as laboratory experiments in memetic engineering. Indeed it is their highly artificial setting and structure, their clarity and simplicity that makes them interesting to us today.

Many students at the time were very excited about the projects because the topics they dealt with were new and everyone was still trying to understand what those new possibilities could all mean one day. While some people are of course still trying to come to grips with the new ways of communicating and sharing, there is a new generation in schools and universities today, for which communicating in this online world is simply second nature. The generational gap that is currently opening up with respect to the relationship to the online world may be in no area more problematic than in the world of education and learning. The students of the current generation communicate differently, they deal with their own and other people’s ideas differently and they learn differently (Ackermann, 2008). If we want to be able to react to this generational gap, we first have to understand what constitutes it. This is where I believe that this thesis truly makes a contribution. And this contribution has to do with the nature of the case studies.

The projects were developed in the spirit of Negroponte’s motto ‘Don’t dissect a frog, build one!’ Among our group there was a tremendous enthusiasm to try things out, to get them to work. We didn’t care about analyzing them. To write this thesis I went into the opposite mode: I delved in, analyzed and dissected the data, compiled tables with numbers about them. I did maintain some of the ‘build a frog’-spirit in that I also developed new ways and tools for interpreting, visualizing and statistically evaluating them. But mostly I was just dissecting, which, much to my surprise, was actually quite good fun. It was fun, because the clarity of the findings often surpassed my expectations. The patterns I discovered, the various personal ways of acting in this online world that I could discern: the systematic narcissists, the inspirers, the loners - they all emerged from my investigations and started to form a tableau that was much more colorful, much more multifaceted than I had expected. When I say that the functionalities the projects used have become commonplace today, I should really add that that’s only partially true. There aren’t any projects out there that I’m aware of which take the notion of collective authorship as far as phase(x) did, none that experiment with collective story-telling in as radical a fashion as fake.space. Still, none of these projects could be repeated today. The environment is too thick with peer-to-peer networking as to permit projects of the naïve simplicity that the case studies had to be conducted in the current situation. But we can certainly learn from them and get ideas what the next generation of such collaborative endeavors might look like.

While I am happy that the thesis is finally completed, I conclude my work on it feeling that I will be able to draw on the findings for quite some time. Thus I invite the readers to see for themselves whether or not these ancient projects can also hold some fascinating new insights to them. If you’re impatient I advise you to skip chapter three, which is there because it has to be, but is somewhat dull. Move right on to chapter four and five and explore the case studies including the charts and graphs in the large chapter six. It is there where maybe some new frogs might get built in your mind that may start to leap about on their own. Then we can discuss the rhetorical question again.

Graz, July 2008
1 Introduction

1.1 Goals

This thesis describes four different types of classes teaching the fundamentals of Computer Aided Architectural Design to large groups of architecture students at ETH Zürich that were carried out between 1996 and 1999. These teaching projects have received considerable attention and acclaim at the time. They are interesting to this day for their novel and unique ways of sharing and exchanging ideas and expertise. While they have been the subject of a number of publications and discussions in the past, this study is not just a more extensive version of those earlier reports. Using new statistical and visual analysis methods, it presents an in-depth survey of the complex interpersonal and creative processes that were captured by the database-driven project websites. In fact the author is not aware of a similarly detailed level of analysis of such interpersonal processes having ever been performed on a teaching project.

Based on the extensive critical analysis of the theoretical premises as well as the actual outcome of those experimental projects, their potential as well as their failings can be discussed with more rigor.

The goal of the thesis is to

- Improve the knowledge about effective collaborative teaching methods
- Contribute to and test the theory of memetics in the context of online education and e-learning
- Provide new theoretical insights in the field of information architecture
- Inform and inspire similar projects by other people at other schools of architecture or even in entirely different environments

1.2 Terminology

The title of the thesis introduces a number of terms that need to be defined. While the more detailed discussion of these terms is the subject of the whole thesis, a summary of these definitions shall be given up-front in order to clarify the context of the argument.

- ‘Memetic Engineering’: The theory of memetics applies Darwinist thinking to explain the evolution of ideas and is centered around the notion of so-called ‘memes’ as units of cultural replication. This theory will be introduced and discussed in some detail in the chapter on Processes in Design and Learning. While it is not established as a science (yet), use of the word memetic in various combinations is quite frequent, ‘memetic engineering’ being one of them. As memetics is often used to describe the evolution of trends and fashions, memetic engineering is used by some to describe manipulations of public opinion. Memetic engineers, along these lines, are public relations managers or spin doctors. In the context of this thesis, however, memetic engineering is meant to stand for something much more pragmatic. All
engineering disciplines are based on the application of scientific theories to solve practical problems with technological means. Just so, it is argued here that the environments for creative collaboration that are presented in the case studies apply the theory of memetics in a practical way. As the thesis will show, they not only significantly enhance the exchange of memes, but also provide means to trace and evaluate this exchange in an objective way. It is hoped that the thesis can help to establish memetic engineering as a more technical and more theoretically founded term.

- ‘Transparency’ is understood as a quality of organization that makes it possible for people to deal with large quantities of information without introducing the bias of an imposed interpretation. Thus, transparency is an essential aspect of memetic engineering as it is described here. In order to provide an optimal chance of proliferation for all the memes it manages, the information architecture must try to both give them maximum exposure and minimum distortion through its interface. A common term with positive implications in both architecture and information architecture, transparency is also rather difficult to define in exact terms. The definition given in the paper about transparency in architecture by Colin Rowe and Robert Slutzky (Rowe & Slutzky, 1997) is used as a reference, because their distinction between literal and phenomenal transparency provides interesting insights to the field of information architecture. Literal transparency, the see-through type, is a rather pointless ideal, when it is applied to digital data. That openness or accessibility is not an interesting quality of a thing in itself, but either of the relationships of its parts or of its own relationships with its context is never more clear than when applied to digital information where one bit, the quintessential atom of any data, is all but meaningless if taken out of the context within which it is set. Just so, the “equivocal sensations which derive from phenomenal transparency” (Rowe & Slutzky, 1997, p. 43), can be seen as a richness of information that is available for data that can be read and understood as being simultaneously part of different contexts. The thesis argues in what way the collaborative environments of the case studies can be regarded as transparent and derives a set of guidelines from them that can be used in the design of transparent information architecture.

- ‘Creative collaboration’ stands for the joint effort of a group of equals both in terms of their expertise as in their assigned roles in the process. It is labeled creative, because it is collaboration without predefined hierarchies or specializations in the group. Instead everyone does everything. While this anarchical type of collaboration is inefficient for well-defined tasks, where all the actions that need to be taken are already known and just need to be executed, it is however appropriate for ill-defined problems that can only be solved by coming up with an original solution and therefore demand creativity. Such problems are very common in architecture and other creative disciplines. In its pure form, creative collaboration among equals has long been common in the scientific community. Researchers publish, compare and debate the results of their work and use results of their peers in their own work. More recently it has become a phenomenon in online communities, such as the groups working on the development of open source software. In educational settings, creative collaboration is common where the learning process involves project-based work, as the condition of equal expertise is usually a given in groups of students. In architectural design project-based work is the dominant form of teaching and learning.

- ‘Large scale’ stands for the size of the group involved in a creative collaboration and emphasizes that the difficulties that transparency and memetic engineering address are
most pertinent and most interesting for groups that are larger than the standard team with a maximum of about eight to twelve members. In a creative collaboration as defined above, everyone can contribute whatever they choose and everyone is entitled to know everything about what everybody else contributed. Therefore the dissemination of information among the group is a key element that is very much tied to the size of the group. In the case studies, between 50 and 150 people worked together on the same project and shared the information about their creative efforts through a common online environment. With traditional face-to-face communication this could not have been accomplished.

- ‘Via networks’ stands for the use of digital networks to accomplish the mentioned dissemination of information in the case studies. In traditional settings bulletin boards and posters in the workplace are the more informal, in-house publications, newsletters and progress reports the more formalized ways of spreading information. Digital networks provide a powerful addition or alternative to both of these. They have a farther reach than bulletin boards and unlike publications on paper they make it possible to keep the information they contain up-to-date. Their main disadvantage is that one has to turn on a networked computer to access them. But in the case studies, and for that matter in a growing number of collaborative settings, all the work that needs to be disseminated is done on the computer anyway. Therefore to extend the computer’s function to being a communication medium as well as a tool is very natural and easily can become part of the working routine. It does however lead to the question how these online environments, which introduce a virtual dimension to the individual workplace, need to be designed.

- ‘Architectural Education’: All the case studies were done at architecture schools with architecture students as part of an architecture curriculum. What’s more: the online environments which made this particular educational approach possible were also conceived and designed by architects. While arguably similar methods could be very valuable in other fields, the architectural aspects of both the environments and the collaborative learning they supported were key for their development. The online environments were designed as information architecture, but also as environments to design in. They are based on and must be seen within the context of the long tradition of project-based learning in architectural education as it takes place in studio settings at architecture schools. In their information architecture, they seek to provide an appropriate environment for a discipline in which the sensual and the analytical are equally important, in which the switching between different media and forms of expression is an important part of any design process and for a discipline which has, through its methods and traditional forms of representation, developed a very sophisticated level of non-verbal communication.

1.3 Methods

While some general questions about teaching Computer Aided Design in architecture are addressed, the focus of the evaluation is on the novel aspects of the teaching models used in the case studies. The most notable of these novel aspects, which all projects have in common, is the use of so-called networked environments as an integral part of the teaching. These networked environments were conceived with certain expectations. The study investigates to what extent they were met and interprets these findings.

The means by which this is done is that of formative evaluations. Formative evaluations are
evaluations of process. They address questions about implementation and ongoing planning that the project authors deem most important (Quinones, 1998). They are typically done during the early stages of a project, but because the projects discussed here were recorded and documented in a database, nothing stands in the way of doing the evaluation after the fact, by testing the expectations against the evidence provided by the database records. The timestamps of the database records still allow to analyze the temporal dimension of the recorded events. As adaptations in the environments were made, the evaluation can also compare the relative success of different implementations with regard to these expectations.

Not all of the case studies are described with the same amount of depth. Phase(x), chronologically the first of the projects, pioneered many of the concepts taken up by the other projects. Therefore it is described in most detail. Nevertheless all description follow a similar pattern:

- **Description** provides a documentation of the projects, the scope and goals, the nature of the assignments and the number of students. The reason why the particular teaching model was adopted as well as the expectations linked to various aspects of their concepts and functional features are outlined. Where applicable, a summary of the changes that were introduced in the different installments of the projects is given.

- **Design** looks at the online environments developed for the case studies in terms of their Information Architecture. It describes the various views and navigation modes that were available to their users and discusses to what extent the case studies provided successful environments to design. Based on the observations in the four case studies, a set of guidelines for the design of transparent environments for creative collaboration is formulated in the interpretation chapter towards the end of the thesis.

- **Process** discusses the evolutionary aspects of the courses, using the theory of memetics as a way to describe and analyze the different types of exchange of information and collaboration that took place as part of the projects. By focusing on individual representative examples the process is illustrated in a pars pro toto way. The examples provide factual evidence of the way memetic processes can be traced in the environments and lead to a discussion in how far they can be said to support memetic engineering.

- **Evaluation** focuses on the expectations about the projects that can be verified by performing quantitative analysis on the database records. One of the most important expectations was that the networked environments enhance peer-to-peer learning among the students. As many relevant transactions between students and their designs were tracked and recorded in the class database, it is possible to assess the extent to which peer-to-peer exchange took place, whether it transgressed the boundaries of the workshop groups. Another expectation was that the collaboration through a networked environment as a mediator, would allow a more unbiased reception of the work by the peers, less influenced by personal relationships among the students. This question can be investigated by looking at patterns of choices by participants. At the same time the question can be analyzed whether the website itself introduces new similarly distorting factors. The findings with respect to this question are relevant for the formulation of the design guidelines in the interpretation chapter.
1.4 Case Studies in Architecture

Architecture is usually defined as the art and science of building. A long established academic discipline with a scientific tradition, it is at the same time an art. It is part of both worlds, and can never be limited to either. Thomas Kuhn describes the characteristics of any mature science through the existence of a leading paradigm that is shared by the scientific community and that allows normal, paradigm-based research. (Kuhn, 1962). Such research is possible in many architectural sub-disciplines (structural engineering, building physics, architectural history), but not for architectural design itself. As will be discussed later in this thesis, there have been many attempts to establish such paradigms, but to this day none of them have been successful. While one might point out, that this capricious role between science and art was claimed by many major scientific fields, before a leading paradigm was established, it seems plausible that the complexity of the architectural discipline should resist the formation of such a leading paradigm for good. Or to put it more bluntly: as long as we have not found a way to quantify beauty in general terms, there can be no exact science of design.

Of course the lack of a leading paradigm and of a way to quantify good design is not a problem for practicing architects. It does however put architecture at a disadvantage when competing for research money with other academic disciplines. And it complicates the assessment of design teaching, which is relevant for this thesis.

As will be shown later in this section, it is rather straightforward to describe the differences in the designs that were produced in the case study projects and in the corresponding courses taught in the years prior to them. But it is quite impossible to say which are of higher design quality, as such judgments will always depend on subjective standards. The impossibility to come to grips with these subjective standards lies in the inherent complexity of the discipline. Which is not to say that there is no way to judge design or for that matter design teaching.

Architectural design teaching is traditionally centered on project-based work in which concrete examples provide the necessary constraints to deal with this complexity. In a similar way, the use of case studies is a common method in architectural research. Case studies have proven to be a productive way around the dilemma that the lack of a leading paradigm represents. Their main disadvantage in scientific terms, that they don’t isolate individual factors in the way an experiment does, can also be seen as their advantage: they study phenomena without separating them from their context. A case study analysis can be a good basis for reasonable conjectures. But it also keeps the door open for other interpretations. There is no such thing as a failed case study. Because the case study, by definition, is based on a real-life case, even an uninteresting case provides some experiential learning. And the possibility for anybody to come to different conclusions is always given.

Interestingly case studies and project based work are becoming ever more relevant in the academic world today. Part of their relevance is the need for interdisciplinarity, as leading paradigms are often not established across different disciplines. But also the need for fast innovations tends to favor case studies. Conducting larger scale surveys is not only more time-consuming it also requires a more precise concept of what it is one is looking for. By being more open-ended, case studies are better suited to inform new approaches as they evolve. This need for more creative approaches also is promoted by the availability of information technology. Computers cut down on the time and effort that needs to be spent on quantitative evaluations, thereby raising the importance of the speculative tinkering that is always a part of scientific research, even in the so-called hard sciences.
So architecture is not only in good company, in some ways its methods have the potential of becoming a model for other disciplines. The *recherche patiente* that Le Corbusier describes as his way of working out a design (Le Corbusier, 1960) points to the fact that for some architects, every project is a case study for which they develop methods and concepts in a quasi scientific way. The foremost examples have provided architectural theory with numerous cases which can be studied and from which new theories can be derived. Architecture may well be the most case study driven academic discipline.

The case studies presented here differ from traditional case studies in architecture, because they are not (projects for) physical buildings. But they were designed by architects as environments for designers to design in. Design thus plays a double role: firstly as the design activities of the individuals that are part of the classes and learn to design with the computer and secondly as the design of the environments for creative collaboration. The former is the domain of the architect who finds himself or herself in the new role of designing with digital media. The latter is the domain of the information architect who designs the environment within which this designing and sharing of digital information can take place. The case studies show how digital media can be used to increase the interpersonal dynamics of the former and how methods and theories from traditional architecture can be applied to the design of the latter. They are case studies in information architecture, but they also testify the close relationship between traditional architecture and this emerging new field.
2 Computers in Architectural Education

2.1 A Brief History of CAAD

Computers have become mainstream in architecture – in practice as well as in education. Nowadays students will not get internship positions unless they have adequate CAD experience. The building and construction industry in all its facets heavily relies on computing. From simulations to facility management, from drawing plans to manufacturing parts, computer support is always a central topic. Given this situation in practice, it is not surprising that the computer is also a standard part of the architecture curriculum. But this general acceptance does not mean that there is also a general agreement among architects on how the various possibilities of the computer should be used, or for that matter, taught. To understand where we stand today and also to give a broader context to the particular teaching approach we adopted in the case studies, it is necessary to give a brief history of the role of computers in architectural education.

The birth of Computer Aided Design can be dated to the early nineteen sixties. ‘Sketchpad’ by Ivan Sutherland is usually considered the forefather of later CAD programs. A groundbreaking achievement, it was published with Sutherland’s Ph.D. thesis in 1963. It pioneered such concepts as object hierarchies and rubberbanding and had a graphical user interface, before the term was coined (Sutherland, 1963).

In the sixties and seventies, graphical computing remained largely a research activity with practical applications limited to settings with considerable financial possibilities. The fact that CAD was much more quickly adopted in engineering than in architecture may partly be due to the architect’s resistance to the computer, but mostly to the financial possibilities that were much greater in the big engineering firms than in typical architectural offices. Nevertheless the application of CAD in architecture was soon recognized as a special field. William Mitchell’s book ‘Computer Aided Architectural Design’ (Mitchell, 1980) established the acronym CAAD for it. Mitchell’s book has four parts: Fundamentals, Data Bases, Interfaces and Problem Solving. The parts about data bases and problem solving most clearly show the main interest of CAAD research at the time: encoding architectural data so that “the possibilities for development of programs to solve architectural problems of various types are virtually limitless” (Mitchell, 1980, p.379).

The application of computers in architectural offices started in the eighties on a broader scale. As a consequence, in many places, (particularly in the United States, in Europe the same development took place later) CAD also became more important in teaching. It was no longer just a specialized research subject.

2.1.1 Gap Between Research and Practice

At the same time the gap between the interests of CAAD researchers and computer applications in architectural practice became apparent. Researchers explored the possibilities of the computer in a way that was largely different from the standard practice. They experimented
with the possibilities of artificial intelligence based on different ways of encoding architectural
data and were particularly interested in how the computer as an intellectual tool could influence
or even fundamentally change how buildings are designed.

In the offices on the other hand, where computer systems were still a huge investment, such experimental uses could not be afforded. The primary use of computers was to make the planning process more efficient. The adoption of digital means usually happened on a one-for-one substitution basis (Eastman, 1991). Rather than changing the entire process, computers made isolated inroads into an unchanged setup: 2D CAD instead of the drawing board, 3D modeling and rendering programs to replace presentation drawings and models. CAAD researchers had high flying hopes for a new type of architectural planning that would make use of their findings in shape grammars, emergence, case based reasoning, knowledge bases, virtual reality and advanced simulations. But the reality (that is still dominating the market today) is that the software used in offices was the one that best fit the premises of the previous paper-based techniques.

Of course the offices are not to blame. If anybody, researchers must be blamed for not making their tools more suitable for practice, for being content with publishing papers about techniques that weren’t ready for any real world application. But maybe no one is to blame, because this is a process that can be observed in many domains, when new technologies are introduced. It has been nicknamed “paving the cow path”. The development at this point is far from finished. One does not have to be a prophet to predict that once viable alternatives to the cow path are available, practice will be quick to take them.

2.3 Different Approaches in Teaching

For teaching under the given circumstances however, the situation is not so simple. In a way one is torn between the two worlds. The goal is to strike a balance between teaching the principles of the new design media to make students aware of the far reaching potential, while at the same time acquainting them with the rather pragmatic usage that is dominant in practice.

There are different approaches about how this balance can be found. The first question is in which context the digital media are to be introduced: Should they be taught as a separate subject or should they be fully integrated with design studio teaching?

The other question is that of the timing: At what point in the curriculum should the computer be introduced and should it be mandatory?

For both questions a variety of approaches were adopted in different combinations at different schools. It’s difficult to say which works best. Integrating CAD directly in the studio teaching is ideal for giving students experience in designing with the new media, but it demands extra skills and instruction time from design studio teachers, which they often do not have. Therefore students tend to merely learn how to draw their projects on the computer. They understand the software, but not its driving principles and future potential. Critics of this approach say that especially students that start with this at the beginning of their studies never properly learn how to draw by hand, but instead depend on the use of hard- and software that is outdated by the time they graduate.

Making CAAD a separate subject on the other hand creates the problem that the skills can only be trained with either very simple design tasks or – as is often done – by rebuilding some architectural classic. The latter is a successful way to concentrate on the new possibilities of the computer. But, especially when existing classics are modeled, the dynamic of the computer
in design development, rather than just as a representational device, is largely missing. Simple design tasks on the other hand can be both methodical and challenging, but tend to stand in competition with studio design.

Certainly also the question when to introduce the computer is debatable. Many design teachers feel that it would be bad if students never learned how to properly draw plans and build models by hand and would favor that the computer be introduced when students are already proficient in the traditional media. On the other hand the computer opens up so many powerful technologies and synergies between different disciplines that it seems necessary to introduce its possibilities as a mandatory subject early on.

Over the last years the tendency in many schools has been to introduce computer technology as a mandatory subject rather early in the curriculum and also to treat it as a separate field rather than fully integrated with studio teaching (where computer skills are usually taken for granted). As we will show later, this has also been the path that computer education took at the architecture department at ETH Zürich. This tendency takes on different forms, but basically it is a phenomenon that has to do with the quick growth of the field.

2.4 Coping with a growing field

Computer support in architecture was traditionally equated with Computer Aided Design, or just CAD, the type of vector-based programs suitable for the production of design documents like plans, 3D models, etc. that Sutherland and others pioneered in the sixties. As computers became more available and more versatile, this narrow view has been replaced by a broader interpretation of where computers can be helpful for architects. The CAD programs (which have become much more powerful and complex) are still at the core, but Desktop Publishing, Rendering, Animation, Image Processing, Web Authoring, Computer Aided Manufacturing, Virtual Reality, Facility Management, Geographic Information Systems and various simulation programs are all seen as relevant to architects, as well. At the same time, the computer is no longer seen as only a tool, but equally relevant as a communication device that opens many possibilities for architects.

This expansion and diversification obviously has consequences for teaching. If it is not generally true that teaching must be treated like a research subject, it is certainly true in this field, which is changing (expanding) so rapidly and where expectations of future practice have to be updated almost as quickly as the standard software. We’ve stated above that teaching has to find a balance between research and practice. This is not surprising – it can be said of most fields of instruction. But it is particularly difficult in this case, where the two references are changing so quickly. Unless one fully succumbs to the pragmatism of practice, that is, as long as one wants to stay ahead and lead the way rather than lag behind the status quo, there will be something rather speculative and fleeting about this balance. This precarious condition makes it necessary to take risks, to make experiments in teaching. At least that was the general attitude of the people at the chair for Architecture and CAAD at the time the case studies described in this thesis were developed.

2.5 CAAD@ETH

At the architecture department of ETH the chair for Architecture and CAAD of Prof. Gerhard Schmitt was founded in 1988. Until a curriculum reform went into effect in 1996, the chair only offered elective classes, available for students in the upper (5th through 8th) semesters. In
1996 “Introduction to IT and CAAD” became a mandatory subject in the first and second year and a large pool of graphics workstations accessible day and night all week was set up in the department. Some of the design studio professors had already set up their individual computer clusters before that and notably the first year studio of Prof. Kramel for a number of years had taught a small group of students on the computer from day one on. Still: until 1996 the elective CAAD classes offered by the chair were the only way to get an introduction to CAAD that was open to all architecture students. For the ones that had started studying under the old curriculum it remained the only one until 1999. Not surprisingly, therefore, these classes were in heavy demand. Well over 100 students signed up for them every semester and some always had to be turned away.

The classes described in the case studies of this thesis were carried out within this framework as elective classes for computer aided architectural design between 1996 and 1999. The EventSpaces class, the fourth of the case studies, already marks the end of this era, because from then on, the class no longer needed to be designed as an introductory class. The introductory CAAD instruction at that point had become mandatory for all architecture students in the first and second year.

2.5.1 Wahlfach CAAD

The elective class “Computerunterstützter Architektonischer Entwurf” (CAAD) was introduced by Prof. Gerhard Schmitt in 1988 and taught in different ways over the years. There were other elective offerings like a programming class and a class for advanced students, but for the reasons outlined above, the introductory “Wahlfach CAAD” was by far the most popular one. The class consisted of both lectures and workshops. The lectures took place in a big auditorium and for the workshops, which were held in the computer cluster, students were split into five or six groups of about twenty to twenty five students.

The balance between research and practice that must be found in teaching such a class has been mentioned above. The teaching of the Wahlfach was always very much oriented towards the intellectual understanding of the computer as a tool and towards exploring novel possibilities in design that arise out of this understanding. The software used in the class was never “off the shelf”, but customized or extended with a rich set of tools that were developed by members of the chair.

The class came to be called the “principia”-class for the emphasis on the basic principles of design computing. The program “types&instances”, developed by members of the chair on top of AutoCAD was emblematic for the teaching approach taken in principia between 91 and 96. It is based on an understanding of architecture as a language and on an object oriented modeling approach based on a library of types that can be instantiated (Madrazo, 1991, Schmitt, 1993, Madrazo, 1995).

The principia teaching chose a different focus for the summer- and winter semester. In the winter, the principles were introduced designing abstract geometric compositions. In the summer, an architectural project was taken on and developed with these tools. The summer semester classes of 95 and 96 students modeled and then redesigned their own homes. The classes were called @home.

The winter semester principia class was the precursor for the Phase(x) classes and the @home classes greatly influenced the concept of the fake.space classes. Therefore both of these shall be briefly described here. Figures 1.1-4 show examples of course booklet covers for each of these four courses. Their differences in content are obvious from the design.
COLOR PLATE 1: Covers of Wahlfach CAAD course booklets

fig. 1.1: Principia ws 1995 (Design L. Madrazo)

fig. 1.2: @home ss 1996 (Design F. Wenz)

fig. 1.3: fake.space ss 1997 (Design F. Wenz)

fig. 1.4: Phase(x)3 ss 1999 (Design U. Hirschberg)
2.5.2 Principia

The winter semester allowed the students to focus solely on the design methods in a completely abstract way. The principia class was structured in a sequence of exercises around an object oriented concept of design as language. With each assignment, the vocabulary as well as the design possibilities became richer. It started with a composition on the plane, where rectangles in different colors and sizes could be arranged on a square grid, it went on to objects on the plane, levels of detail and finally to hierarchical structures. In 1996 students could choose between an interior or a façade design for the final assignment. (see color plates 4 and 5)

- Assignment 1: Composition on the plane
- Assignment 2: Objects on the plane
- Assignment 3: Hierarchical Structures
- Assignment 4: Levels of Detail
- Assignment 5: Façade / Inner Space

2.5.3 @Home

In the summer semester questions of plan representation, architectural scale, material and to some extent construction were taken on. With graphics workstations becoming ever more powerful, possibilities for texture mapping, real-time visualizations and light simulations made these topics more and more interesting and led to a greater differentiation between the winter and the summer teaching. In the summer semester of 95 and 96 this concern with issues of perception and visualization led to an entirely new teaching concept. The class was called @ home and dealt with these very topics. In a first step students took measurements and photographs of their own apartments, which became the basis for their homes on the web. While learning about CAAD and web-technology, they first modeled and visualized their own apartments. For the final assignment their task was to redesign their apartments.

- Assignment 1: @Home. Document apartment with photographs, text and sound on a webpage.
- Assignment 4: Bild + Auge: Make light simulation studies of space in Radiance and document on the web.
- Assignment 5: Design: Redesign the Apartment and document on the web.

2.6 An Overview of the Case Studies

While the case studies each get their separate section later, it is necessary to briefly summarize their main innovative aspects here, as they will be referred to in the next section.

2.6.1 Phase(x)

Phase(x) was the first database supported class carried out at the chair for Architecture and CAAD. Using many of the ideas developed for the Principia classes, it also departed from this
fig. 2.1: Phase(x) 3D outworld view (montage): design evolution and collective authorship

fig. 2.2: fake.space outworld view and nodes (montage): collective storytelling about space
fig. 3.1: Virtual Design Studio (montage): International Collaboration based on the Phase(x) principle of collective authorship

fig. 3.2: Eventspaces Outworld applet: Collective Hyperspace / Online Game Development
model in that it consisted of a series of assignments that were designed as consecutive Phases in a continuous learning process. Every work turned in for one assignment could be reused and developed further in the next phases. The twist was that no author could continue to work on their own works. Everyone was asked to start the next phase by using someone else’s design as the starting point.

One consequence of this principle was the automatic formation of “virtual design teams”, founded entirely on the interest of the individuals to work on one particular file. The switching of authors also resulted in an evolutionary development: as more than one student could choose the same design to develop further, a selection was made and only a small number of initial schemes ended up having offspring in the final phases. So-called outworld views, abstract, computer-generated visualizations of this process allowed the authors to see the overall development they were an active part of. (see fig. 2.1)

2.6.2 Fake.space

Fake.space is the sibling course to Phase(x) building on the pedagogy developed for @home. Like in @home, students were to model their own homes and document them as plans and renderings on the web, but it also departed from this by embracing the topic of narrative.

The whole class revolved around the exploration of different concepts and different representations of space. Based on a number of texts that were made available to students in the fake.space reader, the students’ assignments were contributions to a hyperspace, the fake.space node system, in which they could collaboratively develop story lines. Fake.space can be described as a multi-author narrative with multimedia content. Collecting student’s individual ideas and stories about their own homes, the node system is – just as Phase(x) - an introductory CAAD class, but at the same time it is an example of collective story telling. Various navigational methods were developed for fake.space that would allow the authors to keep an overview of the vast node structure. (see fig. 2.2)

2.6.3 VDS

The Virtual Design Studios Multiplying Time and Place2wait were international collaborations that were carried out during the seminar-weeks of winter semester 1997 and 1998 based on the Phase(x) principle. The setup comprised groups of students at three universities in three timezones, roughly eight hours apart and therefore made it possible to multiply time: three working days could be compressed into one. The design task in Multiplying Time was a building design (rather than a geometric composition like in Phase(x)), bringing the cultural differences of the collaborators into play (a house for a Chinese writer and a swiss painter on an island off the coast of Seattle).

The continuous exchange of designs across time and space led to the formation of a global think tank, operating twenty four hours a day. Videoconferences at the end of each session allowed the groups to personally present their work to eachother in a review situation. Nevertheless one challenge was that the designs essentially had to speak for themselves. Students had to converse in a universal architectural language, as one of the participants from Hong Kong put it. (see fig. 3.1)

2.6.4 EventSpaces

EventSpaces is the follow up class to Fake.space and Phase(x). It is no longer designed to be an introductory CAAD class and instead focuses on advanced issues in more depth. The
main challenge taken on beyond the Phase(x) and Fake.space classes is that EventSpaces was designed to allow a group of designers to come up with one coherent final product in a distributed, bottom up fashion. The project was a game, but also the process of creating the project was designed as a game. The project of the first EventSpaces class was Le Corbusier's famous Villa Savoye. Students could focus on individual spaces in the villa and turn them into interactive scenarios, linked to the rest of the Villa in various ways.

Subsequent versions of EventSpaces were taught with different premises, the class has also been exported to the Harvard GSD where it has become the means to teach the Fundamentals of CAAD class. While some of the overly complex functionalities have been eliminated in later versions, the basic idea of developing a game, with a game-like working method has matured into a successful teaching method. For EventSpaces another type of outworld view was developed that allows to see the connections between the different scenarios the game is made up of. (see fig. 3.2)
3 Method of Evaluation

3.1 Assessing the Quality of Design Teaching

Assessing the quality of teaching is never an easy task and when the subject taught is one that is in itself difficult to judge objectively, like design, then the assessment becomes even more tricky. Nevertheless there are established methods and criteria based on which a meaningful analysis of different teaching efforts can be made. Educational literature generally differentiates between two main methods of evaluation, which are often used in combination: formative and summative evaluations (Quinones, 1998). In the following paragraphs, these two methods are described and their applicability to the case studies is discussed.

3.1.1 Summative Evaluations

Summative evaluations are performed at the end of a project to judge it based on the results it produced. The most common way to go about this is to make questionnaires that poll the opinions of students that were enrolled in them. The advantage of summative evaluations is the possibility to summarize the whole experience. If the students’ learning progress is also tested in a final exam, their test scores can be considered along with subjective experiences, their recollections of strengths and weaknesses of their learning experience. The limitation of summative evaluations is that they judge the whole experience from just one point in time usually by external judges that have no stake in the process and that their emphasis is mainly on results and not on the process that leads to these results.

3.1.2 Formative Evaluations

Formative Evaluations are evaluations of process by the actors themselves. They are designed to help the actors evolve the process as they go. They are usually performed during the early phases of a project to check on certain aspects which the project authors deem most important. They are useful as a way to recognize problems that a new approach may have early on and can help identify the questions that need to be asked in the summative evaluation. Their limitation is that they do not look at the net result of an approach, but instead compare it to expectations, when it is still in progress. Their advantage is that the observations are spread out in time and thus provide insights about the process. For reasons outlined below, formative evaluations will turn out to be the more appropriate ones for the case studies.

3.2 Summative Evaluation of the Case Studies

Summative evaluations were done on a routine basis for most of the classes discussed here. As part of the teaching evaluations, the classes were rated by the students in various categories. The outcome was that they generally received high marks over all, whereby the use of technology as part of the teaching was especially well rated, while the main criticism was that the exercises...
took up too much of the students’ time. However, since these evaluations were not performed in a consistent manner and don’t reveal much about the special nature of the projects, they are not considered as material for this thesis.

The other obvious summative evaluation that can be conducted for the projects is to look at the students’ designs. Ideally these results would be compared to the results of similar classes, which differ significantly in just a few aspects. This approach appears to be possible at least for two of the case study classes, Phase(x) and fake.space. As was pointed out in the previous chapter, these two classes took over many ideas from earlier CAAD elective classes taught in the same environment. The teaching content and some of the exercises are quite similar, even though the overall concept and methods of instruction are very different. One should note that the evaluation is not done by an external judge. Having been a teacher in both projects, the author may still claim relative neutrality.

### 3.2.1 Comparison with results of earlier classes

Comparisons are an essential aspect of any evaluation: only by using other data as references (if just mathematically gained probabilities) can any quantitative evaluation become meaningful. The coherence of the comparison also determines the quality of its results. The proverbial comparison of apples and oranges illustrates this truism. But, arguably, comparing apples and oranges can lead to meaningful results, if the comparison respects the fact that they’re not the same fruit.

For two of the case studies, a direct comparison with an earlier teaching model is possible. Phase(x) was the follow up of the Principia class, fake.space was taught instead of @Home. But there are several obstacles to a meaningful comparison. The first problem one is faced with when trying to compare the results of the different classes is the level of documentation. Before databases started to be used in teaching the documentation of the semesters was always a major effort, which the teaching team made for the final presentation of the class in the last lecture of the semester. Obviously only the best or the most interesting results were presented at this occasion. In the classes that were documented with a database on the other hand, the entire classwork, good and bad projects alike, are documented. Obviously one can make a selection of the best ones and use just these in a comparison. But it’s important to acknowledge that the evaluation will then only take the teaching successes and not the failures into account, which is a very unbalanced way to look at teaching, although it is of course very common.

### 3.2.2 Nature of Assignments

Considering only the best designs is a first step to create a level field for a comparison. Next, one needs to look at the nature of the assignments. As stated above, the content of the classes was quite similar. The concentration on abstract geometric composition establishes a common ground between Principia and Phase(x). The modeling of students’ own homes was a task for participants in both @Home and fake.space. Again one is faced with a serious difference, however: in Principia and @Home there were half as many assignments as in Phase(x) and fake.space (Principia 95 had five assignments, Phase(x) 96 had ten; @Home 96 had four, fake.space 97 had eight). Because one can expect the overall time that the students were able to spend on the class to be about the same, the assignments necessarily had to be simpler in scope in Phase(x) and fake.space.

So despite the similarities in content, to just compare the outcome in terms of the best student work will not be meaningful. The nature and scope of the assignments is too different.
3.2.3 What’s success?

It is reasonable to assume that meaningful comparisons can be made between the different teaching methods, but there are many things besides the documented results that need to be taken into account. In the end the goal is to come to a well-informed assessment of how successful the different teaching methods were. Before looking at the students’ designs, which will have to be judged bearing all of the above in mind, there may be more straightforward criteria to measure the efficiency of the teaching. An obvious thing to look at is the grading, or rather, since these were ‘pass or fail’ classes, the overall view of how many students successfully completed the class.

3.2.4 Comparing the Success Rate

There were no grades given in the Wahlfach, just a “Testat” (credit), signifying the successful completion of the class. To find out how successful the classes were, we could measure how many students finished the class and got a “Testat”. Here the data is available for all classes:

<table>
<thead>
<tr>
<th>Class</th>
<th>Signed up</th>
<th>First ass.</th>
<th>Testat</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principia WS 1994/95</td>
<td>135</td>
<td>52</td>
<td>0.385</td>
<td></td>
</tr>
<tr>
<td>@Home SS 1995</td>
<td>98</td>
<td>50</td>
<td>0.510</td>
<td></td>
</tr>
<tr>
<td>Principia WS 1995/96</td>
<td>130</td>
<td>65</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>@Home SS 1996</td>
<td>120</td>
<td>58</td>
<td>0.483</td>
<td></td>
</tr>
<tr>
<td>Phase(x) WS 1996/97</td>
<td>120</td>
<td>108</td>
<td>70</td>
<td>0.583 (0.648)</td>
</tr>
<tr>
<td>Fake.space SS1997</td>
<td>145</td>
<td>99</td>
<td>50</td>
<td>0.344 (0.537)</td>
</tr>
<tr>
<td>Phase(x)2 WS 1997/98</td>
<td>156</td>
<td>139</td>
<td>80</td>
<td>0.512 (0.575)</td>
</tr>
<tr>
<td>Fake.space SS1998</td>
<td>116</td>
<td>64</td>
<td>38</td>
<td>0.327 (0.593)</td>
</tr>
<tr>
<td>Fake.space WS1998/1999</td>
<td>98</td>
<td>86</td>
<td>51</td>
<td>0.520 (0.593)</td>
</tr>
<tr>
<td>Phase(x)3 SS 1999</td>
<td>80</td>
<td>61</td>
<td>39</td>
<td>0.488 (0.639)</td>
</tr>
<tr>
<td>Total (average)</td>
<td>1198 (120)</td>
<td>(93)</td>
<td>553 (55)</td>
<td>0.460 (0.591)</td>
</tr>
</tbody>
</table>

That the success rate is never much higher than 50% is a result of the specific situation of architecture students at ETH Zürich and can be taken as a given for a Wahlfach (a non-mandatory class) that requires so much commitment from the students. If only those students that completed the first assignment are counted (a figure not available for the earlier courses), the ratio is generally closer to sixty percent (figure in parenthesis).

Comparing the relative effectiveness of the two generations of classes, the statistics aren’t really too telling. Both methods are within the same range, with the later classes showing more variance. The least successful classes, according to this chart, were the first two fake.space classes. With the phase(x) classes usually being the ones with the best ratio, this might indicate that fake.space was either too demanding or not so well organized, or just not a very exciting class. But it’s just as likely that the low attendance was due to the fact that Prof. Gerhard Schmitt was either on Sabbatical (SS 97) or had become Vice President (SS 98) and therefore was not lecturing in those semesters. The relative lack of authority that we assistant teachers had may well explain why the classes didn’t produce as many testats. Also the fact that in the summer semesters attendance tends to be lower than in the winter is a factor. When we reversed the traditional rhythm and taught fake.space in the winter term in 1998 we could verify this

1 The numbers listed here do not correspond exactly to the numbers used in the statistical analysis of the case study classes in chapter 6. The reason for this is that the listing here shows only regular students taking part in the class, while the analysis needs to take all contributions to the database into account, which in some case included authors with a special status (most importantly the assistants who were also listed as authors and sometimes made contributions to the class database)
point. After the disappointing turnout in the summer semester of 98, we wanted to find out, how fake.space would fare in the winter term. Though with a lower attendance than earlier semesters (which was not surprising, as a good part of the eligible students had taken the mandatory CAAD intro class in the first two years at that point) the class worked really well and in fact had a better ratio than the second or third Phase(x) classes.

3.2.5 Missing Context

Other more circumstantial factors also influence these statistics. The number of people signing up was particularly high in the WS of 97, because the limit of 120 slots in the sign up period was no longer maintained, then. This new policy was adopted because there were additional computers available that students could work on and the two database supported classes in the preceding semesters had shown that it was possible to accommodate more participants. By only looking at those students that actually submitted the first assignment and thus filtering out the ones that had signed up just in case, changes the statistics in favor of the case study projects. But one should also add that the environment was changing in other ways than just in the way the class was taught. Signing up for the Wahlfach had been the valuable entry ticket to the CAAD computer cluster before 96 as it allowed students to do other work than just the classwork on the workstations available to them there. From 1996 on, every architecture student automatically got access rights to the large new departmental cluster and our smaller cluster (and with it the registration for the Wahlfach) had lost much of this additional appeal.

So there is more proof of how potentially misleading these figures are because they don’t show relevant context information. In the end, maybe the only thing that can safely be said based on the success statistics is that the classes of the case study period were the largest ones ever taught in the Wahlfach and that this was accomplished with the same number of teachers and without affecting the success rate.

3.2.6 Stylistic Comparison of Student Design

As pointed out above, the assignments of the case study period and those of the principia classes were different in scale and in nature and should only be compared using the best designs of both classes, because that’s all that is documented in the case of the older classes. As the assignments are about applying principles of Computer Aided Architectural Design, the level of coherence between the task set and the results that were handed in can be seen as a measure of success. For the evaluation of the designs, this seems to be the only reasonable way to judge the effectiveness of the teaching, although of course it will not tell us anything about the quality or relevance of the topics covered.

It can be supposed that the best results of either classes met the expectations of the instructors in terms of the design concepts that were to be explored in an assignment. So the comparison between the results will ultimately be more a stylistic one. Since the use of CAAD software and the choice of the task, especially in a CAAD class, tends to generate a certain look in the student designs, the comparison will have to focus on the nature of this look and how consistent it is with the goals of the teaching.

A stylistic comparison may seem very subjective, but it turns out that some rather clear observations can be made at this level. The pictures on color plates 4 and 5 show some of the more interesting, yet also typical works from both classes in juxtaposition. The Software used was in both cases AutoCAD, with customized extensions provided by the chair. The only exception is Phase 9 and 10 in Phase(x), where the program Sculptor was used in combination
ex1: Composition on the plane

fig. 4.1-4: Principia ws95: examples from exercise 1. Phase(x) took up many concepts from Principia and uses the same software (AutoCAD).

ex2: Objects on the plane

fig. 4.9-12 Principia ws95 exercise 2. At this stage, principia works tend to be more more elaborate.

ex3: Hierarchical Structures

fig. 4.17-20 Principia ws95 exercise 3. Principia models tend to work with the square grid.

p1: rectangle  p2: extrude

fig. 4.5-8 examples from Phase(x) ws96. Phases 1 and 2 were done in the same time as exercise 1 in Principia.

p3: split  p4: rotate

fig. 4.13-16. Phase(x) works are more dynamic and involve switching of authors. For every Principia exercise there are two Phase(x) phases.

p5: solid  p6: cut

fig. 4.21-24. Phase(x) models bear accidental traces, they exhibit a different type of complexity.
fig. 5.1-4 Principia ws95 exercise 4. Detailed models in perspectival view.

**ex5: Façade / Inner Space**

fig. 5.9-15: Exercise 5 in Principia was a more involved design of a façade or an inner space.

**p7: substitute**

**p8: instantiate**

fig. 5.5-8 Phase(x) phases 7 and 8: similar level of detail with more unusual, irregular parts.

**p9: model**

**pX: render**

fig. 5.16-21 In Phase(x) the final phases were as short and simple as the rest.
with the Rendering software radiance. These tools were also used in the fifth exercise of the Principia class.

As there were twice as many phases in Phase(x) than exercises in Principia, it is no surprise that the Phase(x) assignments on average are simpler in scope. The Principia results are more quintessential and more elaborate. Yet the level of geometric complexity that the designs reach after a number of phases tends to be higher in Phase(x) than in Principia and there is a certain dynamic in many of the Phase(x) results which the principia designs lack. This may also have to do with the fact that the third dimension was entered earlier in Phase(x) than in the Principia. But mainly it is due to the fact that the designs in the Principia class, because they are by one single author, tend to have one clear and consistent compositional strategy, whereas we can observe a layering of design ideas by different authors in the Phase(x) examples.

The final exercise in the Principia class has the scope of a larger design assignment. There is no equivalent in Phase(x) where all assignments had the same relative importance. It is therefore not surprising that the final assignments of the Principia class are clearly superior to the tenth phase in Phase(x). To put more emphasis on the process as a series of small assignments rather than on a larger final assignment was a measure taken to cut down on the time demands the course put on people. As it was not as effective as it was hoped to be, the tendency in subsequent semesters was to go back to fewer assignments that could be dealt with more in depth.

Putting less emphasis on the individual phases, where a lighter, more playful approach to design was sought, Phase(x) promotes the idea of process and of collective authorship, while strictly single authorship was maintained in the Principia classes. Whether one sees this multi-author layering as a good thing or whether one prefers the more uni-intentional designs of the Principia classes is ultimately a rather subjective question. Those interested in typology will probably prefer the principia designs and the personal documentations of the @Home classes. Architects that read the city as a palimpsest (Corboz, 1983) on the other hand may find more interest in the Phase(x) objects or the fake.space stories. Taken all circumstances into account, it would be hard to argue that students’ designs were better or worse in one of the classes. The case studies do however offer a potential the Principia classes lack: the peer to peer learning through collaboration. Since it is this type of learning that ultimately differentiates the two teaching methods and since all other comparisons cannot be taken much further, the evaluation of the case studies must concentrate on this collaborative aspect.

3.2.7 Summarizing the differences

The comparison of the summative evaluations of the case studies and the Principia classes make it difficult to say which of the respective pedagogies is more successful. Their success rates indicate no clear tendency, especially when all the circumstantial factors are taken into account. It’s fair to say that both types of classes worked and were equally successful in their respective ways.

The most notable differences can be observed in the student designs. These differences can be attributed to two main factors: The first is that there was a stronger emphasis on process in the case study classes. This is apparent in the more numerous assignments and the lack of a main final project. The second is the emphasis on peer to peer learning. The sharing and exchanging of ideas and design content in the case study classes clearly left its mark on the designs developed by the students. These two factors represent the main differences in the pedagogy, but they cannot be assessed well through summative evaluations. Instead they are more aptly investigated by means of formative evaluations.
3.3 Process Evaluation of the Case Studies

There were no formative evaluations done during the case study projects. So at first glance it seems pointless to discuss them here, as doing them after the fact would seem a contradiction in terms. However since all of the students’ submissions and many of their interactions and exchanges (including in most cases a timestamp) were recorded in the class databases, the evaluation of the processes can still be undertaken after the fact. Rather than formative evaluations they should more appropriately be called process evaluations. The main point however is that the unique nature of the case studies allows for such an evaluation to be performed after they are over, which in itself can be seen as a powerful argument for this pedagogical approach.

3.3.1 Boundaries of Groups

The lab teaching in groups played an important part in both the case studies and the earlier courses. While theory was taught in the lecture to the class as a whole, the lab sessions happened in groups of about twenty students, assigned to one assistant as their instructor. Their purpose was to provide the instructions and the skills-teaching needed to complete the assignments. But they were also more personal and allowed for individual discussions and for getting to know the other students in the groups. Obviously the personal acquaintance between the students made it easier to ask each other questions and help with the many operative problems that tend to come up in computer-related classes. The bonding of the groups was further strengthened by the types of discussion that were specific to the individual groups, as each of the assistant instructors had a personal style of teaching. There were also email aliases for the groups set up that the instructors or any of the group members could use to send email to all group members at once.

So clearly, there was an emphasis on peer-to-peer learning in all of the teaching projects, not just in the case studies. The primary unit for this peer-to-peer interaction was the group, especially in the earlier projects. The case studies tried to intensify and broaden this peer-to-peer exchange by establishing the online environment as an additional way for the students to interact and exchange data and ideas. To test whether the online environments actually delivered in this respect one can investigate how far the boundaries of the groups were maintained in the online linking and exchanging behavior of the students. If there is a clear preference to stay within the limits of the group apparent in these linking and exchanging patterns, the respective case study project must be considered unsuccessful in its claim to promoting peer-to-peer exchange more than the previous classes did.

Exchanges beyond the boundaries of the groups are a quantifiable indicator of the success of the online environments as peer-to-peer communication and learning interfaces. An analysis of this can be performed for all the projects. The details of how this was done are different in each of the projects and is presented along with the results in their respective evaluation section.

3.3.2 More Objective Assessment of Peer Designs

The online environments give students access to a larger pool of references, one that, as was pointed out in the previous section, transcends the boundaries of the lab groups. The boundaries of the groups are strong in the classroom teaching, but very much downplayed in the way the web environment functions. If the students choose precedents outside of their groups, it means that they take advantage of the web environment. Another hope or expectation of a rather related nature pertains to the choice of references by the individual students. In a studio
situation or during a lab session for most students it is psychologically awkward to ask for help or advice or to just simply look over the shoulder of someone they don’t already know. The web environment tries to minimize this psychological barrier, by enabling the viewing and taking over of someone else’s work in an indirect fashion that is free from underlying social codes or expectations. It is important to note that these transactions are not meant to replace, merely to complement the group interaction in the classroom, which, as was pointed out, continued to be an essential part of the teaching. Nevertheless, if successful, these impersonal transactions paradoxically can be expected to lead to more personal choices. Because they are less shaped by social or interpersonal influences they will be more tailored to the students’ individual preferences. One can argue that this way of choosing which designs to look at and learn from is in the original sense of the word “more objective”, as the designs are isolated from their authors and thus more reduced to their object-character. It doesn’t automatically follow from this that the decisions that are made in this objective manner are also more rational, however, but that would be quite impossible to measure anyway.

To test whether the linking patterns are indeed more objective is difficult, but it can be done under certain assumptions. The main assumption is that in the majority of the cases, the linking behavior will not follow a certain pattern. In a traditional setting where exchanging data and collaborating on narratives is the task, most authors would be expected to choose the work of someone they know or with whom they get along well or whose previous work they like. We could expect to find many cases of people trading back and forth, of repeatedly linking up with the same partners or of forming circles or groups of likeminded authors that share their work. It is much less likely that such patterns will form, when the choice is mainly based on the objective assessment of the available works in the database. So under this assumption one can show that the social dynamics are not a strong factor in choosing precedents in the works of their peers, if patterns of crosslinking between friends, of repetitive relinking to works of the same person etc. are the exception and not the rule. A lack of such patterns would indicate that the choice of precedents happens in a rather objective fashion.

This proof is more difficult to make and the assumption it is based on is debatable. Indeed the patterns that are described as signs of socially motivated choices could also emerge when choices are based on the content of the work alone. But even where no sufficient proof can be made, visualizing those patterns shows the range of behaviors that occurred. This in itself provides interesting feedback about the nature of the web environments. A more extensive discussion of these implications in the different projects is presented with the results in their respective evaluation section.

3.3.3 Bias inherent in the web environments

The impersonal linking patterns open up a number of issues pertaining to the design of the web environments. The web environments were not impersonal in the sense that they tried to conceal information – quite the opposite: all relevant information about the works (like authorship, group-affiliation, time of submission, rating, other works by the same author) was more or less directly accessible. But the expression “more or less directly” points to a potentially severe problem. The obvious question is how far the design of the web environment itself distorts the presumably objective choices it is supposed to enable. As will be discussed in more depth when dealing with the issue of transparency, there can be no absolute equality in the display of information. Even the most considerate way of displaying large quantities of information will introduce involuntary distortions. They can be questions of sequence or
positioning due to alphabet, affiliation, time, etc., or they can be differences in legibility due
to size, lengths of names, choice of colors, etc. to name just a few. The best a designer of such
displays can do is to keep these inherent distortions as small as possible and to make the reader
aware of them. But that won’t eliminate them.

So the question is not whether the online display of the data introduces any distortion. The
question is how severe the effect of this distortion was in the case studies. As the claim was made
that the choice of a precedent could be done more objectively through the impersonal mediation
of the website, it must be ruled out that the bias of the online display is more important for the
choice than the personal preference. If the bias inherent in the web environment is a strong
factor, this must be considered a problem.

The way to investigate this tricky question is by studying the impact of the most obvious
distortion: the default display of designs. Although the arrangement could be customized in
various ways in the different projects, the default display showed in all cases the most recent
submissions. The degree to which a correlation between being part of the default display and
being chosen can be established can be used as an indicator of how strong this distortion was
in the case study projects. As the design of the websites became more sophisticated with every
new version of the projects, the results can also be compared and provide some answers as to
what design measures successfully reduced the impact of the different distorting effects.

3.3.4: Summary: Three Criteria To Evaluate

Thanks to the documentation in the database, process evaluations of the case studies can
still be performed in retrospect. Three different questions were proposed that can be assessed
quantitatively and are indicative of the success of the projects. The first was called ‘Boundaries
of Groups’: If the online collaboration and exchange transcends the boundaries of the student
groups, the case studies successfully enhanced peer-to-peer exchange (and as a consequence
presumably peer-to-peer learning). The second was referred to as ‘More objective Assessment
of Designs’: If the individual linking and referencing patterns show great variability, rather
than repetitive patterns, it can be concluded that the assessment of the peers’ work is not
guided by social pressures or inhibitions. The third was named ‘The bias inherent in the web
environments’. Here it is argued that the impact of the default display on the likelihood of a
design to be selected can be analyzed to get an indication to what degree the web environment
itself conditions the interaction between the students and their works. All of these questions
need to be more thoroughly explained for the individual case study projects.

These are certainly not the only quantitative analyses that could be performed with the data
available for the case studies. But they suffice as ways to put some of the case studies’ claims
to a quantitative test. The specific means that were developed to perform these quantitative
tests: the ‘Analysis Outworld’ tool and the ‘Distortion Maps’ will be introduced in the opening
chapter of the case study section.
4 On Processes in Design and Learning

4.1 Two Kinds of Processes

The last chapter established process evaluations as the main method of evaluation for the case studies. Before these process evaluations can be undertaken it is necessary that we come to a better understanding of the nature of these processes. One thing all of the case studies have in common is that they can be described as two kinds of processes: as individual learning processes of the participants and as collective processes that the whole networked group of students were a part of. This chapter investigates these two different types of processes and analyzes in which way they are related. To do so, it introduces the theory of memetics. Memetic theory not only provides a way to describe the mutual dependencies between these two processes, it will also allow us to put the empirical findings of the case studies into a broader context. I will argue that they can be described as case studies in memetic engineering and that the empirical findings of the process evaluations provide insights into certain aspects of cultural evolution and creativity.

4.1.1 Individual Learning

Individual learning must be the bottom line of any pedagogical effort. Individual learning processes have traditionally been thought of as being in contradiction with collective learning, as it was never clear whether the individual or the group was the main beneficiary of the collective processes. This thesis offers ways to think about this interaction differently.

What is generally noteworthy about the way the individual learning could take place in all of the different environments is that many different modes of learning were available concurrently. Through lectures, workshops, assignments and (online and offline) interactions and exchanges with their peers, the students enrolled in the case study projects could build up both knowledge about and skill in architectural design with digital media. Their project work, the different digital artifacts they created for the different assignments, provides the evidence that these learning processes indeed took place and presumably gave them a sense of accomplishment.

Obviously the students could learn directly from their instructors. Lectures and workshops offered both theoretical background and hands on instructions about the topics covered and about the assignments. To complement the lectures and workshops, online and hardcopy versions of the syllabus were available that contained software tutorials, a glossary of terms and other texts and information related to the class work.

Just as important as these traditional means were the different ways the students could learn from their peers. As the computer cluster was used almost exclusively by students enrolled in these classes, there was always a good chance that a neighbor could help out when some problem came up.

More characteristic of the case studies are the indirect types of peer-to-peer learning they emphasized. The participants were part of a network. The networked environments always presented all works by all students and on top of that also allowed the students to continue to
work on a file or an idea that one of their colleagues had previously submitted to the course database. It is this last type of peer-to-peer learning that links the individual learning processes with the collaborative, networked process that all participants were a part of. This networked collaboration is the other type of process we can observe.

4.1.2 Collective Process

While the participants are the subjects of individual learning, for the collective process the entirety of all individual contributions is what we need to look at. In a sense, thereby the objects become the subject of our investigation. As was stated earlier, an essential characteristic of the type of collaboration that took place in the case studies is that it was collaboration among equals, without hierarchies. With the exception of the EventSpaces class, where so-called Special Interest Groups were introduced in the second half of the semester, no special roles were assigned to the participants in any of the projects. No one had to take orders from anyone. The participants’ status was entirely defined by their contributions to the process, which is to say by the assignments they uploaded to the database and by the way these assignments were then taken up or linked to by other authors. While the assignments could be traced back to their authors, they nevertheless were treated as independent entities, separated from their authors and free for anyone to take up and develop further. To understand how the collective process happened we therefore need to concentrate our investigation on the relationships between the individual works rather than between the individual authors.

4.1.3 Evolution of ideas

Some of the collective processes in the case studies (especially Phase(x) and VDS) follow an explicitly evolutionary pattern. The graphics on color plate 6 explain the difference between Phase(x) and the traditional cultural model, referred to as the Gutenberg Galaxy (McLuhan, 1962). The Gutenberg Galaxy is dominated by single authorship, usually in printed works, which, as McLuhan states “fosters a mentality that gradually resists any but a separative and compartmentalizing or specialist outlook” (McLuhan, 1962, p. 126). That different authors and texts can influence one another in the Gutenberg Galaxy is generally acknowledged, but it is always speculative. In Phase(x) however, the two processes, the contribution of the individual author and the exchange with others, can clearly be observed. Submissions from one phase (assignment) are taken up and continued by different authors in the next. So the phases are like different generations of an evolutionary process. As one work can be picked up by more than one author, some others will not be continued. The Darwinist principle of the survival of the fittest can be observed very clearly. While some projects are continued throughout all phases, others aren’t picked up by anybody and are left behind. Natural selection is cruel. It’s good to remember that we are just talking about the submitted assignments, about CAAD files, digital information in bits and bytes. But at the same time it’s interesting to ask what constitutes the fitness of these files.

The point is: in the collaborative environments of the case studies it is possible to treat the student’s designs as subjects and to observe if and how they evolve – one can witness the evolution of ideas.

The notion that ideas, languages and cultures evolve in similar ways as biological forms do is not new. Such analogies have been drawn from the early days of Darwinism (Blackmore, 1999, p. 24). More recently a new theory has emerged that takes this notion further: the theory of memes or memetics. This theory is used here, to analyze both afore mentioned processes.
COLOR PLATE 6: Gutenberg Galaxy vs. The Phase(x) Principle

fig. 6.1: The traditional model of cultural processes, the Gutenberg Galaxy, revolves around the notion of single authorship. Authors are the subjects, relationships and influences between authors can only be speculated about.

fig. 6.2-9: The Phase(x) principle as an alternative model of cultural processes: authorship is maintained, but the exchanges between authors become explicit and can be tracked. The works are the subjects.
as different memetic processes. This will lead to the question whether and in what way the networked environments can be said to support memetic engineering, as we have claimed (Hirschberg & Wenz, 2000).

4.2 Theory of Memetics

The theory of memetics proves helpful in understanding and evaluating the networked environments of the case studies.

The word meme was coined by zoologist Richard Dawkins in his 1976 book “The Selfish Gene”. The book’s central topic is what has been described as the most important addition to Darwinism in the 20th century: the idea of genes as replicators. Of course genes are not selfish in the sense that humans think of selfishness: they have no self-concept, they do not think. They are replicators, entities that create identical replica of themselves. The better they are at replicating, the more numerous their replica will become in the gene pool. Following this theoretical approach, the genes can be regarded as the true actors of genetic evolution. Dawkins takes the gene’s point of view, presenting a world in which all life forms have evolved to best support the replication of their own genes, they are merely the genes’ hosts. Genes can be said to be selfish, because only those genes that successfully instruct their hosts to secure their replication will survive. W. D. Hamilton introduced this way of thinking to evolutionary biology (Hamilton, 1964). Most controversially, he has explained altruistic behavior through this mechanism. Despite all controversies, the basic principle Hamilton proposed has now been widely accepted and is considered one of the most successful models in evolutionary biology (Schmid-Hempel, 2000).

"A unit of imitation"

The philosopher D. Dennett investigates the far-reaching consequences of this theory, which, for its simplicity, he likens to an algorithm (Dennett, 1995). He also argues that the same algorithmic logic would apply to memetics. Which brings us back to Dawkins. In “The Selfish Gene” (Dawkins, 1976), Dawkins argues that the theory of the replicator does not have to be limited to biology.

_Darwinism is too big a theory to be confined to the narrow context of the gene._
(_Dawkins, 1989, p. 191_)

As another example he uses cultural evolution. He proposes that there, too, we should expect to find a replicator as its driving force.

_The new soup is the soup of human culture. We need a name for the new replicator, a noun that conveys the idea of a unit of cultural transmission or a unit of imitation. Mimeme comes from a suitable Greek root, but I want a monosyllable that sounds a bit like ‘gene’. I hope my classicist friends will forgive me if I abbreviate mimeme to meme. If it is any consolation, it could alternatively be thought of as being related to memory or to the French word même. It should be pronounced to rhyme with cream. Examples of memes are tunes, ideas, catch-phrases, clothes fashions, ways of making pots or of building arches. Just as genes propagate themselves in the gene pool by leaping from body to body via sperms and eggs, so memes propagate themselves in_
the meme pool by leaping from brain to brain by a process, which in the broad sense, can be called imitation.
(Dawkins, 1989, p. 192)

In the spirit of Dawkins one can say today that the theory of the meme and the word itself were successful memes. The theory has found many followers and especially since the mid nineties a number of books by authors from different backgrounds were published that try to establish memetics as a scientific field. A short survey of these books will be given in the next section. The time lag of twenty years from the seventies to the nineties is not unusual as the time it takes for any new theory that challenges the status quo to gain wider acceptance. But the sudden intensive interest in memetics in the nineties also appears to be related to the advent of the World Wide Web. As will be discussed when applying memetic theory to the case studies, the possibility to exchange data in digital form via electronic networks has important consequences for the way and the speed at which memes can spread.

4.2.2 A brief digression: “Memesis – the future of evolution”

Before it can be argued why memetics is useful to describe the collaborative processes, the theory needs to be explained in more detail. But before even getting into that, a short anecdotal digression shall serve to illustrate two things:

- Memetics has been part of the way these projects have been conceived from their first beginning.
- Memetics is not (yet) considered an established scientific theory. Until recently it has mostly been hyped rather than seriously discussed – some examples of this hype are cited. Nevertheless there is also a serious discussion of memetics to which this thesis wants to contribute.

In 1996, the year of the first Phase(x) course, the Ars electronica symposium in Linz, Austria, was held under the title “Memesis – the future of evolution”. The symposium takes place every year as part of the week long Ars electronica conference, arguably the most important venue for electronic art in Europe. It can be said to have a track record of early adopting and discussing topics and questions of cultural relevance. The symposium on memetics was held 20 years after Dawkins coined the term, but at a time, when it was only just starting to appear in the cultural mainstream.

As some members of the CAAD chair attended the symposium, it became an inspiration for the first Phase(x) course – if not in the way it was initially conceived, then certainly in the way it was discussed and presented. The paper Florian Wenz and the author co-wrote about Phase(x) was titled Phase(x) – Memetic Engineering for Architecture (Wenz & Hirschberg, 1997). It was Florian’s title – I was a bit reluctant to adopt it at first. Too many things about the meme theory seemed to be too vague and too much hyped at the time.

Partly this was due to my ignorance – I did not know much about memetics before we started discussing it in the wake of the symposium. But partly it was also due to the way memetics was dealt with at the conference. While Dawkins in 1976 had been hesitant about the etymological construction of his coinage, the organizers of the symposium ingeniously extended the field of reference to the biblical Genesis. This alone can serve as an example of the sort of mutations the theory of memetics is often subjected to. Clearly it invited the religious rather than scientific fervor that dominates the online discussion about memes that preceded the conference. The
statement the conference chairman issued to spawn this discussion was itself full of hype and neologisms:

[...]  
The discussion is intended to probe specific segments of the techno-cultural revolution against the background of the idea of a “culturally based history of creation”. This is not to develop new utopias, but rather critically assess the current scenario, which promises the fulfillment of long prophesied visions of the future.  
The possibility of the emergence of a post-biological, cyberorganic line of evolution out of universal binary code systems, of which the first protozoans have names like Internet, Cyberspace and I-way.  
As the biological body coincides with its mechanical and now informational clone as well, neurobionic, robotic prosthetics question our relationship to the body and to gender; cyborg theory and cyberbody fetish as response.  
Media memory - the collective memory and experience of humanity externalized in world-wide networks. Memes, as a “mass crystal”, the identification and integration of virtual communities that gather only in network interfaces.  
[...]  
(Stocker, 1996)

Based on this, the discussion, which included a number of rather well known artists, scientists and writers, took strange paths. Memetics was accused of being a fascist theory, designed to protect neoliberal political agendas etc.

While the discussion was not very helpful, the symposium was still an inspiration for our new direction of teaching. A main influence was Francis Heylighen who stood out as one of the clear thinkers in the discussion, and who also wrote an interesting paper in the symposium proceedings (Heylighen, 1996). But before we go on to describe the relevance of memetics for the case studies, some common doubts about its value as a theory shall be addressed.

Popular discussions of the above type are not the only reason, why meme and memetics are usually put into quotation marks when scientists mention them (if they dare mentioning them at all). One problematic factor appears to be the very close etymological proximity of meme and gene. Even though this proximity is an artificially constructed one, or maybe precisely because of that, it has not always been good for the theory of memetics. Dawkins had originally suggested to use memic as the adjective pertaining to meme. But memetic, presumably because it sounds more like genetic, has become widely used. (Dawkins now uses it, too.) As Susan Blackmore argues in her book “The meme machine” (Blackmore, 1999), and her article in Scientific American (Blackmore, 2000), much of the criticism that memes have received from different sides is due to the overdrawn analogy that people make between genes and memes (Blackmore 2000, p. 73).

4.3 The State Of Memetics As A Science

As mentioned above, a number of books on the subject of memetics have appeared. The most well-known among the authors are of course Dawkins himself, who revisited his coinage in later books, and the philosopher Daniel C. Dennett. Both Dawkins and Dennett are best selling authors and have done much to make the notion of memes a topic of popular discourse. The fact
that a philosopher and a zoologist are the two most well-known proponents of a new scientific theory about cultural evolution is indicative of both the appeal and the problem of the theory: it is so broad in its scope that it's neither clear what training the real specialists of memetics should have, nor what empirical research in the field of memetics could or should look like. It is not surprising, then, that the memetic movement that started in the mid nineties included authors from outside the academic mainstream, such as the former Microsoft executive turned motivational speaker and professional poker player, Richard Brodie who wrote *Virus of the Mind: The New Science of the Meme* (Brodie, 1995) and Aaron Lynch, a mathematician and philosopher who worked for many years as an engineer, who wrote *Thought Contagion: How Belief Spreads Through Society* (Lynch, 1999). The social sciences, however, that one might have expected to jump on the prospect of having a new explanatory model at their disposal, remained rather skeptical if not downright dismissive of the theory. One critic called it “a pseudoscientific dogma” and “a dangerous idea that poses a threat to the serious study of consciousness and cultural evolution” (Benitez-Bribiesca, 2001, p. 29). As Robert Aunger writes in his introduction to ‘Darwinizing Culture’ (a book he edited and which brings together many of the leading intellectuals debating the issue of memetics): evolutionary theory is applied to ever more fields of research, but the social sciences have long resisted this ‘evolutionarization’ (Aunger, 2000, p. 1).

Nevertheless, probably the most interesting and thought-provoking book on the subject was written by a psychologist: “The Meme Machine” by Susan Blackmore. She boldly takes Dawkins’ notions about memes further, proposing her theory of the memetic drive as a compelling explanation for things that have so far been inexplicable to fields such as sociobiology.

Before we look at Blackmore’s take on memetics which I will largely adopt for the discussion of the case studies, more closely, some general remarks about the state of memetics as a science are in order. To make it short: for the moment there is no established science of memetics. Even the research journal of memetics, which was published during eight years, has ceased to appear in 2005 (although it is announcing a relaunch). Interesting books about memetics along with their dismissals continue to appear. The fundamental problem that there never was a clear cut academic community that claimed memetics and instead the situation that anyone that had read a couple of books about it felt entitled to publish their own version of the theory, this situation persisted and has kept memetics from becoming acceptable so far. Mostly, though, it seems that the problem of memetics in the academic arena has been its lack of a basis in sound empirical research.

Of course this thesis could be taken to be just another example of this very problem: its author has no credentials in the social sciences and approaches the topic largely as a dilettante. What is different, though, is that in this case there actually is plenty of empirical data to work with. And there also is a situation that makes the nit-picking about how the transmission of memes could or should work, irrelevant. As will be explained later on in more detail, the situation in the case studies was so highly artificial and unique that it could almost be called a laboratory experiment about memetics. The case studies show memetics at work: they can illustrate the theory and the theory is capable of describing them. There is such a thing as memetic engineering. This thesis presents empirical proof of it.

The other reason why the “dangerous” theory of memetics is taken up here is the topic of creativity. Strangely, none of the authors that have written about memetics spend much time dealing with this issue. Of course they mention variation and mutation, but they don’t explore it in more depth. Blackmore’s chapter about creativity is just over one page long (Blackmore,
1999, p. 239-240). Distin actually tries to reconcile evolution and design (Distin, 2005, p. 181), but even though she describes how engineers approach a problem and how they test and dismiss ideas as possible solutions, she never asks where those ideas come from. As an architect one may have a somewhat different take on the subject: the question how new ideas come about, is the very reason why memetics is interesting to us. While much of this thesis just applies memetic vocabulary to describe the case studies, the one extension of memetic theory it proposes is an admittedly rather speculative memetic theory of creativity. But we are getting ahead of ourselves. First the meme theory must be presented with a bit more detail.

4.4 Blackmore’s Meme Machine

Of all books that deal with the theory of memetics that have appeared to date, Susan Blackmore’s “Meme Machine” (Blackmore, 1999) is the most compelling. While some of her views are disputed even inside the memetics community, her book has remained the most important reference about memetics. Her defense of memetics that was published in Scientific American along with position papers of three scientists that disputed it, stands up well. The main points of the critics and her replies are outlined further down.

In her book she argues that there are at least two commonly accepted criteria over what makes a scientific theory valid. First, a scientific theory should be judged by whether it is able to explain things better than its rival theories; more economically or more comprehensively. Second, it must lead to testable predictions that turn out to be correct. Ideally these should be unexpected outcomes that one would not have been able to predict without the help of the theory (Blackmore, 1999, p. 9). Blackmore takes on this challenge for the theory of memetics, arguing that it offers elegant explanations for a number of phenomena sociobiology\(^2\) has so far been struggling with.

4.4.1 The memetic drive

The human eye has been a prime example of people doubting evolutionary theory. Such an incredibly complex arrangement of parts could impossibly just come together by mere accident is the classical criticism that has been raised since Darwin’s times. Evolutionary theory is established today precisely because natural selection is the only power known that can produce such complexity – step by step, over times far outside the scale of human imagining. The human eye is nothing short of marvelous, but its evolution can be explained because being able to see represents such a tremendous advantage, that selection pressures for developing and refining vision are very high.

In other cases, it is much harder to find these selection pressures. There is no accepted theory today that explains why humans developed big brains or language. Unlike eyes, which we share with many species, our brains are rather unique. Not only are they much larger in proportion to our body than those of other species, they are also uniquely predisposed to process language, thought and reasoning – all unique to mankind. Blackmore argues that memes can explain what has been inexplicable so far.

“The mystery of language origins apparently presented us with an unpleasant choice – abandon hopes of a Darwinian explanation or find a function for language. But this is only a forced choice if the function has to be for the genes. If there is a second

\(^2\) For standard literature of sociobiology see Wilson, 1971, and Wilson 1975

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replicator this is no longer the only option. I shall argue that once imitation evolved and memes appeared, the memes changed the environment in which genes were selected and so forced them to provide better and better meme-spreading apparatus. In other words, the human language-capacity has been meme-driven, and the function of language is to spread memes."
(Blackmore, 1999, p. 93)

Blackmore introduces memes as the second replicators that co-evolve with genes but are at the same time independent of them. In Blackmore’s view, there is no primacy of the genes over the memes, a point in which she differs considerably from the common positions held in sociobiology.

In a nutshell, her argument goes like this: Memes came to exist, when people started to imitate. Imitation can give a better chance of survival as it allows the adopting of useful skills, such as making tools, eating the right foods, making fire, etc. As soon as good imitators start becoming more numerous in the gene-pool, the predisposition for imitating will become more and more common, providing the ground for the second replicator: the memes. As replication processes don’t follow a purpose or goal, but simply the survival of the fittest, the memes will not necessarily benefit the genes. Once being a good imitator is established as a sign of fitness, the good imitators will be in competition and prove their imitation skills at other arts than the ones that will necessarily benefit our fitness. Depending on how things evolve, imitators may be recognized by their ability to dance or to sing or to paint. This co-evolution of memes and genes results in what Blackmore calls the “memetic drive” that can explain many unique developments in human evolution.

This is not the place to explain Blackmore’s theory about the memetic drive in more detail. She takes Dawkin’s idea of a second replicator further than he ever dared (Dawkins, 1999) and develops it into a theory with the power to give new insights and new explanations. Blackmore’s take on memetic theory is something entirely different from the discussion about memes that was quoted from the Ars Electronica web forum. Still memetics is far from being accepted. In fact it receives rather fierce criticism from many sides.

4.4.2 Blackmore responding to critics

As Blackmore herself deals with some of the most frequent criticisms that the theory is confronted with, the following paragraphs try to briefly summarize her arguments, to which she devotes a chapter in her book (Blackmore, 1999, p. 53-66). They will lead to the essential aspects of memetics in the context of this thesis: what are memes and what do we know about the mechanism of how they are spread.

Criticism 1: ‘We cannot specify the unit of a meme’

Are just the four opening notes of Beethoven’s fifth a meme, or should we consider the whole symphony as a meme? Some people see this as a problem, but Blackmore doesn’t think it matters. She points out that the unit of a gene will be defined differently by different scientists, too. Blackmore suggests we should be flexible with our definition: the meme is ‘whatever is passed on by imitation’ (Blackmore 1999, p. 56).
Criticism 2: ‘We do not know the mechanism for copying or storing memes’

Blackmore points out how far evolutionary theory got before DNA was even heard of. While she predicts that we shall eventually know much more about these mechanisms, she suggests that it’s okay to make some educated guesses for the time being.

While the ‘internalists’ among memetic theorists, such as Robert Aunger, insist that memes can only be stored in brains, in Blackmore’s take on memetics, memes can take on many different forms, they can be written down, stored on computers, transmitted via soundwaves etc. Thus she avoids terminology like ‘meme vehicles’ that Dennett has introduced.

From the point of view of the internalists, this is the main flaw of Blackmore’s theory. A strictly internalist version of memetics is presented by Robert Aunger in his book “The Electric Meme” (Aunger, 2002). It is devoted almost entirely to developing a theory of memetics in which memes exist in only one single form. He calls it the single-substrate rule. To him “Memes can’t be translated from brain stuff to signal stuff and back again” (Aunger, 2002, p. 236). Signals and artifacts to him are instigators of replication, not replicators themselves. Thus, instead of calling artifacts memes, as Blackmore would, he introduces the notion of “artifact-based signal templates” (Aunger, 2002, p.293). As a consequence of this purist approach, he refers to the relationship between evolving memes and artifacts as a co-evolution. While he states that “only a unified Darwinism, using a single set of principles for both memes and artifacts, can place such disparate phenomena into a common analytical framework” (Aunger, 2002, p. 300), he himself is not prepared to offer such a framework. At the point in his book where he would have to describe this co-evolution of memes and artifacts he states that “an entire class of relationships will have to be developed to deal with the varying kinds of relationships that memes and artifacts can have together. This simply hasn’t been done.” (Aunger, 2002, p. 300) He concedes that this is “somewhat unsatisfactory”. In fact it basically leaves all that is interesting about memetics for others to figure out. Aunger’s main hope is that based on his theory electric memes could one day be discovered neurologically in brains. Until then, for lack of empirical evidence, memetic research would probably have to be suspended, although, as he puts it in his closing remarks “the study of the most complex evolutionary process we know – cultural evolution – looms as one of the most significant and exhilarating undertakings in science today.” (Aunger, 2002, p. 334)

Faced with so much long-winding, yet inconclusive theory, one appreciates the wisdom of Blackmore’s refusal to adopt a more complex terminology for the time being.

To conclude - it is true that we do not know in detail how memes are stored and transmitted. But we have plenty of clues and we certainly know enough to get started.

(Blackmore, 1999, p 58)

Criticism 3: ‘Memetic Evolution is Lamarckian’

This criticism points to the difficulties with analogies between memes and genes. Lamarckian here stands for the inheritance of acquired characteristics, one of the theories proposed by Jean Baptiste de Lamarck that have long been proven wrong. Blackmore argues that the question whether memetic evolution is Lamarckian best not be asked, because it is based on the distinction between genotype and phenotype that is clear in genetics, but does not have an equivalent in
memetics.

Because it is important in the context of our own usage of the term meme, a bit more time needs to be spent on this point. Many authors that write about memetics try to find the equivalent of the phenotype in memetics – with little success. F. Heylighen argues that the equivalent to phenotype is the sociotype: the group of people that share a meme. This analogy is interesting when the meme is a religion (religion is a favorite example of memetic theory), but of little use if the meme is a recipe for making soup. Realizing that the analogy is shaky, Heylighen adds that as memes are less precise than genes, the sociotype is also fuzzier than the phenotype (Heylighen & Campbell, 1995).

Blackmore is concerned with the question of fidelity, too, but doesn’t come to the same general conclusion as Heylighen does. She suggests that memes can be replicated with extremely high fidelity (think of Einstein’s E=mc²) in some cases and with very low fidelity in others (jokes that are told differently by different people).

Instead of phenotype and genotype, Blackmore suggests a different terminology. Using recipes that are written down in a cook-book and recipes that are reverse-engineered after tasting a dish as examples, she calls her two categories of memes “copy the instructions” and “copy the product” (Blackmore, 1999, p. 61).

This solves some confusion, but also points to the fact that memes can be passed on in many different forms. In fact, one main criticism of memetic theory revolves around the definition of imitation. It is necessary to spend some more time with this fourth criticism, though it isn’t separately addressed in Blackmore’s book, as the ways memes can be passed on between people are essential for the discussion of the case studies.

**Criticism 4: People Do More Than Imitate**

There are a number of critics who do not agree with Blackmore’s reaction to criticism 2. While for Blackmore it is simply obvious that culture is spread by imitation, many take issue with this concept and consequently see its unclear definition of imitation as the essential flaw of memetic theory. In fact, Aunger, whose “Electric Meme” was already quoted above, sees one of the advantages of his approach to memetics in the fact that he avoids the notion of imitation altogether. Aunger is aware of the controversy around the term imitation in memetic theory. In a counterpoint article to Blackmore’s “The power of memes” in Scientific American (Blackmore, 2000), H. Plotkin, a professor of Psychobiology, writes “Human culture is about sharing of knowledge, beliefs and ideas. Imitation, properly defined, does not come into it.” (Plotkin, 2000). His own definition of imitation, which he says is based on the prevailing definition in psychological research, is “learning to do an act from seeing it done.” Based on this definition (which Blackmore also mentions in her book, but extends to include other than just visual forms of perception) he dismisses Blackmore’s argument altogether, calling it simpleminded.

Sharp criticism against Blackmore’s definition of imitation also comes from Dan Sperber (Sperber, 2001). He takes issue with the idea of replication by imitation. With a simple experiment he demonstrates how people use previously gained knowledge or experience in imitation. In this he sees a contradiction with what he describes as the “three minimal conditions for true replication”:

*For B to be a replication of A,*

1. *B must be caused by A (together with background conditions)*
2. *B must be similar in relevant respects to A*
3. The process that generates B must obtain the information that makes B similar to A from A.
(Sperber, 2001)

The examples he uses in his test are two hand sketches, the first one a couple of crooked lines, the second one a five-branched star drawn without lifting the pencil. Obviously people are better at reproducing the star, because to do so they simply need to apply a previously acquired pattern. For Dawkins and Blackmore this falls into the category of “copy the instructions” (the instructions are not actually given in this case, but they are ‘obvious’ because they are known to the imitator) resulting in high fidelity replication, while the other sketch has to rely on the “copy the product” mechanism and will be imitated rather poorly by most people. Sperber argues that the triggering of previously stored information cannot be considered replication and basically discredits memetic theory on this ground.

Sperber does a good job showing how difficult it is to differentiate between the triggering of laughter and the triggering of learned patterns such as drawing a star. But his arguments don’t contradict memetics in any way. He uses the amazing predisposition for language acquisition in human brains to show that imitation is not replication, because it depends on pre-existing dispositions. But he actually just restates Blackmore’s argument that the human brain has evolved to be extremely good at imitation. Blackmore not only acknowledges this fact, she offers a compelling explanation with her theory of coevolution of memes and genes and what she calls the memetic drive. (Sperber in this article never refers to Blackmore’s theory, he only comments on Dawkins’ foreword to her book).

Sperber’s criticism can be paraphrased as imitation is not replication. Plotkin on the other hand says that imitation is not communication. He states “if imitation means any and every manner of communication between people, [...] then the term becomes so vague as to be meaningless” (Plotkin, 2000). Therefore he uses the more narrow definition of the term we quoted above, which in turn makes memetics absurd.

Sperber and Plotkin both have a point. Their critical views are valid, but they don’t really contradict memetic theory. Their main complaint against memetics seems to be that it overly simplifies psychology. Sperber actually published a text in which he argues ‘Why a deep understanding of cultural evolution is incompatible with shallow psychology’ (Sperber, 2006). In this text he accuses memeticists of this shallowness. His own version of cultural evolution uses a different terminology. He refers to Cognitive Causal Chains (CCCs) and Social Cognitive Causal Chains (SCCCs), arguing that mental constructs are not atomic entities, but must be considered as embedded in social and cultural contexts in which they form chains of cognitive events. This makes sense, but is not something that memeticists would disagree with. Sperber actually admits that his theory resembles memetics to an extent, but maintains that it’s different in that his emphasis is not on replication, but on reconstruction of cultural representations.

If I am right, a good part of the explanatory weight in the explanation of cultural stability and evolution should move from mechanisms of inheritance and selection to the mechanisms of construction and reconstruction and to the cognitive and environmental factors that cause these mechanisms to have converging outputs.
(Sperber, 2006)

This change of focus, which we also saw in his example of the five-branched star, is indeed
important for the study of cultural evolution. It does not contradict memetic theory, but rather points out that there is large amounts of research and scholarship available that looks very closely at the issues involved in the broad definition of imitation memeticists prefer. A theory interested in explaining cultural evolution ought to take these findings into account. We shall heed his advice at least to a certain extent as it seems important in our context to come to better terms with the complex subject of perception, which is the prerequisite of both imitation and communication.

4.4.3 Memes and Perception

Ernst H. Gombrich (1909 – 2001) was an art historian who made important contributions to experimental psychology, especially the psychology of perception. In his books “Art and Illusion” (Gombrich, 1960) and “The image and the eye” (Gombrich, 1982) he in numerous ways shows how closely related what we see and what we know are. According to Gombrich, seeing and recognizing an object occur almost simultaneously. Gombrich refers to Popper who likens our everyday perception to the way scientistst form and verify hypotheses about the world (Gombrich 1984, p. 179). Whatever we perceive we try to match with something in our previous experience, that is we form a hypothesis about what it is we perceive and then go on to verify (or, as Popper would have it: falsify) this hypothesis. To put it more extremely: we automatically start guessing what it is we perceive at any moment. We are driven to make sense of whatever signals our senses receive. The more faint the signals, the more we need to fill in by guessing.

Gombrich mostly deals with visual perception, but he mentions that auditory perception basically works the same way. We guess whose voice we’re talking to on the phone and we are able to understand someone talking to us in a noisy bar, because we can guess what the syllables were that were probably said, although they were inaudible due to the background noise. Similar observations could be made about our sense of touch or smell, although their role in communication most of the time is not as important. Apparently our brain constantly decodes these perceptual signals. Decoding means it translates them into information it can make sense of, using guesswork based on prior knowledge or experience. So, decoding actually means forming and falsifying hypotheses. It is essentially a productive process. As various optical illusions famously show, this forming of hypotheses is to a large extent innate. We cannot help but try to see a three dimensional shape in these ‘impossible’ drawings.

4.4.4 Schematic Nature of Perception

Gombrich was not the first to observe the schematic nature of our perception.

*The schematism by which our understanding deals with the phenomenal world ... is a skill so deeply hidden in the human soul that we shall hardly guess the secret trick that Nature here employs.*

Immanuel Kant. Critique of pure reason (translation by E.H. Gombrich)

*Dieser Schematismus unseres Verstandes in Ansehung der Erscheinung ... ist eine verborgene Kunst in den Tiefen der menschlichen Seele, deren wahre Handgriffe wir der Natur schwerlich jemals abraten ... werden.*

(Gombrich, 1960, p. 63)
Kant describes mankind’s perception as innate. For all we know today this is correct to quite a large extent. The relativist view that all pictorial perception is learned and thus culturally shaped cannot be maintained. Gombrich cites the common myth according to which people from primitive cultures cannot understand photographs or perspective representations. He claims it is not true and argues that learning to see familiar objects on a photograph is comparable to learning to look through a pair of binoculars – it may be a bit confusing the first time, but most people can pick it up easily, without the need to be familiar with some cultural context (Gombrich, 1984). Gombrich thus rejects pure conventionalism, the theory that all understanding of images is learned and thus shaped by cultural conventions alone. But he also insists, that cultural conventions do play a role.

Blackmore argues along the same lines, when she proposes to overthrow the Standard Social Science Model of the mind as a blank slate, debunking some of the myths of cultural relativity (Blackmore, 1999, pp. 111-116).

Nevertheless she, too, argues that the innate capability to perceive we have in common with many animals is only one part of the story. There are also many aspects of perception, which are shaped by culture. Different cultures have developed highly sophisticated visual codes. They are all in some way based on our innate ability to perceive things, but at the same time quite impenetrable to an outsider. Written language is certainly the most obvious example of such visual codes, but it’s not the only one. In fact there are many types and levels of messages that can be found in pictorial representations. Most of these will be automatically decoded by people familiar with the cultural context. The difficulty is that it is often extremely hard, if not impossible to distinguish between learned and innate reactions to things we perceive.

But for our context this distinction is not as relevant as what Gombrich calls the distinction between recognizing and remembering precisely. He shows that if we are able to recognize a familiar object this does not mean that we also have a precise memory of this object that would for example allow us to draw it. In his book “The Image and the Eye” (Gombrich, 1984) he shows an artwork of a rural culture, picturing a cow and points out the incapacity of its creator, who presumably spent much of his life around cows, to come up with a pictorial representation of a cow that is faithful to the original in relevant aspects like the position of the horns relative to the ears. Obviously he chose to copy some pictorial representation of a cow rather than trying to come up with a drawing that is entirely based on what he could see in the original. (Gombrich, 1984, p. 14)

In a different essay Gombrich says “painting is an activity and the artist will therefore tend to see what he paints rather than to paint what he sees.” (Gombrich, 1996, p. 107). He then quotes Nietzsche’s mordant comments on the claims of realism:

‘All nature faithfully’ – But by what feint
Can Nature be subdued to art’s constraint?
Her smallest fragment is still infinite!
And so he paints but what he likes in it.
What does he like? He likes what he can paint!

(F.W. Nietzsche, Scherz, List und Rache no. 55 in Die Fröhliche Wissenschaft, Nietzsche Werke 5 (Leipzig 1895), p. 28)

Treu die Natur und ganz! – wie fängt er’s an:
If we ignore the sarcasm in Nietzsche’s quote, what he says is essentially that all pictorial representations of the world are necessarily abstractions. The peasant incapable of drawing a “correct” cow demonstrates that it is no mean feat to come up with such abstractions. It is much easier to copy an existing abstraction instead. Gombrich says “Painting is an activity”. It is a craft, with its set of tools and tricks and its customs and rules that can be learned.

4.4.5 Role of Hypotheses in Perception

We are back at the ‘copy the instructions’ versus ‘copy the product’ question and can try to make a brief summary of our findings that are relevant to our argument. Strictly speaking, for human perception there is no “copy the product”, there is only “come up with your own instructions, based on the product”. According to Gombrich, we do this in two steps. When we perceive something: we automatically form a hypothesis about what it is we perceive. We use our prior experience to form this hypothesis. For communication, this is usually sufficient. For imitation, however, it is not. Imitation demands more than recognizing, it demands remembering precisely, which, as noted above, implies the formulation of an abstraction. In memetic terms what this means is that to be able to spread a meme, one must also be able to formulate the instructions to express it. Such instructions are all but obvious to come up with. Nature being infinite in its smallest fragments (and thus offering infinite ways of how it could be abstracted), it is much easier to take over existing abstractions, tricks of a trade, than to come up with entirely new abstractions. Gombrich suggests that this is how pictorial styles could spread even in so-called ‘realistic’ painting traditions that claimed to paint ‘true to nature’.

Dan Sperber’s observations about how people infer an instruction based on a result in the case of the five branched star are perfectly in line with Gombrich’s argument. If there is a set of instructions at hand this will always be preferable to coming up with them from scratch. That’s why the rural artist copied a pictorial representation rather than his living cows. For the same reason, most people will remember that they know how to draw a five-branched star, and won’t have to reverse engineer the instructions for it (although, as the example of the rural artist shows, that would not be so hard for most people, either). Imitation always works like this, it always involves first the forming of a hypothesis about what is perceived, which in itself means to filter out all non-relevant signals, and then an inferring of the instructions necessary to express the meme. Sperber’s point is that this explanation invokes another mystery: that we’re able to infer these instructions is what needs to be explained.

But for the consideration of the validity of the theory of memetics this indeed very complicated question of why our perception works the way it does, can essentially be neglected. Blackmore does offer an explanation with her memetic drive, but even if she didn’t: if we can agree on the fact that perceiving something always involves the activation of previous experience, the forming and verifying of hypotheses and the filtering of irrelevant information based on these hypotheses, this gives us a good enough model of how memes can be transferred from one brain to another and why some forms of communication can spread memes more accurately and efficiently than others.

Plotkin’s complaint, which was paraphrased as “imitation is not communication”, seen in this
light is certainly still correct, but it doesn’t contradict memetics either. Being able to recognize a cow on a painting is not the same as being able to paint a cow, just as being able to receive, that is to recognize or notice some message is not the same as being able to actively express it in turn. So, clearly: communication and imitation are not the same, but they are related. Therefore it is not meaningless, but straightforward to argue that the concept of imitation can be applied to all possible forms of communication and not be limited to “learning to do an act from seeing it done”.

Which brings us to the question of terminology.

4.4.7 Terminology

Spoken and written words, images, artifacts (of all kinds and sizes from tools and machines, to buildings and cities), all types of art including music, even gestures and behavior can convey information and therefore must be considered potential carriers of memes. In other words, just about anything can be a meme. If this is so, how can we construct a useful theory out of this randomness? Plotkin’s argument that this makes the term “so vague as to be meaningless” can also be turned around: the very power of memetics lies in the fact that it provides a single theoretical model, the common ground for all types of imitation. Just as genes are the replicators in plants as well as in mammals, so memes can be exchanged through gestures as well as mathematical formulae. And of course memes need not be atomic, but will in most cases be embedded in complex cultural contexts or causal chains. Using simple terminology to clarify an overall argument does not mean that the finer levels of analysis can no longer be considered. And if, as Aunger would have it, it turns out to be more helpful to refer to expressions of memes as “signal templates”, this still doesn’t change the general thrust of memetic theory.

But Blackmore would hasten to add: not everything is a meme!

When speculating about the storage and copying mechanisms of memes, Blackmore suggests that any meme must at some point of the process be stored in a brain (Blackmore, 1999, p. 57). At the same time she points out that not all of our knowledge and skills, not everything our brains contain, is the result of a memetic process.

4.5 Memes and Learning

Blackmore gives a brief overview of theories of learning, stating that much of learning in animals and humans is acquired through conditioning: psychology traditionally differentiates between classical conditioning (Pavlov’s salivating dogs) and operant conditioning (B.F. Skinner’s experiments with rats: learning through a process of trial and error with punishments and rewards given for certain behaviors) (Blackmore 1999, pp. 42-52). Probably even more relevant for human learning, though not mentioned by Blackmore, are the theories of Jean Piaget. He showed that humans from early childhood on are active builders of knowledge. According to Piaget, children are little scientists that are constantly creating and testing their own theories about the world (Ackermann, 1991).

None of these types of learning are based on imitation, so they are purely non-memetic. Nevertheless, after our description of how the forming of hypotheses is involved in perception, it’s straightforward to argue that Piaget’s building of knowledge makes use of some of the same human faculties that are also involved in memetic processes.
4.5.1 Imitation

If Blackmore’s version of memetic theory is correct, then our capability to imitate has represented a competitive advantage over other creatures. This in turn led to the co-evolution of memes and genes in human development, manifest in our big brain and the creation of language. Imitation clearly is something humans have evolved to be good at. Blackmore quotes Meltzoff who has described humans as ‘the consummate imitative generalist’ (Meltzoff, 1988, p. 57, Blackmore, 1999, p. 50). Apart from birds that are able to imitate songs, few examples of imitation are known in animals. This may seem surprising, because we see imitation as a capability hardly worthy of humans and refer to it as aping (similarly in German: nachäffen). As Blackmore puts it we’re quite wrong there: “apes rarely ape” (Blackmore 1999, p. 50).

To become more respectful of our capability to imitate seems appropriate, once we analyze what true imitation (which Blackmore differentiates from contagion and social learning, which according to her are not memetic) really entails.

As was already sketched above, imitation actually requires a series of steps: first we need to perceive something, then we need to analyze what we perceived and choose what it is that we want to imitate. The chosen observations then need to be translated to something that is compatible with our own faculties. Then we can turn it into bodily actions. But this last step requires the others to precede it. And none of these steps are simple.

4.5.2 Perception and Interpretation

We’ve pointed out that perception, according to Gombrich, is almost the same as recognizing something we know, as we instantly form hypotheses about what it is we perceive. Gombrich actually suggests that we use the hypothesis that can most easily be falsified, first. (Gombrich, 1960, p. 301, Gombrich, 1984, p. 57) In other words, the first step in any imitation is already an interpretation.

Given how closely related imitating and interpreting are, we can argue that the two capacities – due to what Blackmore calls the memetic drive – must have evolved in parallel. This could explain the drive to constantly form hypothesis about what they perceive that Piaget found in young children. We might even speculate that this drive evolved in order to make us the better imitators.

The building of knowledge in the manner Piaget describes has been much promoted by constructivist and constructionist pedagogy (Ackermann, 2004). Our capacity to playfully construct and verify hypothesis about the world is held as essential to our creativity by these schools of thought. Based on all we know about perception, they are equally essential to our capacity to imitate. In fact, human creativity may not be so fundamentally different from learning by imitation as it might appear at first glance.

4.6 Memes and creativity

This thesis describes environments for creative collaboration. So far the memetic theory seemed to deal with copying only. As a matter of fact, considerations about how memetic processes and creativity go together aren’t much dealt with in most texts about memetic theory.

Blackmore has a section on creativity towards the end of her book. The (strong and rather controversial) point she makes is that we don’t need consciousness for creativity. All we need is the competition between replicators (Blackmore, 1999, p. 239). Implicit in her argument
is that any creativity is always the recombination of existing ideas to form new ones. This sounds like what we call thinking is basically a random shuffling around of information and could impossibly account for logic, research or artistic endeavors. But before we jump to such conclusions we should remember the basic premise of memetics, which is based on the logic of replicators. This premise is that indeed ‘blind’ replication processes are the only power known that can build structures of such amazing complexity as the eye (when the replicator is the gene) or as scientific thought (when the replicator is the meme). So, as counter-intuitive as that might seem, Blackmore’s argument is not simple-minded. Indeed, the theory about memetic evolution she presents also provides very elegant explanations for the origin of creative activities. But of course by just stating that it’s all based on memetic processes, we really don’t learn so much more about them.

What is proposed in the following sections is an interpretation and extension of Blackmore’s theory to come to a memetic theory of creativity. This theory will be applied to explain the creative processes in the case studies. But at the same time it must be pointed out that the case studies do not provide enough evidence to prove this theory. It is largely speculative. Given the fact that Blackmore’s arguments, which the theory builds on, are, as she herself contends, in part speculative, too, this is hardly surprising. But while speculative, the arguments are logical within the theory of memes and what we know about replication processes, and they open a new perspective on the methods employed in the case studies. They also fit in rather well with what others have written about creative processes.

4.6.1 Fidelity, Fecundity and Longevity

Successful replicators will become more numerous in the replicator pool if they possess as much as possible of the following three characteristics: fidelity, fecundity and longevity. This is the set of characteristics Dawkins proposes (Dawkins, 1976) for any type of replicator. Therefore we can expect to find these characteristics in successful genes as well as in successful memes.

With Blackmore we have defined Memes as ‘anything that can be passed on by imitation’. So memes depend on imitation for their replication.

Blackmore shows how memetic evolution can kick in, as soon as a species develops imitation as a way to gain a competitive advantage. If imitative behaviour represents an advantage for any creature, which presumably it did in early humans, because imitation allows it to pick up useful skills such as toolmaking etc., then imitators will grow more numerous in the population, giving memes a larger playing field. This is when the memetic drive starts to influence the direction of genetic evolution: The species evolves to best suit the needs of the memes. The memes define what an imitator has to be good at imitating. According to this theory, the human brain has evolved to be ideally suited to memetic evolution, that is to accurately and actively spread memes and to store them for a long time.

Blackmore makes a convincing case for the evolution of language being based on this memetic drive. She also quotes results of recent research, which clearly show that our brains are not some clean slate general purpose processing device as was the dominant opinion in the social sciences for some time, but predefined in numerous ways. Among other things it is so ideally prepared for language processing, that humans can be said to have an instinct for grammar. (Blackmore, 1999, pp. 93-97).

According to Blackmore, language evolved because it fits the bill of memetic replication (and our capacity for it can therefore be attributed to the memetic drive in meme-gene co-
evolution). Language provides a means of communicating that has high fidelity, can be picked up by many and remembered easily.

4.6.2 Memes as Mind Tools

At the same time it is important to point out that memes are not just dead pieces of information. They can be mind tools, make us more intelligent. Language is a prime example for this (Blackmore, 1999, p. 118). This is no contradiction to the mentioned three characteristics: fidelity, fecundity and longevity. It just shows that, once we start looking at different types of memes, there are many strategies to attain them. Creating copies like mad is a strategy for fecundity – catchy tunes belong into this category. Others are more constructive. Memes can secure their survival by teaming up with other memes and by actively promoting the construction of additional memes or conglomerations of memes that confirm them.

Such a constructive strategy is not improbable, because the very act of imitation, as we’ve pointed out before, partly depends on the formulation of a hypothesis, another constructive act that produces memes from scratch in order to promote copying and spreading of existing memes. Actually, these hypotheses aren’t memes at the time of their construction. They can become memes only if they’re passed on again, that is communicated to someone else. Before that they are just potential memes – it is proposed here that they be called proto-memes.

4.6.3 Proto-Memes – an Extension to Memetic Theory

So far this thesis has only reported on the state of memetic theory, not extended it. The stance that was taken, whenever there were different opinions available among memeticists, was to keep things as simple as possible. Why is it now necessary to introduce a new term? A new term definitely shouldn’t be introduced if it leads to new questions that cannot be aligned with the existing thinking that has been outlined so far – lest one would want to revolutionize the field rather than just modestly contribute to it, as this thesis is meant to do.

The term proto-meme passes this test, because it fits with existing theories of memetics, which agree that memes need to be recreated in people’s brains. Aunger speaks about the “normal, non-memetic information processing in the brain” (Aunger, 2002, p. 326) and compares it to the replication of memes. According to him, memes must first have evolved as electric signals within brains. It is suggested here to call this normal non-memetic information processing in the brain as the construction of proto-memes.

The term proto-meme also fits with Susan Blackmore’s insisting that not all learning is memetic. What the introduction of the term proto-meme is meant to achieve, then, is build a bridge between the apparently unrelated theories of constructivism and of memetics. It suggests that the construction of proto-memes lies at the heart of both memetic as well as constructivist learning. This seems plausible since after all it is the same brains who are engaged in both types of learning.

Thus we introduce the term proto-meme to describe any and all new signal patterns that are created in our brains during normal, non-memetic information processing. This includes acts of perception as well as communication as well as learning. These are obviously very different types of brain activities and they involve innate as well as learned and imitated patterns. How could it be meaningful to refer to all of these indiscriminately as the construction of proto-memes?

The goal here is not to come to a better understanding of which brain functions are innate and which ones are learned. This is a hugely complex topic that could impossibly be discussed
in this thesis. We do, however, know for sure that there are predispositions in our brains that
influence how we learn, what we perceive. Among these predispositions there are innate ones
as well as acquired ones. But at least part of these predispositions are influenced by memes
and proto-memes that already exist in our brains. This is rather obvious and uncontroversial:
What we already know does influence what we perceive or are able to learn. It can be seen in
the observations Gombrich makes about how our expectations and the context we are in affects
what we are able to see. But it is also obvious for any field of learning: Without some previously
acquired knowledge one cannot understand a sentence in a foreign language or a mathematical
formula. If we can agree that the capability to create new proto-memes in our brains is at least
in part determined by existing memes, then this opens up a new ‘selfish’ survival strategy for
memes. They can be more numerous and live longer in brains if they support memes that are in
accordance with them and keep rivaling proto-memes from forming.

Proto-memes, according to our definition, include all the structuring of our brain that happens
when we acquire new skills, knowledge or experiences. The production of proto-memes also
takes place as part of any imitation. Proto-memes are not memes. They are potential memes
only insofar as there might be a way to express them, which for many if not most types of brain
activities is not the case. For them to become memes, we have to find a way to express them
faithfully. For most proto-memes this is impossible, but the line between what can and what
cannot be expressed is very difficult to draw. Thus the term proto-meme also indicates that
the distinction between what can be and what cannot be expressed is not forever fixed. It is a
distinction that may itself be evolving.

If we create a proto-meme as the result of a communication process (if we receive or
perhaps rather perceive a meme from someone else, that is) the proto-meme will hardly ever be
completely faithful to the original. This process can explain the high mutation rate (some also
call it the fuzziness) of memes. Mutation can be caused by bad perception or bad interpretation –
both lead to the construction of proto-memes that are different from the original memes. But
that doesn’t mean that there can be no true replication, as Sperber claims. It just means that the
replication of memes is a much more complex process than the term might suggest. Sperber
is right in pointing out the detailed knowledge that exists about how it actually can take place
and that it involves filtering and re-construction and is influenced by the context it happens
in (Sperber, 2006). But the end result is still that replication can and often does happen. And
Blackmore’s theory of the memetic drive also suggests an answer to the question why our
cognitive apparatus is so good at executing these complex processes.

Given how similarly our brains are structured we can assume that the similarity between
meme and proto-meme will in some cases be very high. If it is high for many people that
have received (that is: re-constructed) the meme, we usually refer to something as easily
understandable as well as relevant. So while we do not know what memes, or for that matter
proto-memes are and how they manifest themselves in our brains, an educated guess will tell
us that 100% matching proto-memes in two different brains would be a rather unlikely finding
if we did know how to measure their similarity. Nevertheless we probably come pretty close in
some cases, close enough to be referring to our own version of it as replications of the received
memes. Besides: The relative similarity of the proto-meme in our head with the original meme
may be of secondary importance if the meme has some other way to ensure its fidelity. That’s
where language comes in as a way to store memes. If the meme is based on a written text the
fidelity in passing it on will not deteriorate, no matter how closely the proto-meme in a brain
resembles the one in the sender’s. If the proto-meme, for whatever reason, leads one to pass on
the text to someone else, the meme will have successfully replicated itself. We will look at the
new twist that our technological means to spread memes give to this story later.

Let’s stay with the problem of fidelity a little longer. The mutation rate of memes is also
high, because, as we showed when we discussed Gombrich’s findings about human perception,
forming hypotheses (proto-memes) about the world based on what we know about it and checked
against what we perceive of it is just the type of processing our brains are typically engaged in.
So new proto-memes in the form of hypotheses are formed almost constantly.

4.6.4 Rivaling vs. Cooperating Memes

Given how much flashes through our minds that we don’t find fit to share with others or that
we’re not even aware of (such as dreams), the vast majority of those proto-memes never gets
anywhere (they don’t become memes). And it’s probable that there are other memes instrumental
in keeping these proto-memes in check, because preventing rival memes from being replicated
is just as obvious a selfish strategy (and memes by definition have to be selfish!) as promoting
the replication of matching or supporting memes.

With regard to creativity this opens up a rather interesting argument. Memetics only makes
sense if memes aren’t just dead pieces of information, but active mind tools which we can use to
construct new proto-memes, that is to think, to make decisions, to be creative. At the same time
we can conclude from the replicator logic of the survival of the fittest, that the most successful
memes will be those that act as mind-tools on their own behalf, they will be selfish, so to speak.
They will team up with cooperating memes and keep rivaling memes from forming. While we
tend to think that we make our decisions rationally, evaluating all possible options in an unbiased
way, the theory of memetics would describe a decision making process somewhat differently.
Memetically speaking there are some strong and established memes in our brains, we may call
them certain knowledge, beliefs, values or convictions. These strong memes are so strong for
many different reasons. For example it could be that we have received them from our parents
or other sources that we consider valid, so they may well be cooperating with other memes
we’ve received from our parents. We’ve also tested them in many situations, they are useful in
informing us about the world, we can share them with others, etc. Francis Heylighen makes a
list of ten subjective criteria which determine how far an individual is willing to assimilate a
particular meme (Heylighen, 1996).

Probably quite often, these subjective criteria are themselves determined by memes. Memes
as mind-tools can be expected to exert a certain control over the types of hypotheses we form
about the world. They keep us from even considering certain options, because the proto-memes
we would thereby be forming would be its rivals. Somebody who believes that the world is
round, won’t be afraid to fall off its rim. His conviction about the world being round will keep
any such thought from even entering his mind. Again, if we don’t explain these things in terms
of memetics, they are quite commonsensical.

But if we shift the focus from general considerations to scientific decision making, this
memetic view of things becomes quite controversial. How can it be scientific not to consider
certain options? Yet Thomas Kuhn describes all established scientific research to follow this
pattern: The paradigm, once it has been established, will not be challenged, it will only be
refined until the scientific work comes forth with results that don’t fit the expected, which can
lead to a crisis and later to a revolution. But until then, in the daily business of scientific work,
many things are just taken for granted. Indeed, scientific undertakings would simply not be
possible without a reduction to certain essential characteristics (Kuhn, 1996).
Thus we arrive at a memetic explanation of a common phenomenon in expert knowledge. Experts are quick at finding the proper answers to questions in their domain. Even from an incomplete set of phenomena they are good at guessing their cause and the appropriate reaction because they have such refined and complete knowledge about their domain that the formulation of the proper proto-memes is done very expediently by their brains. This comes at a cost, though. For such experts, it is much harder to “think outside the box”. They are so efficient in solving their common problems because any proto-meme that conflicts with their established and highly efficient memeplexes is not given the chance to establish itself in their brains.

This filtering is necessary, to a large degree it is also innate: there’s no way we could make sense of the world if we gave all phenomena that hit our sensual apparatus equal attention. The schematic nature of our perception, as was stated above, is innate. But memes can still act as additional filters and help us to decode the signals around us to fit not only with our biological, but also our cultural selves. This filtering is a good thing, then, to a certain extent.

4.6 Memes as Creativity Killers

But we can look at these expert filtering mechanisms also with less favorable eyes. We can say that certain types of memes in our brain, certain types of knowledge about the world are actually creativity killers – they filter the production of proto-memes and thus limit our capacity to form hypotheses about the world. In a talk at TU Graz in July 2008, Jean-Jacques Dordain, General Director of the European Space Agency (ESA), stated that the most difficult thing for the researchers at ESA was to “respect the facts”, giving anecdotal accounts of how their coming up with ad-hoc theories that explain unexpected results of experiments and tests had led to the failure of missions. In a more crass way, the popular saying “If your only tool is a hammer, everything starts to look like a nail” also points to the inherent dangers of this ‘deformation professionelle’.

Realizing the dangers of such preconceptions is relevant for both scientific as well as artistic or engineering endeavors. Teachers at engineering schools often report on how their students are very creative when they start in the first semester and how their projects become less and less exciting the more they know about the real-world problems. On the other hand of the spectrum are artistic approaches that disregard technical realities. In his famous essay “Der Sattlermeister” Adolf Loos has the saddle maker say to the professor who brings him 49 designs of new saddles: “Professor, sir! If I understood as little as you do of riding, of horses, of leather and its working, I too could have your imagination.” (Loos, 1903)

As being incompetent about such real world problems is not an option, keeping an open mind and the capacity to come up with new and beautiful solutions to known problems, while at the same time being knowledgeable about the standard procedures, is a balancing of competences most creative disciplines wrestle with. Just as scientists, arguably artists and engineers depend on the short-cuts of expert knowledge and yet should equally be wary of them. Are there ways to have it both ways? Can these filtering mechanisms be avoided in certain cases? Does the theory of memetics suggest a strategy how this might be done?

4.6.4 A Memetic Theory of Creativity

As we saw in the last section, it is plausible that there are memes, e.g. acquired knowledge and competences, that act as creativity killers. While making us experts at finding quick solutions to known problems they at the same time filter out the production of proto-memes that don’t fit the standard theories or procedures. This filtering is often very useful, but it also prevents us
from having certain ideas, which sometimes may limit our creativity, our capacity to respect fact, maybe also our ability to learn new things. How could this be avoided?

Given that memes are usually specific to a domain or context, it is equally plausible that the same is true for control over the production of proto-memes they exert. Therefore, to avoid the influence of the expert memes that we have referred to as ‘creativity killers’ we might use ways of reasoning from other fields.

This is very similar to what a number of theorists have written about creativity. Donald Schön first published his book “Invention and the Evolution of Ideas” (Schön, 1967), under the title “Displacement of Concepts”. He describes invention as the result of using acquired ideas in a new context. Arthur Koestler in “The Act of Creation” (Koestler, 1964) described the creative act as “bisociation”, as the thinking in more than one reference frame or plane at once: “I have coined the term bisociation in order to make a distinction between the routine skills of thinking on a single plane, as it were, and the creative act, which as I shall try to show, always operates on more than one plane.”(Koestler, 1964, p. 35).

New ideas, according to these theorists, are typically formed by using analogies, concepts borrowed from another domain, sometimes also by metaphors. This technique is actually a very common strategy. As Kuhn shows, many scientific revolutions are based on some analogy from a different field initially (Kuhn, 1996). Likewise in many creative disciplines, including architectural education, it has become common to introduce methods and theories or just objets trouvés from other fields to open one’s mind and to serve as the starting points of an architectural project.

The memetic explanation of such procedures could be that these techniques can enable new ways of thinking because they bypass the control of the established memes about architecture. Such analogies or metaphors can serve as the antidote to the controlling meme which acts as a creativity killer in one domain. They can work as an eye-opener, that is, to let other rivaling proto-memes give it a try. It is a trick to get new, un-checked proto-memes produced. Of course, if we don’t like the memetic terminology, we could also call it inspiration.

4.6.5 „Whereof one cannot speak, thereof one must be silent“

Most of our proto-memes don’t even need to be checked. We are simply unable to express them in any way. Wittgenstein’s famous quote “Wovon man nicht sprechen kann, darüber muss man schweigen“ (transl.: “Whereof one cannot speak, thereof one must be silent”) (Wittgenstein, 1922) suggests that there are things that cannot be expressed. For the same reason we are unable to acquire them by imitation. This may be true of more things than we realize, but is obvious for certain skills. The legendary pianist Glenn Gould once told a reporter that he could tell him everything he knows about playing the piano in 30 minutes. It’s very improbable that the reporter would have been able to play the piano as well as he after those 30 minutes.

The point cannot be stressed enough: not all learning is memetic. The reason for suggesting to refer to all of learning as the construction of proto-memes is that it seems impossible to draw the line between what we indeed will never be able to express and what could be expressed, but isn’t because we haven’t learned how, yet. Sometimes a new type of meme we acquire can guide the way to turn many proto-memes into memes. Just like children can start to tell what it is that hurts them, when they acquire language. So the introduction of proto-memes into the discourse highlights the need to consider the constructive or re-constructive aspects that happen during memetic processes. And it points out the fact that creativity and taking over ideas from other people are very much related.
4.6.6 What about logic, what about consciousness?

Talking about thoughts and ideas in the way done here, that is, purely as the result of blind replication and mutation processes, is deeply disturbing to many people. Consciousness, logic, our free will, they all seem to be in direct contradiction to such a model of our thinking. But from a scientific point of view there is no contradiction. It is normal that people get uneasy when memeticists say, as Blackmore and many others do, that they don’t really think themselves, that it’s their memes doing it. But in the end that’s like saying that people are made up of atoms and it’s physical or chemical reactions in their brains doing the thinking. The question whether we have a free will is of no scientific interest, because it is one that can never be answered. So the controversy is not about the free will, it’s about the structure of the mind.

Blackmore is very clear in her writing that the evolution of memes is just as mindless as biological evolution, that in living organisms just as in culture progress happens by virtue of replication processes and not according to some grand plan. This, according to her, applies to culture as a whole as well as to the workings of the individual brain. “If you believe that you live inside your head and direct operations, then creative acts can seem especially good examples of things that ‘you’ have done. But, as we have seen, this view of the self doesn’t hold up. There is no one inside there to do the doing – other than a bunch of memes.” (Blackmore, 1999, p. 240).

Kate Distin disagrees with Blackmore about this point. She proposes that the mind is something innate, much like our predisposition for language.

“Yet culture does not build human minds in the same way that biology builds our bodies. [...] Although that faculty could not fully develop and play its vital role within cultural evolution without the acquisition of existing memes, this developmental process has more in common with the development of a muscle by use and exercise than with the ontogeny of an organism. [...] A human mind then, is partly the product of the memes that bombard it, but only because it has the innate potential to interact with and develop in response to those memes.”

(Distin, 2005, p. 202-203)

Memeticists are not alone in putting forward theories about the mind that we find counterintuitive. Engineers and researchers in Artificial Intelligence like Marvin Minsky hold that it is possible to build intelligent systems out of unintelligent parts (Minsky, 1986).

Edith Ackermann in “The Agency model of Transaction” (Ackermann, 1991) describes how psychologists and engineers consistently use different sets of concepts for describing the functioning of self-regulating devices, a polarity she sums up in the following way:

“The story goes as follows: Through actually building intelligent systems out of unintelligent parts, engineers make it clear that goal-orientedness (or knowing how to reach a goal) by no means requires the system’s awareness (its knowing that it knows how to...) or intentionality (its deciding to...), or free will (if willing, it could...). Engineers usually insist that no vital principle needs to transcend, or live independently, from a material substrate. To them, if mind might well emerge out of matter, the building of a mind – out of matter – does not require the use of high-order concepts such as purpose or intentionality. For engineers such concepts are not operational or useful in their work. In contrast, most psychologists (as well as educators) study behavior as it becomes
meaningful to – and controllable by – a subject. This is not surprising, as it is their job to help people use whatever reflecting capabilities they have (self-awareness) as a means to control their own behavior. To the psychologist, the concept of “subject” is a useful construct, and so are the concepts of purpose and intentionality.” (Ackermann, 1991, p. 369-370)

This beautifully solves the contradiction that seems to exist between our traditional thinking about ourselves and others in terms of goals and intentions and the “mindless” theory of artificial intelligence that is so similar to Blackmore’s version of memetics that has been described in some length in this chapter. The answer is that it is simply unproductive to argue about which one is right. They are both concepts that can be useful constructs for certain considerations, no more, no less.

So who is right about how the mind works? Or rather which one has the more useful construct for our discussion? Is it the extreme view of Blackmore that there’s just a bunch of memes where we expect to find our ‘selves’? Or is it the milder version of memetics put forward by Distin, that tries to reconcile evolution and design? (Distin, 2005, p. 181) We can safely leave this question to others to figure out. Our proposed extension to memetics, the proto-memes that we introduced as a conceptual bridge between imitation and individual learning, is consistent with either view of our minds.

For the moment we can pause our general discussion of memetics. We have introduced its basic tenets, shed some light on its explanatory power as well as on its unresolved controversies. We are now ready to look at how memetic theory can be applied to the case studies.

4.7 Memes in the case studies?

We initially described the case studies as two processes: the individual learning and the evolution of the collaborative project. The contributions of the participants are digital files of different types. But according to Blackmore’s definition that memes are “everything that is passed on by imitation”, we can just simply refer to them as memes. We can now see that memetics provides a way to discuss what happens in both processes from the meme’s eye view. The works that the participants submit to the website are in competition with each other. Together they form what could be called a meme-pool. The website as a way of publishing these memes has to be as neutral a structure as possible. It should give the memes the best exposure possible without bias, so that the functionality of the environment has no adverse or distorting effect on the evolution of the memes. For the individual students, the memes are received as building blocks in their own learning processes. The link between the two processes can be described as memes, which can be considered and described as subjects, just as we wanted.

4.7.1 Copy the product vs. Copy the instructions

As was stated above, the genotype-phenotype distinction does not work in memetics. Blackmore considers the many different ways that memes can be transmitted, but finally comes to a simple distinction between two basic transmission types: “copy the product” and “copy the instructions”. (Blackmore, 1999, p. 61)

We will come across both types in the case studies and have occasion to discuss them in more detail. When we discuss the project fake.space we will encounter memes of the “copy
the product” type. As we shall see, in this project students did not upload their source codes, only images and other multimedia formats (like animations etc.) they rendered from them. If students wanted to work with similar imagery, they first had to recreate the 3D CAD file based on the existing images. Thus, the meme had to be reconstructed from the result (the visualization) rather than from the instructions (the complete 3D CAD file). In the other three projects, Phase(x), Virtual Design Studio and EventSpaces, however, we mostly find the “copy the instructions” type. In those projects, students actually shared the entire source code of their designs, that is, the CAD files.

If this sounds conclusive and convincing, it shouldn’t. Actually it is quite a stretch to claim that the memes, that is the design intent of a designer, could be captured in a CAD file, no matter how complete. One could of course point out that intersubjectivity, to describe something in a way that someone else will be able to understand it, is a basic requirement for any architectural construction document. But this intersubjectivity is never complete: it is a very common experience for architects that people (be they members of competition juries or construction workers) don’t understand (or appreciate) their design intent. When the CAD file is separated from its author, the thoughts and aspirations of the author which shaped the design in the file can only be inferred from what is in the CAD file. Therefore one might just as well argue that they are also “copy the result” types, because the CAD files, even though they contain the full information about a three-dimensional form, do not include the history how it came about, nor why. To get to a full understanding of a design, this how and why had to be reconstructed from the CAD file. Thus, in some ways even what we labeled as the ‘copy the instructions’ kind of memes can be regarded as a ‘copy the product’ type.

To make matters worse, in fake.space, which was just labeled as the only ‘copy the product’-type project, the class really wasn’t about imitation. It was about story telling with these types of content. Therefore students had to copy neither the product nor the instructions to successfully participate in the class. Rather they could re-interpreted the work of someone else to make it fit with their own storyline. Whether this type of re-interpretation, that has no intention or need to be faithful to the intentions of the original author, is still the same re-interpretation we referred to as ‘copying the product’ is a tricky question.

As should be clear by now, when the individual projects are later on described in more detail in memetic terms, there is much that still needs to be explained. Doing so, we will get a fresh perspective on what happens in these processes and in which way imitation, inspiration, creativity and learning are related. But we also get many different examples of the role digital media can play in memetic evolution.
In the last section we have run into the need to provide the memes in the case studies an even playing field, so that memetic processes can take place in as unbiased a way as possible. This leads to the double role that design plays in these projects. The web environments were designed to facilitate the collaboration and exchange between designers. They can be described as designs to design in.

To open this topic more broadly, different aspects of design are discussed. Since the information architecture of the web environments is of great interest in this thesis, the question is asked in how far architecture and information architecture are related and what theories from traditional architecture might be applicable to this emerging field. After considering different candidates, the theory of transparency by Colin Rowe and Robert Slutzky is chosen. The term transparency works well in both physical and digital realms and its focus on the phenomenal makes it a particularly “architectural” theory. But it is also suggested that other architectural theories might well be tested for their applicability in information architecture.

5.1 What Design?

When we discuss online environments in terms of their design, the first thing we need to clarify is what we mean by design. We could be referring to the graphical design, the specific look of the interface elements of the websites. Or we could be addressing the usability of the interface, the clarity and consistency of the navigational tools. Finally we could use design to stand for the underlying structure, the information architecture of the environments.

By listing these three interpretations of design one might imply that it’s easy to differentiate between them. But this is not the case. In fact the three are so mutually interdependent that any one of them is almost meaningless without the other two. Therefore any serious consideration of design must necessarily discuss all three. The three aspects are introduced for two reasons: First to acknowledge the complexity we’re faced with when we talk about design in this context. Secondly to establish a hierarchy between these areas. Arguably there is a natural dependency between these three aspects: the navigational structure must be based on the information architecture, just as the graphical design of the interface must be designed to suit the navigational structure. One might differ on the relative importance of these three design aspects. As far as their mutual dependency goes, there is a primacy of the information architecture that is hard to deny.

Our focus here will be primarily on information architecture. The first reason for this is the mentioned dependency. Among the three, information architecture is the most fundamental design aspect. It is also the one least dependent on current technology. Graphical and navigational possibilities are highly dependent on the human computer interfaces available to the users. Higher resolution screens will do away with many of the strategies motivated by limited screen-space. Not to mention entirely different in- and output devices from the currently dominant mouse-keyboard-screen variety (wearable computing, intelligent buildings etc.) which we can expect to change the game for the graphical design (which might actually become architectural
design in its own right) and the usability (which at some point will need to include considerations of physiology and bodily comfort) entirely. The information architecture meanwhile could still remain largely the same.

The emphasis also reflects the author’s personal bias as an architect: it is no wonder that in a doctoral thesis in architecture, information architecture is considered to be the most interesting of the three. More importantly it is the design aspect on which we directed most of our effort in the design of the case studies and arguably the one where they make the most relevant contributions.

Finally there is the aspect of the relative novelty of this field: graphic design has a long standing tradition and usability engineering has been intensively pursued in multimedia design. Information architecture is not nearly as well established and is most in need of theoretical investigations.

As a matter of fact, to come to a definition of information architecture and to investigate in how far traditional architecture might be a useful reference for its design will be the focus of this chapter. To this end we will give brief overviews of different aspects of architectural theory and their potential for information architecture. Candidates are:

- the design methods movement,
- common classificatory systems that treat architecture as a language,
- theories based on the phenomenology of architecture.

Obviously not all of these theories can be discussed here in any amount of depth. With reference to other possible candidates we will argue however why we will focus on a phenomenological approach, more specifically on the distinction between literal and phenomenal transparency established by Colin Rowe and Robert Slutzky (Rowe & Slutzky, 1964), which appears to be of particular interest in information architecture.

### 5.2 Information Architecture

The term information architecture was introduced without a proper definition. Given how much it is used nowadays this may not be surprising. There are books about information architecture, people who introduce themselves as information architects. The first definition of this new profession is from Richard Saul Wurman. On the jacket of his book Information Architects (Wurmann, 1996) he characterizes it as follows:

> Information Architect: 1) the individual who organizes the patterns inherent in data, making the complex clear; 2) a person who creates the structure or map of information which allows others to find their personal paths to knowledge; 3) the emerging 21st century professional occupation addressing the needs of the age focused upon clarity, human understanding and the science of the organization of information. (Wurman, 1996)

These are actually three definitions, though rather similar. They will serve as a useful reference. The definitions are neutral. In terms of the media no preference is given. The reference to the 21st century does hint to the fact that the need for organizing the patterns inherent in data has

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become most pressing with the widespread use and dissemination of information in digital form. Just like for so many professions related to information, the boom for information architecture came with the World Wide Web.

In a popular book about “information architecture for the world wide web” (Rosenfeld & Morville, 1998) Wurman’s definition is quoted. In the foreword of this book, the case is made for information architecture, arguing that “you can’t just jump in and start writing HTML, the same way you can’t build a house by just pouring a foundation and putting up some walls” and promising that “principles of architecture and library science are applied to web site design” (Rosenfeld & Morville, 1998, p. 10). The authors concede that information architecture isn’t yet a fully established discipline and that potential information architects have to be recruited from other existing disciplines. In the list of professions that might qualify as backgrounds of future information architects we find Graphic Design, Information and Library Science, Journalism, Usability Engineering, Marketing and Computer Science. Architecture isn’t listed, which is surprising as Richard Saul Wurman, who invented the profession, was himself an architect by training.

The book clearly isn’t intended as a contribution to an academic discourse. Nevertheless it is interesting here as an indicator of the general assumptions the term information architecture has come to stand for. Information architecture is described as “the framework that holds mechanics and aesthetics together”. According to the foreword, information architects are the ones that look at the big picture. Information architecting (sic!) is an activity that will make all the difference as soon as a certain size of a web site is reached and as soon as something like an overall vision is needed to tie the different parts of a complex whole together.

Even though architects didn’t make the list of qualifying candidates, they should not feel too unhappy about the reasoning, why the “principles” of their profession are needed in this field. If we scan the book for those principles, however, we don’t find much that goes beyond the flat analogy between designing a website and constructing a building already quoted.

5.2.1 Architecture and Information Architecture

There are many architectural metaphors used in web parlance. The homepage, the website and the chatroom are the most obvious ones. But also the fact that we use spatial metaphors like visiting or surfing forward and backward when we are really just clicking on hyperlinks shows that the world wide web is perceived as a spatial phenomenon. One can speculate that this established metaphorical way of referring to the online world as a space has its roots in the so-called ‘cyberpunk’ books of such authors as Gibson and Stephenson (Gibson, 1984, Stephenson, 1993). But no matter where it comes from, the spatial metaphor that has become established for the online world can be taken as a fact (Hirschberg, 2002b). So it is rather straightforward to assume that the space-making discipline of architecture has something to offer for the design of cyberspace in general, not only for the construction of virtual 3D worlds, as is commonly assumed.

William Mitchell treats all of cyberspace as the “city of bits” and puts its design quite naturally within the competence of architecture as the profession that designs our environment (Mitchell, 1996). According to Mitchell, architects clearly have a claim to stake in cyberspace. Our profession’s definition of environment should include the infosphere as well as the “electronically augmented, reconfigurable, virtual bodies” (Mitchell, 1996) and environments that connect our physical existence with it.

But architecture is not the only discipline that can make this claim. If we take the above-
quoted book by Rosenfeld and Morville to be of any indication, the general public doesn’t see a strong connection between information architecture and architecture. Journalists, computer scientists, graphical designers or librarians are seen to be better equipped to (quoting Wurman) “organize the patterns inherent in data, making the complex clear” or to “create the structure or map of information which allows others to find their personal paths to knowledge” (Wurmann, 1996). Despite Mitchell’s claims it appears that architecture has not yet sufficiently proven that it has anything to offer to “the emerging 21st century professional occupation addressing the needs of the age focused upon clarity, human understanding and the science of the organization of information” (Wurmann, 1996).

Obviously the author’s vantage point is that of an architect who sees information architecture as a field that very naturally lends itself to architectural thinking. The following paragraphs will therefore try to define the common ground between architecture and information architecture and show that theoretical approaches from traditional architecture can be applied to information architecture.

5.3 Theories of Architecture

To find out in what way we can learn from traditional architecture about information architecture, it may help to start with a common definition of the term architecture itself. The Merriam-Webster Online Dictionary gives the following one:

archi.tec.ture n (1555) 1: the art or science of building; specif: the art or practice of designing and building structures and esp. habitable ones 2 a: formation or construction as or as if as the result of conscious act <the ~ of the garden> b: a unifying or coherent form or structure <the novel lacks ~> 3: architectural product or work 4: a method or style of building 5: the manner in which the components of a computer or computer system are organized and integrated (Architecture, 2008)

The dictionary confirms that the word architecture can be used in other contexts, but there is no doubt that its roots lie in the first meaning, the “art and science of building”. The more general meaning of architecture can be seen as an abstraction that emerged out of the art and science of building as its most essential characteristic. In the most general sense, then, the architect is the one who designs “unifying or coherent forms or structures”.

If we want to test principles of architecture for their applicability in other fields, we should test if there are design methods that the architectural discipline developed that could be similarly abstracted from their original purpose of being helpful in designing and building habitable structures.

Since architecture established itself as a discipline with scientific aspiration in the fifteenth and sixteenth century it has developed a history not only of facts but also of methods, theories, modes of thinking and of different representational systems and classificatory models (Oechslin, 1993). We shall here briefly investigate some of them and ask in how far they can be abstracted from their roots in the “art and science of building” to become general methods for defining unifying forms or structures.

This investigation is helped by a general tendency towards abstraction in the theoretical discourse about architecture through history. This tendency can be illustrated with the notion of...
architectural space. Today, space is generally regarded as the primary object of the architectural discipline, and architects frequently refer to themselves as spacemakers. But this has not always been so. Space entered the architectural discourse only at the end of the nineteenth century. This coincided with an increasing interest of the field of architecture in theoretical discourse (van de Ven, 1978). The modern movement during the first half of the 20th century propagated a new vision of space and time (Giedion, 1941). It also moved the discipline closer to the more quantifiable engineering disciplines. Le Corbusier’s famous dictum of the house as a “machine for living in” (Le Corbusier, 1928, p. 160) signaled a departure from historicism in the functional and formal conception of buildings. Getting rid of the historical formal repertoire also meant adopting more rational problem solving strategies. The modern movement has since been criticized by some as being too reductionist (Venturi, 1966). But also the post-modern and other movements since then have not reversed the general trend towards increasing intellectualization. The second half of the 20th century has rather opened the discipline to a stronger influence from the social sciences, but also from art and philosophy, making architecture an even more theoretical and intellectual field. This has led to what is perceived as a strong split between what is taught at leading architecture schools and the practical expertise expected from architects by the building industry.

At the same time a strong emphasis on the “learning by doing” in design studio teaching dominates architectural education. Despite its intellectualization, architectural designing is considered an activity that cannot be learned strictly as a method. Although many efforts have been made to find such methods.

5.3.1 Design Methods

To establish a science of design has been a recurring theme in architectural research. The design methods movement was particularly strong in the late sixties and seventies. Many of the theoretical approaches that were developed then have had a revival twenty years later, when similar formalizations were discussed again in the context of CAAD research (Schmitt, 1993).

Most methods describe design as a decision making process that involves a series of analysis and synthesis stages. Jones and Thornley proposed a design process as an orderly sequence of phases (Jones & Thornley, 1963) that also became the basis of a VDI guideline (Schmitt, 1993, p. ??). The method is based on the assumption that any design problem can be structured in a hierarchy of sub-problems, a view rejected by Christopher Alexander in his essay “A City is not a Tree”(Alexander, 1966). Alexander, a mathematician as well as an architect, proposed the use of graph and set-theory instead and came up with a design methodology that was based on patterns of relationships.

Interestingly, Jones and Thornley’s model bears much similarity with approaches to structural programming developed around the same time in computer science. The modularization and standardization of writing program code was proposed to turn programming, which had been considered an art, into an engineering discipline. The parallel is striking. Alexander’s theories by comparison, appear to have been ahead of their time in the sense that his patterns of relationships were discovered by computer science researchers that study object oriented systems, the programming method that has followed structural programming as the leading paradigm in computer science (Beck & Cunningham, 1987).

These parallels with computer science show another thing: the methods were essentially problem solving strategies and as such largely independent of any domain. They could be applied in any planning discipline (in fact, the parallel to engineering disciplines was a central
argument of this approach). They don’t address the specifically spatial nature of architecture. It’s a bit like a circular argument: the deployment of the design method allows the qualitative assessment only of the design method, not of the design result.

If we treat information architecture as a fundamentally spatial (or rather: hyperspatial) discipline, then these methods for problem structuring are probably generally helpful. But they won’t open any new specifically architectural insights, as they are essentially non-spatial in nature.

Alexander’s pattern language may be seen as an exception in that his patterns are derived from architectural precedents. They are an attempt to come to a design method that reapplies successful design solutions including their spatial nature in a flexible way. A method based on Alexander’s patterns for the development of educational software was proposed by Thomas Fischer (Fischer, 2001).

So is there a science of design? There are many aspects of building where rigorous empirical studies can take place, such as statics or building physics. But those are essentially engineering tasks that apply scientific methods from other disciplines (physics, material science, etc.). But architecture understood as the act of designing itself, the activity of envisioning and planning a building, a spatial organization of parts that has to satisfy an almost endless list of different requirements, and that involves considerations of disciplines as different as psychology and physics, can this architectural core business be said to have become a scientific discipline?

As was mentioned in the introduction, architecture lacks a leading paradigm that is shared by the scientific community and that would allow it to conduct normal, paradigm-based research. Among the numerous methods proposed to guide successful designing, many have become common practice. But not one can claim to have gained wide enough acceptance to be considered a paradigm for the whole discipline. Most architects reject the idea that there even could be such a universally acceptable design method. This is the true meaning of referring to architecture as an art and a science. While we can remind ourselves that this has been the case in all scientific fields, before any leading paradigm was firmly established, it also seems plausible that the complexity of the architectural discipline should resist the formation of such a leading paradigm for good. Nevertheless most architects develop a rather rigorous personal working method to go about their designs. The “recherche patiente” that Le Corbusier describes (Le Corbusier, 1960) does indeed show many parallels to paradigm-based scientific work – in some way architects tend to develop a paradigm for every project.

5.3.2 The Logic of Architecture

Even if we’re unable to identify a universally accepted design method in architecture, the art and science of architecture is an extremely rich field. Its history and tradition are ever present in the buildings and cities around us. Seeing and interpreting our architectural heritage has often been likened to an act of reading. In his famous text “Eupalinos or the Architect”, Paul Valéry goes as far as giving buildings themselves the capacity to speak, or even, to sing:

“Tell me (since you are sensible to the effects of architecture), have you not noticed, in walking about this city, that among the buildings with which it is peopled, certain are mute; others speak; and others, finally – and they are the most rare – sing?...”

(Valéry, 1956)

In our quest for the principles of architecture that could become guidelines in information
architecture, we now turn to the classificatory models most common in architectural theory. Many of these models are based on some language analogy. In his book “The logic of architecture”, William Mitchell describes some of these approaches to “show (…) how architectural languages can be established, interpreted and used” (Mitchell, 1989).

A more detailed description of the language paradigm in architecture cannot be attempted here. Instead we briefly outline some of the fields of research that were derived from it and that received some prominence within the field of CAAD. Some of them have already been mentioned in our brief discussion of the history of the computer in architecture and have been very important in our teaching of computer aided architectural design.

• **Design As Language** proposes an understanding of architecture as a composition of individual parts that are arranged according to a spatial syntax. As the parts themselves are found to be compositions of individual parts, a hierarchical structure is introduced similar to the hierarchy of words, sentences, paragraphs, etc. found in language. (Mitchell, 1989, Madrazo, 1991)

• **Shape Grammars** take the language analogy a step further and formulate rules that can identify the correct usage of an architectural language. Mitchell and Stiny describe a grammar that produces floorplans for Palladian villas (Mitchell & Stiny, 1978)

• **Typology** stands for the systematic classification of buildings and building parts according to certain characteristics. Durand was an early proponent of this approach that has much in common with the language approach. (see for example Mitchell, 1989; Madrazo, 1995).

• **Case Based Reasoning** is a reaction against the shortcomings of purely typological classification. Instead of abstract typological notions, designers tend to abstract certain qualities from complete cases, rather than from types. Much like we tend to know a word not just by its meaning, but from the context it is used in, case based reasoning proposes entire cases rather than context free abstractions as the basis of new design approaches. Early research in case based reasoning was done in the domain of cooking (Hammond, 1989). To make case based reasoning work as a computational tool in architecture, often some approach of the language analogy is used to describe the cases.

• **Pattern Language**, the method developed by Christopher Alexander is a similar idea as case based reasoning, but the description of the cases is done in the form of a pattern language. Rather than on a vocabulary of parts, the relationships and the context of a pattern are precisely defined. (The fact that Alexander’s method appears in this category as well and will, in fact, be mentioned in all three categories shows how unique and hard to classify it is and how rich despite the amazing lack of convincing architectural works that were developed based on this method.)

### 5.3.3 Architecture as a phenomenon

A third theoretical branch is the one that studies architecture as it is perceived by our senses and tries to derive compositional rules from this. Rudolf Arnheim’s “The Dynamics of Architectural Form” (Arnheim, 1978) belongs in this category as does Camillo Sitte’s “Der Städtebau nach seinen künstlerischen Grundsätzen” (Sitte, 1889). We can also mention Christopher Alexander’s “Pattern Language” (Alexander, 1966) here again, or Rowe and Slutzky’s “Transparency in Architecture” (Rowe & Slutzky, 1964), to name but a few. These approaches have in common that they need to avoid appearing purely subjectivist and therefore
usually introduce more established theories from other domains to support their findings: Geometry and Gestalt psychology in the case of Arnheim, historical references from medieval cities in the case of Sitte. Alexander supports his claims for the “quality without a name” in his patterns with sociological data that document them as people’s natural preference in a given context. Slutzky and Rowe borrow a theory from painting and apply it to architecture.

Other ways to arrive at phenomenological theories are the numerous surveys about physiology and comfort, leading to guidelines about temperature, lighting and dimensioning particularly of interior space. Such surveys are the equivalent of usability studies in interface design. They provide critical instruments to judge the outcome of a design process. Attempts to derive general design principles from them are problematic as they necessarily neglect the notion of context. However, if they are combined with some set of ideas that is merely confirmed by them and not derived from them, such surveys can be successful instruments.

Most phenomenological approaches can be said to have produced a method or a set of design principles that can serve as guidelines. As these principles are usually very much anchored in the physical, tactile, dimensional and proportional world of the built environment, it is not easy to derive a more abstract set of guidelines from them.

5.3.4 Choosing an approach

To summarize our little survey so far. We have presented three approaches to architectural theory:

- **design methods** (architectural design as a structured decision making process)
- **logic of architecture** (architecture as a spatial language)
- **architecture as a phenomenon** (architecture as a spatial experience)

All of these could be interesting as starting points to look for methods that could be used in information architecture. The fact that Alexander’s pattern language actually appears in all three of these shows that the categories are not mutually exclusive. They do however each represent a particular strategic approach that could be meaningful to focus on when looking for principles of architecture that are applicable in information architecture.

At first glance, the design methods and the architecture as language theories seem to be the more abstract ones and therefore more prone to formalization and transfer to other disciplines. In fact, most of the research done in computer aided architectural design concentrated on these two approaches. It might seem, therefore, that theories based on the phenomenology of architecture will be the least interesting to pursue here. On the other hand, as was stated earlier, there are phenomenological similarities between cyberspace and architecture. Even though it has no place and no physical extension, the World Wide Web is perceived as a space. This is apparent from the many spatial metaphors used to refer to it. To further explore this fact, the

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7 In a public event held at the Harvard GSD in 2007 (Eisenman & Herzog, 2007), the architectural theorist Jeffrey Kipnis moderated a debate between the two famous star architects Jacques Herzog and Peter Eisenman. Eisenman, a very influential theorist in his own right, in an attempt to clarify the differences between him and Herzog, suggested that there are three architectural movements at the present: performatists, conceptualists and phenomenologists, labeling himself as a conceptualist and Herzog as a phenomenologist. Herzog didn’t disagree with being interested in the phenomenological, but said that their firm was really very much based in conceptual approaches, as well. He added that conversely Eisenman’s best designs show that he is interested in the phenomenological as well. Thus Eisenman’s three categories (which could be mapped onto the categories we set up) emerged as theoretical lenses, rather than full architectural programs that any firm could limit itself to.
phenomenological approaches may be better suited than the other two more abstract ones.

So there are good reasons for any of the three presented theoretical approaches. There are probably others that could be considered, too. The list may not be a complete classification of architectural theories. Necessarily the choice will be based on personal preference. The particular theory we are going to look at in more detail, the essay about transparency in architecture by Colin Rowe and Robert Slutzky, can be said to fall into the phenomenal category, where it stands out for its modesty and simplicity. It does not attempt to propose a solution for architectural problems, but rather concentrates on the exploration of a single phenomenon: transparency. By carefully looking at chosen works it manages to formulate qualitative criteria in architecture, which can be observed objectively and without a value judgement, like a litmus test, as Bernhard Hoesli put it (Hoesli, 1997, p. 85). Hoesli also used the text as the foundation of his own design methodology.

To establish similar phenomenological criteria in information architecture and “make an efficient critical instrument” of the term transparency (Rowe & Slutzky, 1964, p. 22) is an interesting challenge.

5.4 Transparency: Literal and Phenomenal

When describing the ideal environment for sharing information, the word transparent invariably comes to mind. It seems to imply such positive characteristics as open, trustworthy, reliable and easy to understand and therefore is uniquely suited to describe the ideal information architecture. But what, in concrete terms, do we mean, when we describe something as transparent?

In their essay “Transparency: Literal and Phenomenal” (Rowe & Slutzky, 1964), Rowe and Slutzky and extended a phenomenological discourse from the two-dimensional world of painting, where a distinction between literal and phenomenal transparency was first made by Gyorgy Kepes in his book “language of vision”, into the three dimensional realm of architecture. At the same time their text can be read as “The search for a reliable Design Method in Accordance with the Principles of Modern architecture” (Oechslin, 1997).

This thesis tries to extend their phenomenological theory from the three-dimensional field of architecture to the multidimensional realm of information architecture. By working, as Rowe and Slutzky did, with juxtapositions and case studies, we will try to define, by way of example, what the nature of phenomenal transparency in information architecture is. Before we can engage in this, we first have to document and discuss the case studies in detail. Based on the findings we shall return to the discourse about transparency, which we then explore at more length. Drawing on this discussion and on the documentation and evaluation of the case studies, we are then able to put forward some guiding principles for the design of transparent environments for creative collaboration in architectural education.
6 The Case Studies

6.1 Motivation and Goals

6.1.1 The World Wide Web as a Teaching Environment

Schools are places of exchange. Sharing and discussing ideas, seeing how others solve the same problems are important parts of an education, particularly in design. What designers tend to like least about computers is their tendency to hide the visible artifacts that are typical of designers’ workplaces. Whether in offices or in schools: screens and CPUs take the place of half-finished plans, models, and sketches. And on those screens, one typically sees only a fraction of any one project. Under these circumstances, it is much harder to see what the colleagues are doing. Computers can be said to have eliminated formerly available communication channels.

Fortunately, they also opened up new ones. With the advent of the World Wide Web it became clear that we have to think of computers as media as well as tools. This double role lies at the heart of the potential use of computers in design.

Before the first of the case studies discussed in this thesis, the Phase(x) course from 1996, the chair for architecture and CAAD had already gathered a lot of experience in using the World Wide Web (WWW) as a teaching environment for its courses. The web’s capabilities for communicating and sharing multimedia data had become an integral part of the way CAAD was taught. Besides the many administrative advantages, the main educational benefit was the rapid and intense exchange of ideas that this promoted between the large numbers of students that would take these courses every semester. While the students’ homepages were the place where they would present their coursework individually, other means had been developed of getting more of an overview of the work being done: WWW pages were generated by scripts that collected documents from all of the students’ homepages and displayed them in a “panoptic view”. The goal was to recreate the natural exchange of design information that existed before screens and CPU’s invaded the studio, this time inside the computers, in cyberspace.

6.1.2 Database Driven Websites as Working Environments

The positive experiences with web-based means led to the Phase(x) experiment and since it was a success, to fake.space, the Virtual Design Studio and EventSpaces (as well as many other projects inspired by them). In all of these projects a central database holds the information about every student as well as documents of their work and displays them in various ways. All functions of this database are available through a custom web-interface that showcases as well as manages all data related to the course. The web browser, with which the students can access this database, becomes a central part of their working environment.

The main goal of the introduction of the database was to further intensify the advantages of the previous web-based teaching, namely the exchange of ideas and expertise between the students.

Another problem was also addressed with this set-up. As was pointed out in the introduction,
Phase(x) as well as most of the other case studies were elective classes that students usually
took parallel to design studio work. Therefore the time students could spend doing work for it
is limited. With the many different software tools and concepts that are covered in the CAAD
Wahlfach, students often spend a lot of time overcoming operative problems rather than
concentrating on the intelligent use of the computer as a design medium. In reaction to this,
the assignments were designed as simple well-defined tasks that students could accomplish in
relatively little time. What also helped in this respect was that students didn’t have to start from
scratch: they were faced with an object that one of their colleagues had prepared in the previous
assignment. So their creative energy was spent on finding an intelligent answer or reaction to
this object. This made for a design task that was more well-defined than starting from scratch
would have been, but certainly not less challenging. It also sped up their learning because they
could check out the CAD files by the most accomplished students and learn their tricks from
them.

6.1.3 Collective Authorship and Collaboration

We soon realized that the projects did more than just that. The Phase(x) principle that forces
the students to take one of their colleagues’ work as the basis of their design in every phase
actually shifts how individual authorship can be perceived. In the traditional cultural model,
individual authorship is dominant. The influences between different authors are often unclear
and always debatable.

In Phase(x) the works themselves are the primary thread that is followed, and the contribution
of every author involved in the process can clearly be shown. So in Phase(x) this exchange of
ideas is not only intensified, it is also made transparent. The subsequent projects made different
use of the database, but they all challenged or rather expanded the notion of authorship.

Since the works can be said to be based on the contributions of different authors, there
logically must have been collaboration involved. It was asynchronous collaboration in almost
all cases, discussed here. And it happened in many cases without the different contributing
authors actually being aware of each other. Since the term collaboration is part of the title of the
thesis, one should be clear about the intentions. The point that the title makes is that this type of
indirect, anonymous and asynchronous collaboration is indeed that: collaboration. Even though
it might not seem so to those involved.

It doesn’t necessarily follow from this that this new type of online collaboration is actually
more desirable than the face-to-face variety or that the thesis is endorsing the forming of teams
that work together but don’t get to know each other. It would indeed be a sad thing if we found
that these web-enabled collective interactions were somehow replacing traditional forms that
let us socialize as well. There is nothing indicating that this will happen and this thesis was not
written with the intention to promote such a development. But these new types of collaboration
are interesting. And they deserve to be investigated thoroughly, because they challenge some
assumptions about what can be done collectively and how.

6.1.4 Earlier Publications on the Case Studies

Before the individual case study descriptions start, it should be mentioned that all of them
have been described before. There are papers, journal articles and a book chapter about all
projects. Some of them were drawn on for the preparation of this thesis:

• Phase(x) : Hirschberg & Wenz, 1997, 2000, Hirschberg, 2001a
• fake.space: Hirschberg, 1998, 2001c
• Virtual Design Studios: Hirschberg et al. 1999, Kolarevic et al., 2000, Hirschberg, 2001b
• Concepts that can be found in several of these projects: Hirschberg, 2002a, 2002b, 2003, 2006.

While this thesis is significantly different in both approach and scope than those earlier texts, when describing the individual case studies, sometimes an identical wording, and occasionally even similar paragraphs may be found. Strictly speaking those should have been labeled as quotes, but for the convenience of the reader (and admittedly also the author), this was not done. Instead, those earlier texts and the sections which draw on them are noted in the introductory lines of each section. Quotes are only used where the original formulation is not either my own or taken from a paper of which I was the main author.

6.1.5 Analysis Outworld tool and Distortion maps

Apart from the scope and detail, the main difference to the earlier publications about the case studies lies in the process evaluations. To enable these evaluations, an interactive viewer, the so-called Analysis Outworld tool was written and a new type of graphical visualization of the processes, referred to as distortion maps, was developed. While an earlier and far less complete version of these developments was presented in a paper and a journal article (Hirschberg, 2002a, 2003) the full scope of the analyses possible with these means is described here for the first time. The interactive tool and PDF versions of the distortion maps, which are difficult to reproduce legibly in print, is available on the CD accompanying the thesis. All evaluations described and shown on figures and charts in the evaluation sections of the case studies (and many others, not shown) can be explored in the more appropriate digital format. Instructions for the use of the CD and the tools and mappings it contains can be found in the appendix.
6a Phase(x)

6a.1 Phase(x) Description

Phase(x) is the name of the elective course on computer aided architectural design (CAAD) that was first taught in the winter semester of 1996. It was the first database-driven collaborative teaching environment implemented at the CAAD chair. The course was improved and taught again in 1997 as well as in 1999, and it also became an important inspiration for many other projects. Because in many ways it pioneered the most important concepts discussed in this thesis, it is the project described in most detail. Earlier texts about the phase(x) projects include Hirschberg & Wenz, 1997, 2000, Hirschberg, 2001a, as well as Hirschberg, 2002a, 2002b, 2003, 2006.

6a.1.1 Key Concepts

The basic idea is very simple: In Phase(x) the design process is structured into individual phases. After every phase the works of all the authors are stored in a common database and become visible to all participants. In the subsequent phase, each author has to select the design of one of their colleagues to develop it further. The same design can be selected by many different authors, but they are not allowed to continue working on their own designs.

While the basic idea is very simple, its consequences are not. The following key concepts can be observed in all of the Phase(x) courses, they are direct consequences of the basic Phase(x) principle, as we’ve come to call the structured sequence of design phases with switching authorship.

- **Evolution**: Phase(x) is an evolutionary system. Only those designs that are appealing enough to be selected will be developed further. Only the fittest works survive.

- **Self-Rating**: Phase(x) has a self-rating mechanism. The success of any work in the system depends on how many offspring it gets, and how successful those are in turn. Therefore, the relevance of the individual work is constantly challenged and redefined by the dynamics of the process.

- **Open Source**: Phase(x) can also be described as an open source experiment. Not just images, but actual model data is being shared and exchanged. The Open Source movement has demonstrated the potential of this mode of collaboration in many examples and contexts (DiBona, 1999). Phase(x) applies this open way of sharing intellectual property to CAD design data.

- **Collective Authorship**: Most importantly, Phase(x) replaces individual authorship with collective authorship. But it also clearly records every individual contribution, thus creating a new type of collective authorship with distributed credits and touching on some of the essential problems facing the networked society.
6a.1.2 The Phase(x) Principle, step by step

Phase(x) is an introductory course that teaches the principles of using the computer in architectural design. In each phase, a new CAAD concept is introduced and applied. Starting with 2D compositions on the plane in phase(1), the topics become increasingly complex, covering free-form surfaces, solid modeling as well as different object-oriented principles, like parametric or hierarchical modeling. The phases are prepared in a way that the design tasks can be fulfilled with relatively few macro commands. The individual contribution of an author therefore can be very simple. Nevertheless, the results tend to be rather formally complex, – a result of the fact that many different authors inscribe their personal ideas into the same objects: CAD models as palimpsests, one could say.

All phases deal with geometric modeling in a very abstract, almost hermetic way. Only in the last phases questions of architectural space become somewhat relevant. As mentioned in the introductory section, there is a tradition for this approach at the CAAD chair (Schmitt, 1993). The Principia classes pioneered this approach. The software tools and methods that are introduced allow students to concentrate purely on the principles of composition. The results are never taken to be representations of something but are always the – intangible – thing itself. The ideas or memes each object contains are entirely expressed as compositions in the language of computer graphics: color and geometric form. That there is indeed such a language and that it is established enough to make the Phase(x) experiment meaningful, was the hypothesis at the outset of our experiment.

To start working on a new phase, students browse through the results of the previous phase, choose a work that interests them and request it from the system. To request a work, the users have to identify themselves with a password. Upon requesting a work, students can download a whole folder to their accounts, which contains a CAD drawing file and sometimes other additional data. Until they have submitted the one they are currently working on, they cannot request another work. When the work is submitted, it becomes available for other students to work with in the next phase.

Using the database and the authentication makes it possible to smoothly exchange the works between the students and prevent any student from using their own results. Additional information can be stored with every work, such as the amount of time that it was worked on, which authors have worked on it and when. This information can be used to analyze various aspects of the process and the collaboration among the students.

6a.1.3 Collective Authorship in Phase(x)

In memetic processes the traditional concept of authorship, which relates an object to a single author and a single point in time, does not make sense any more. In fact, the notion of single authorship does in no way record the mutual synergies of collaborative creative work that is predominant on the Internet and leads to very complex legal implications.

Phase(x) replaces single authorship through collective authorship, because all relations between works, authors and timeline are recorded in the database and can be visualized and evaluated. In Phase(x), authorship is a variable entity that is relative to its current significance in the system. A single submission might thus start off having very little impact on the system, while at some later point, its significance will suddenly increase because of actions of other authors that relate to it. As authorship equals identity in Phase(x), authors find themselves being constantly redefined by other co-authors and subject to a dynamic model of personal identity.
6a.1.4 Peer Assessment Versus Self-Rating System

Phase(x) is a self-rating system, as it is based on an evolutionary process in which free choice leads to a survival of the fittest. Success is easily measured in terms of how many offspring a design gets and how relevant the number of offspring of one particular work become for the whole system. The ratings thus produced give much insight into the nature of evolutionary processes, but they are usually also perceived as rather unpredictable and sometimes unfair. Because a small difference in quality is enough to make many participants choose one work over another one, the differences in relevance are much more pronounced than the difference in quality would justify. Furthermore, sometimes a work is of high quality, but does not inspire one to continue working on it, possibly because it is already too well-defined or because it does not lend itself well to the task assigned in the next phase.

To put the objective self-rating produced by the system into perspective, we introduced a new feature in the third Phase(x) project: an additional, subjective rating mechanism, that allowed students and teachers alike to assess the quality of the individual works regardless of their success in the system. Participants were allowed to rate all designs as "+", ",-" or ",=". There was only one vote per participant and per work, which could be changed at any time. With these ratings we were able to make lists showing the most popular, the most unpopular and the most boring works as determined by peer assessment. Comparing the values for popularity and for relevance it is apparent that relevance, as determined by the system, shows more isolated peaks, whereas popularity, as assessed by human taste and judgment, generates a much gentler landscape.

6a.2 Phase(x) Design(s)

6a.2.1 Overview of Phase(x) Courses

The Phase(x) course was held three times. The first implementation was in the winter semester of 1996, the second and third in the winter semester of 1997 and the summer semester of 1999 respectively. Color plate 6 gives an overview of the three course websites. The basic elements were already in place in the first version.

Some statistics about the three courses:

- **Phase(x) ws 1996**: 120 students signed up, 114 completed the first assignment, 70 students completed the class. They were assigned to 6 groups and produced 807 designs in 10 phases. CAD-Software used was AutoCAD. Teaching staff: Prof. Gerhard Schmitt, Cristina Besomi, Fabio Gramazio, Urs Hirschberg, Patrick Sibenaler, Bige Tuncer, Florian Wenz.

- **Phase(x)2 ws 1997**: 156 students signed up, 139 students completed the first assignment, 80 students completed the class. They were assigned to 6 groups and produced 759 designs in 9 phases. CAD-Software: Microstation. Teaching staff: Prof. Gerhard Schmitt, Cristina Besomi, Fabio Gramazio, Urs Hirschberg, Maria Papanikolaou, Bige Tuncer, Daniel von Lucius

- **Phase(x)3 ss 1999**: 80 students signed up, 61 students completed the first assignment, 39 students completed the class. They were assigned to 5 groups and produced 353 designs in 8 phases. CAD-Software: Microstation. Teaching staff: Urs Hirschberg, Fabio Gramazio, Maria Papanikolaou, Benjamin Staeger, Bige Tuncer.
6a.2.2 Characteristic Design Elements

The interface and its underlying structure evolved during the first Phase(x). It always made use of so-called frames in HTML, which allows different types of content to reside in separate window segments. Links clicked in one frame can open up in another one. To a certain extent the frames can be configured and browsed through independently, making an almost infinite number of states of the interface possible. The color plates 6 through 9 give a comprehensive overview over the websites in the different phase(x) courses, there recurring features and their refinements. As color plate 6 and 7 make clear, the main elements characterizing this frames lay-out were there from the get-go:

• **Origin and Offspring**: The main window in Phase(x) is the one in which the works are presented. The work itself is displayed in the middle while on the left an icon of the origin (or parent) of the work and on the right icons of all offspring, that is all projects that had selected the current work as its origin, are shown. Thus the current work is shown as part of a sequential process. This layout made it very easy to follow threads of works and to see how popular a work was with the community.

• **Works Lined up at bottom**: All across the bottom of the window there was a frame showing all works of one particular phase. By default the most recently uploaded works were shown on the left, to see all one had to scroll. The possibility to change this order to make listings by group or popularity instead only became available in the third phase(x) class and later was a standard feature in the EventSpaces websites. In the phase(x) classes the most recently uploaded works were always visible first. With the commonly used width of the display, the twelve most recent files were visible in this default view. When the bias inherent in the websites is evaluated in chapter 6a.4.3, this visibility in the default view is referred to as being in pole position.

• **Outworld Views**: To analyze the ongoing processes, a number of visual representations of the collected data were developed. They are referred to as out.world views, as they allow for viewing the whole body of works. Developments over several generations become visible and legible. If the data is displayed along the genealogical development, the relationships between works from different phases become manifest. While these representations only became available at the end of the semester in the first Phase(x) course, in the second implementation they were part of the site from the beginning.

In the first Phase(x) project, we were amazed to realize that only four out of the over 120 different two-dimensional compositions that were created in the first phase had any descendants in the tenth generation. We had not expected the natural selection process taking place to be so drastic. In the second and third Phase(x) courses, students could monitor these macroscopical developments while they were happening. They could see where there were dead-ends and where the popular threads were starting and use these means to browse the site and to select which works to develop further.

The fact that these views were available did not make the process of natural selection any less drastic. In the second implementation only four designs had any offspring in the ninth phase, with two being very dominant (see figures 9.7 and 9.8).
COLOR PLATE 7: the websites of the three Phase(x) courses

fig. 7.1-7.2 Phase(x) ws96: Startup view (left) and description of phase(1) (right). Statistics: 114 students in 6 groups produced 807 designs in 10 phases. CAD-Software: AutoCAD. Teaching staff: Prof. Gerhard Schmitt, Cristina Besomi, Fabio Gramazio, Urs Hirschberg, Patrick Sibenaler, Bige Tuncer, Florian Wenz

fig. 7.3-7.4 Phase(x)2 ws97: Startup view with news (left) and view of a design from phase(2) (right). Statistics: 141 students in 6 groups produced 759 designs in 9 phases. CAD-Software: Microstation. Teaching staff: Prof. Gerhard Schmitt, Cristina Besomi, Fabio Gramazio, Urs Hirschberg, Maria Papanikolaou, Bige Tuncer, Daniel von Lucius

fig. 7.5-7.6 Phase(x)3 ss99: Startup view with authors in the bottom frame (left) and view of design from phase(5) with author profile in the left frame and works from phase(5) in the bottom frame (right). Statistics: 60 students in 5 groups produced 353 designs in 8 phases. CAD-Software: Microstation. Teaching staff: Urs Hirschberg, Fabio Gramazio, Maria Papanikolaou, Benjamin Staeger, Bige Tuncer
COLOR PLATE 8: impressions of the first Phase(x) website

fig. 8.1: Work from phase(1) without offspring.

fig. 8.2: work from phase(2) with origin and offspring.

fig. 8.3: popular work from phase(2) with origin and five offspring.

fig. 8.4: popular work from phase(7) with origin and five offspring.

fig. 8.5: author profile with works from ten phases.

fig. 8.6: thread of ten phases showing first and last works in the large window and all stages of development in the bottom frame.
fig. 9.1-2 Outworld views of Phase(x) ws96: The first generation of outworld views was developed for the final presentation. It was not available to students during the semester. The 2D version (fig. 8.1) was already in the version that became available of subsequent courses, in the 3D version, the use of textured landscapes was tried out, that was later abandoned. Both outworlds were shown in separate windows, but contained hyperlinks to the individual works and could be used for browsing the website (see fig. 8.2, the image on the right).

fig. 9.3-8: 3D outworld views of Phase(x)2 ws97: With 759 designs in 9 phases the 3D views of the second phase(s) are very impressive. They were available during the semester most and could be configured differently:
- fig. 9.3, 9.5: color by genealogy, y-axis by genealogy, x-axis by time, length by time, height by offspring.
- fig. 9.4 (top right): color by author, y-axis by author, x-axis by time, length by time, height by offspring.
- fig. 9.6 (bottom left): color by author, y-axis by author, x-axis by phase, length by phase, height by offspring.
- fig. 9.7: color by genealogy, y-axis by genealogy, x-axis by phase, length by phase, height by popularity.
- fig. 9.8: color by genealogy, y-axis by genealogy, x-axis by phase, length by phase, height by relevance.
COLOR PLATE 10: special outworld views in phase(x)3

fig. 10.1: Outworld applet of Phase(x)3 ss99, shown in four different configurations: The outworld applet is different from the other outworld views in that it contains no hyperlinks to the individual works. Instead, it shows detailed information about selected nodes on the right side. Its parameters can be configured dynamically and the works and authors it displays slowly 'wobble' to the location the new parameters call for. It thus portrays the dynamically changing nature of the phase(x) process, where any individual author’s relevance is influenced by the works of others. It can also be used to replay the process.

fig. 10.2: Outworld index of Phase(x)3 ss99: In the narrow left frame listings according to different categories, could be made to search and analyze the site in unprecedented ways.

fig. 10.3: Fevercurve applet of Phase(x)3 ss99: The threat of the transparent student was balanced with a playful attitude, apparent in the fevercurve applet, a way to find kindred souls among fellow students.
6a.2.3 Changes between Versions

While its essentials were already present in the first version that took place in 1996, the system was refined with each version of Phase(x). Some of the changes introduced are briefly outlined here:

- **Fewer phases:** The first Phase(x) class had ten phases, the second version nine, the third only eight. The reduction was meant to give students more time and produce more refined results. With the eight phases of Phase(x)3 a good balance seems to have been found. We probably would not have tried out doing the class with fewer than eight phases, as one of the tenets of phase(x) was not giving too much weight to the individual phases and rather get the dynamics of the exchanges going. Another reason for changing the number of phases was the desire not to repeat ourselves too much. There really were many more changes between the different installments than the statistics might suggest.

- **Database complexity:** The database used in the first class started out very simple. It contained only two tables: one for the authors and one for their submissions. But already during the first class, the database structure became more refined. New tables were introduced, to reflect groups and to store emerging ratings and scores. In subsequent versions there were fewer phases, but the individual phases were more complex. Accordingly the system had to be able to handle more complex submissions in terms of different file types etc.

- **More Outworld Views:** The first outworld views were developed for the final presentation of the first Phase(x) class. In subsequent classes they were available during the semester and could play a different role. These outworld views are described in more detail in the Evaluation section. The third Phase(x) class has three different visualization types labeled outworld: 2D Outworld, 3D Outworld and Outworld List. The last does not really meet the requirements of an outworld as we’ve defined it, as it is essentially a conventional graphic list with configurable filters. The other two however, the two dimensional and the three dimensional version alike, give an impression of the entire dataset as a process and don’t adhere to conventional standards for charts or graphs.

6a.2.4 The Transparent Student?

All the information we gathered about the students from the works they submitted, the time they spent working as well as their relative success and popularity was laid open to everyone. As this could be seen as problematic, especially for the less successful students, it must be pointed out that these were pass/fail classes in which the ratings did not have any effect on the academic record of the students. Furthermore, we dealt with them in a rather playful way.

The best example of this is the fever curve applet we prepared for the final presentation of Phase(x)3. The individual performance of the students, both in terms of success and of peer assessment is mapped as a chart of curves that define an individual profile. Not only does this profile give a good overview of how the student’s work was judged over the semester, whether it was rather even or with pronounced highs and lows, it also becomes an instrument that can trigger personal relationships between the participants. The fever curve applet is based on the assumption that there is qualitative information about the author in the form of this curve. Rather than analyzing, the program tries to match the profile with the curves of the other participants and finds a best match. It is a tool that, based on criteria that can be adjusted by a user, in a playful way is helping students find kindred souls among their colleagues.
6a.3 Phase(x) Process

6a.3.1 Purely Abstract Compositions

As noted earlier, there was a tradition at the chair for CAAD for the emphasis on “first principles” in design teaching. This approach was strong in the so-called Principia courses (Schmitt, 1993, Madrazo, 1991, 1995), but also became an important aspect of the Phase(x) pedagogy. Digital technology is particularly well suited to explore compositional strategies as detached from any direct application. In its sequence of assignments, Phase(x) steered clear of architectural content and encouraged a use of the CAAD program to create abstract compositions. The assignments emphasized the inherent logic and possibilities of the computer as a design instrument. Students explored the possibilities of three dimensional Computer Graphics without real-world constraints. The representations that were produced did not represent anything beyond themselves, that is beyond the CAD files that were necessary to produce them.

6a.3.2 Abstract Compositions as Memes

The compositions students produced in Phase(x) were never meant to be what architects usually work on: plans or other representations of projects. They do not refer to some other, they do not represent anything that could be built. They are more like abstract paintings, but of course they are purely digital and therefore, unlike paintings, do not have any material substance. It is necessary to insist on this point, as it leads to the key problem that needs to be discussed in the context of memetics. The designs are purely abstract compositions, which is what makes them so perfect for the topic of memes and memetics. The compositions can be separated from their authors as simple CAD files, which can be exchanged and propagated within the group without loss of substance. So the most important conditions of memetics, the splitting from the author, and the high fidelity replication, are met.

At the same time the reduction to the CAD file leads to a condition that stands in apparent contradiction to the concept of memetics. While one authors’ thoughts and ideas are what led to the creation of a particular file, the thoughts and the file are by no means identical. The thoughts, the themes of the composition, the aesthetic judgement of the author do not get encoded. Only the three-dimensional form, expressed as points, lines, faces and geometric primitives in the format of some particular CAD software, can be shared.

What one can see in an image and the lines and shapes it is composed of are not the same thing. That the whole is more than the sum of its parts is one of the basic tenets of Gestalt psychology (Ehrenfels, 1890). Some of the findings of Gestalt psychology have been taken up by researchers computer aided architectural design. For the phenomenon “emergence” a different type of geometry processing has been proposed that could alter its component structure to adjust to the different “emerging” readings one might have. Thereby, presumably, one would arrive at a closer relation between design thinking and CAD programs (Gero, 1996).

6a.3.3 Design Ideas vs. CAD files

The discussion of emergence does not help here, as no such geometry engines were employed and even if they were, it wouldn’t change the basic fact: despite the high fidelity replication of digital files, there is no guarantee that whatever ideas end up forming in the heads of those who take over these files are even remotely similar, let alone identical replications of the ideas of the original author. If the condition that “memes must at some point of the process be stored
in a human brain” (Blackmore, 1999, p. 57) is accepted, then these CAD files pose a problem. While the content of the files may be identical, the counterpart interpretations of these files in the human brains most probably won’t be.

This is already a problem with the more traditional forms of cultural expression: written texts, images, songs, etc. As was discussed earlier, what people can understand or remember from what they perceive is probably different for every reader, spectator or listener etc. With digital information the problem is even worse: one can’t even determine what the digital information looks like, as it doesn’t have an appearance in the traditional sense. Clearly it exists and it manifests itself in various ways, but which of those should be considered the default, or for that matter, the meme?

In the Phase(x) courses, the CAD information was often exchanged in the form of DXF files, a common standard for CAD data. Anybody that has ever had a peek at the source code of a DXF file knows that no human brain could ever store the thousands of coordinates, numbers and instructions such files are typically made up of (and of course if the file is in binary rather than ascii format, it becomes even more illegible). It helps to look at such a file in the program that was used to construct it, but even then it doesn’t just look one certain way: Whether or not and how we interact with the data, zooming, selecting, highlighting, etc. will make a big difference to what it is we perceive. Not to mention secondary matters like the resolution of the screen, color settings, brightness of projection etc.

The question of fidelity in replication seems to lead us directly to a genotype vs. phenotype discussion that Susan Blackmore advises one to avoid (Blackmore, 1999, p. 66). It is easy to see why. Already the apparently simple question which is which cannot be answered convincingly. The multiplicity of phenotypes and genotypes that digital information can typically be transformed into makes the terminology absurd.

6a.3.4 Are Memes Virtual?

All of this suggests that it doesn’t help to think of memes as static entities. In his book “Becoming Virtual, Reality in the Digital Age” French philosopher Pierre Levy describes the process of virtualization that characterizes cultural development and proposes an alternative to the “simple and misleading opposition between the real and the virtual” (Levy, 1998, p.23). Instead he suggests that the virtual should “not be compared with the real but with the actual, for virtuality and actuality are merely two different ways of being” (Levy, 1998, p.23). A memetic theory that is based on a notion of memes as potentialities, that are actualized as processes rather than as things may be more to the point and could help to avoid seemingly unsolvable questions that presuppose that memes must have some sort of identifiable physical existence.

Levy does not use the word or concept of memes, but his ideas could also be expressed in memetic terms, especially when he talks about the “objectively based virtuality” and about how objects can trace or mark the relationships between individuals (Levy, 1998, p. 168), or when he says that “we never think alone but always as an element of a dialogue or multilog, either real or imagined” (Levy, 1998, p. 123). Conversely one can argue that memes are virtual by nature. Defining memes as being virtual, explaining them as potential processes rather than things may fend off some questions, but also open up new ones.

6a.3.5 Memetic Pragmatism

Blackmore’s advice is not to worry about this. As long as one does not pretend to have solved all the mysteries that surround memes, Blackmore’s confident “[we] know enough to
get started” (Blackmore, 1999, p. 58) is pragmatic and productive advice. Knowing that memes exist is enough. That some questions don’t seem to lead anywhere doesn’t necessarily mean that there’s something wrong with memetic theory. It’s just as likely that the questions are ill-conceived and that it’s the same old parallel to genetics that is playing tricks again.

Just so, one can stick to facts when dealing with the case studies. It’s not productive to question whether CAD files can be memes, because according to the simple definition that memes are “anything that is passed on by imitation” (Dawkins 1976, p. 192), they clearly are. In Phase(x) the CAD file that one student submits is identical to the one the next student continues to work with, because it is a digital copy. That the ideas which the initial author had about their work are different from the ones the new author has is almost certain. Every author brings their own private cosmos of experiences and ideas to the table. And these personal ideas and ideals may be much more important for the design development than the design intent of their predecessor. The project, after all, involves humans, human creativity. It cannot be thought of as a hermetically sealed experiment. And even if there was only Phase(x) and nothing outside of it, one could never assume that all exchanges of ideas and inspirations that went on through the interface could also be recorded in the database.

One could see this as a problem and argue that the memetic process in Phase(x) really isn’t as pure as the graphic representations of it suggest. But one can also look at it differently. What analyzing the exchanges in Phase(x) as memetic processes makes clear is that copying is in no way adverse to individual creativity. The project the students copy, that is the meme they take over from someone else, may indeed be the smallest part of their creative process because it instantly becomes integrated with everything else they have in their minds. We feed off each other’s ideas most effectively if we appropriate those ideas, make them our own.

But that does not take away from the fact that indeed the database did record the development of memes through different generations and by different authors. There is evidence, there are facts. These facts are the result of a process that was facilitated by technological means, a process that applied memetic theory and that worked and produced results. It is this pragmatism that inspired to call Phase(x) a case study in memetic engineering: there is enough to get started.

6a.3.6 The story of p_8_14_2

As was noted earlier, the Phase(x) course underwent some changes with respect to the functionality of the interface and the nature and number of its assignments. The main concept, however, remained very much the same throughout the three times it took place (WS 1996/97, WS 1997/98, SS 1999).

Therefore it makes sense to look at the development of just a single design in order to gain a general understanding of the collaborative processes in Phase(x). The design chosen as the subject to this close scrutiny was submitted for the eighth phase of Phase(x)3, the third and last inception of the course in the summer semester of 1999. It was named p_8_14_2 by the database, which reveals that it was the second work submitted in the eighth phase and an offspring of the 14th submission in phase seven. All phases of its development will be described in some detail. As all of these phases need to be seen as designs in their own right, the story of p_8_14_2 is not so much the story of a single design as an account of a series of connected design steps. It is the nature of these connections that is of primary interest here. To understand the two types of processes described in the introduction to the process section: the individual learning and the peer-to-peer exchange and how they are related, one must assess what exactly gets passed on from one phase and one author to the next.
Why p_8_14_2?

Is p_8_14_2 a representative example? It is representative in the sense that, like all Phase(x) submissions, it is the result of a series of very different design contributions by different authors. And while it is arguably one of the better contributions to phase 8 (it ranked second in popularity), there are some weaker and some stronger design steps along its development and most of them can be called rather average. In part it was chosen for being average, but it also offers some interesting anomalies. For example its phase 3 is the design with the most offspring of the whole class. Actually, the nature of this anomaly makes it not an anomaly at all: a growing percentage of designs in subsequent phases can be traced back to this particular work. The same can be said about another seemingly non-average quality: incidentally, this same design submitted in phase 3, which became so successful, was by the same author that also created phase 1. In the next section the frequency and meaning of such genealogical patterns is discussed and evaluated. For the process discussion in this section these peculiarities are also relevant, but they do not challenge the pars-pro-toto approach. A more average choice would have been a thread that ended at about phase 5, as there are but a select few designs from phase 1 that have any offspring in phase 8. But for all practical purposes (which include the possibility to briefly describe the design tasks of all the different phases), the choice of p_8_14_2 can be considered representative.

Why Phase(x)3?

Choosing an example from the third Phase(x) course rather than the preceding two projects also poses some questions. There are good reasons for using an example from one of the other two projects instead. The first Phase(x) class is the one that can best be compared with the earlier elective classes, as the main software used (AutoCAD) was still the same (in subsequent courses, Microstation was used as the main general purpose CAD software). The second Phase(x) course could be chosen for having the most students and consequently the richest array of successes and failures in terms of collaborative interaction. With 61 submissions to the first phase (compared with 139 in Phase(x)2), the third Phase(x) is one of the smallest classes and the collaborative processes did not happen at as large a scale. The decision to take an example from this smaller project therefore needs to be explained.

The main reason is that in Phase(x)3 additional information about the choices made by the participants was gathered that give some feedback about the nature of the transitions. When selecting a design, authors had to state a reason for their choice and they had to choose between one of ten themes that should be reflected in their abstract compositions. Furthermore they could post comments about each other’s designs. It would simply be a pity not to use these sometimes quite insightful testimonials in this study. As the influence of the number of participants on the dynamic of the class is dealt with in the Evaluation section (chapter 6a.4), the availability of additional information is given precedence over the other mentioned factors.

(See also color plates 4 & 5)

Phase(1): Rectangle

Topic of assignment 1 is the composition on the plane, using a square format and only rectangular fields of different color values as material. Create a planar composition on a square field using rectangular shapes in different sizes and colors. Two-dimensional space can be explored, using the particular capabilities of the computer: simple transformations and scaling operations and
The designs created thus lay the groundwork for everything to come. See color plate 11, figures 11.1 through 11.5.

_**p_1_0_46 by space025 (M), group fr_1**_

The first work in the thread has the following attributes (see figure 11.5 on color plate 11):

Rating \(-1 = 4 + 15\), selfconf. 3 Children: 2, Memes: 6, relevance 67/292 = 22.95%
Theme: Minimalismus (minimalism)
Motivation: “o2 rules”

The ratings are given by the other students, selfconfidence is a value between one (low) and five (high), given by the author when submitting the work. The theme can also be chosen by the author. The motivation is meant to explain which goals the author pursued, it can be changed at submission time.

Compared with other works of the first assignment, space025’s submission is clearly true to its motto minimalism in that it uses a color palette reduced to greyscales and in that he doesn’t cover the whole format, but works with the black background as part of the composition. What is produced with these simple means is pretty sophisticated, though: the curvilinear pattern that forms across the stripes of different greys evokes different readings, some of them very spatial (a sort of a half dome).

_**p_1_0_46** had two direct offspring and a total of 6 in the next two phases combined (what was misleadingly referred to as 6 Memes in the interface). Of the 292 assignments posted in subsequent phases, 67 can be traced back to it, which results in the second highest rating for relevance of any design of that phase (22.95%, _p_1_0_35 leads the score with 28.76%)

**Phase(2): Relief**

Topic of phase(2) is the extension of the composition into the third dimension. With the addition of a command to give a value to the z-scale of the rectangular colored shapes the composition becomes not fully threedimensional, but what in the computer graphics context is commonly referred to as 2.5D or in art as a relief.

Some examples of phase(2) can be seen on color plate 11, figures 11.6 through 11.10.

_**p_2_46_19 by space115 (F), group fr_5**_

The second work in the thread is by a female author, space115 (see figure 11.10 on color plate 11):

Rating \(-0 = 8 + 11\) selfconf. 4 Children: 3, Memes 13, relevance 60/237 = 25.32%
Theme: Eleganz (elegance)
Motivation: “Dynamische Eleganz”

The second author, space115 starts with the identical file space025 submitted. Presumably inspired by the curvilinear arrangement of the rectangles on the plane, she adds another curve in the third dimension, formed by the differently scaled slender rectangles. This is a straightforward way to work with this composition and rather well suited to her chosen theme, Elegance. But straightforward could mean many things, here. Instead of continuing in a similar pattern in the third dimension, one could also have tried to build an actual half-dome like shape like the
COLOR PLATE 11: the development of p_8_14_2, phase by phase (part 1)

phase(1): rectangle

fig. 11.1 - 4: examples from phase(1) in phase(x)3 ss99

fig. 11.5: p_1_0_46 by space025 (M), group fr_1
Rating -1 = 4 + 15, selfconf. 3 Children: 2, Memes: 6, relevance 67/292 = 22.95%
Theme: Minimalismus (minimalism)
Motivation: “o2 rules”

phase(2): relief

fig. 11.6-9: examples from phase(2) in phase(x)3 ss99

fig. 11.10: thread leading to p_2_46_19 by space115 (M), group fr_5
Rating -0 = 8 + 11, selfconf. 4 Children: 3, Memes 13, relevance 60/237 = 25.32%
Theme: Eleganz (elegance)
Motivation: “Dynamische Eleganz”
COLOR PLATE 12: the development of p_8_14_2, phase by phase (part 2)

**phase(3): void**

fig. 12.1-4: examples from phase(3) in phase(x)3 ss99

**fig. 12.5:** thread leading to p_3_19_16 by space02 (M), group fr_1
Rating: –3 =2 +22 Selfconfidence: 4 Children: 8, Memes: 23, Relevance: 54/183 = 29.51%
Theme: Minimalismus (minimalism)
Motivation: “high rise, low underground then it changed to something else... just have [a] look”

**phase(4): rotation**

fig. 12.6-9: examples from phase(4) in phase(x)3 ss99

**fig. 12.10:** thread leading to p_4_16_24 by space03 (F), group fr_2
Rating: –3 =3 +9; Selfconfidence: 2; Children: 6; Memes: 9; Relevance: 54/183 = 29.51%
Theme: Minimalismus (minimalism)
Motivation: “wow, wohlfehlgefühl”

**fig. 12.11:** thread leading to p_4_16_17 by space00 (M), group fr_2
Rating: –7 =3 +4; Selfconfidence: 4; Children: 5; Memes: 16; Relevance: 26/134 = 19.4%
Theme: Dynamik (dynamism)
Motivation: “Sommer, Sonne, Sonnenschein”
one the color composition suggests. The authors are absolutely free in choosing which of the various readings of a composition they want to expand on.

**Phase(3): Void**

Topic of phase(3) is the three dimensional modeling with solid and void forms. As there is no concept of voids in traditional CAD programs, the work on this assignment is done in Sculptor, a software developed by David Kurmann at the chair for Architecture and CAAD (Kurmann 1995). All of the cubic forms are converted into the Sculptor format, which supports the real-time modeling with positive and negative (“void”) elements.

Some examples of phase(3) can be seen on color plate 12, figures 12.1 through 12.5.

**p.3_19_16 by space025 (M), group fr_1**

Compare figure 12.5 on color plate 12:

Rating –3 =2 +22 selfconf. 4 Children: 8, Memes 23, relevance 54/183 = 29.51%
Theme: Minimalismus (minimalism)
Motivation: “high rise, low underground then it changed to something else... .... just have [a] look ”

The third author is the same as the first: space025 takes an offspring of his first phase design as the basis for his third phase project. He picks the same theme as in phase(1), which could be taken as a sign that he wants to continue with his original idea from phase(1), rather than the second phase design. His design and his motivation don’t appear to support this theory, however. What interests him about the project is what he refers to as “high rise, low underground” – a quality related to the vertical scaling that was entirely added by the second phase author space115. The statement about his motivation which could be reviewed once more before submitting (which, presumably, was when he added “then it changed to something else... .... just have [a] look ”) also reveals that he did not go through with his first plan.

As modeling in Sculptor is done in perspectival view, it favors design-decisions to be made based on particular views or perceptive concerns, rather than higher level concepts or ideas (Kurmann, 1995). Just so, space025 appears to have come across something more interesting than his original concept, something that he doesn’t try to describe. Instead he invites that one should “just have [a] look”, implying that seeing the design will answer all questions. Whether one agrees or not, it probably reflects the way space025 worked: first following some strategy and then coming across something he liked better, which he couldn’t conceptualize beforehand (and maybe still cannot), but which is, in his view, much more interesting than the original plan. The theme of Minimalism seems to have fallen by the wayside as well: the design is very complex and contains many more parts than before.

**Interlude: Programs as Co-Authors?**

At this point one should acknowledge another contributor to the creative memetic process more formally. Without a doubt the design software is a major force in the development of these compositions. This is nothing new, in fact, the very motivation behind the courses’ going back to the “first principles” of design is to come to a better understanding of this notion. In order to thoroughly explore the ways in which the computer as a design tool influences the design process, Phase(x) breaks down the formal repertoire into individual components that are treated
in separate phases. The discovery that the computer is better at some tasks than at others is trivial. But the chance to experience and to observe how it thereby encourages certain formal approaches over others is very interesting.

Does the design software as an additional agent in the process challenge the Phase(x) schema which is based on the simple concatenation of individual authorships? No: whatever hides behind an individual author’s contribution, from the system’s point of view can be treated as a black box. Any design process needs a medium in which it can be expressed and whatever this medium happens to be, it will always affect the resulting design in some way. If, as Levy suggests, any thought process (and thus also any design process) happens “as a dialogue or multilog” (Levy, 1998), one can assume that the software at least in part takes the role of the partner in such a dialogue. How much it thus contributes to the design is irrelevant, at least for the Phase(x) schema. Theoretically the software could be the sole contributor to the design, which would imply that the author of the software – maybe even a team of authors, should be credited with the authorship. As far as the Phase(x) process is concerned none of this matters. Submitting a design is a statement by an author. The submission is expected to be a contribution to a design process, but for all the system cares, it could be the unchanged file from the previous phase or no design at all or somebody else’s design just as it could be some autonomous software-generated design. In all of these cases it would still be the contribution of the author who decided to make the submission.

**Phase(4): Rotation**

The topic of phase(4) is the rotation in three dimensional space. While the first three phases were restricted to orthogonal arrangements, any rotation around any angle in space could be performed here. As objects could be copied as well as rotated, the assignments led to a multiplication of elements.

Some examples of phase(4) can be seen on color plate 12, figures 12.6 through 12.11.

**p_4_16_24 by space037 (F), group fr_2**

Compare figure 12.10 on color plate 12:

- **Rating:** –3 = 3 + 9; **selfconf:** 2; **Children:** 6; **Memes:** 9; **Relevance:** 54/183 = 29.51%
- **Theme:** Minimalismus (minimalism)
- **Motivation:** “wow, wohlfuehlgefuehl”

Because p_3_19_16 had so many offspring and to give an idea of the different directions a design could take at any point, a branch is described here that is not part of the thread that leads to p_8_14_2. Unlike many of the other authors did in this phase, space037 reduces the number of elements in the composition. We can assume that her initial impulse to take up the assignment (“wow wohlfuehlgefuehl” could be loosely translated as “wow, good vibrations”) was guided by intuition rather than some set idea. She just liked the design very much. Maybe she reduced the number of elements because she felt overwhelmed by what turned out to be a rather complex arrangement, leaving not much more than a couple sets of scaled rectangular shapes which she rotated in a way that it now looks a bit like a shell. She actually did a very good job of framing this new composition, but her self-rating of 2 tells us that she was not too proud of herself for having left so much of what she liked about the original behind.
COLOR PLATE 13: the development of p_8_14_2, phase by phase (part 3)

phase(5): wrap

fig. 13.1-4: examples from phase(5) in phase(x)3 ss99

fig. 13.5: thread leading to p_5_17_12 by space061 (F), group fr_3
Rating: –2 =8 +6; Selfconfidence.: 3; Children: 4; Memes: 8; Relevance: 11/88 = 12.5%
Theme: Ruhe (calm)
Motivation: “zweiter Versuch, da es immer noch regnet!”

phase(6): library

fig. 13.6-9: examples from phase(6) in phase(x)3 ss99

fig. 13.10: thread leading to p_6_12_29 by space114 (M), group fr_5
Rating: –3 =2 +4; Selfconfidence.: 5; Children: 3; Memes: 6; Relevance: 6/47 = 12.77%
Theme: Nervosität (nervousness)
Motivation: “ichwerdewiedereinmalwahnsinnig,obschondersolidmodelerimsolidmodelermodusistmodelterimcmmidiesenflaechenzumwahnsinnigwerdenwiedieseamerikanischetastatureau.”
COLOR PLATE 14: the development of p_8_14_2, phase by phase (part 4)

**phase(7): fractal**

fig. 14.1-4: examples from phase(7) in phase(3) ss99

**phase(8): light**

fig. 14.6-9: examples from phase(8) in phase(3) ss99

**fig. 14.5: thread leading to p_7_29_14 by space078 (M), group fr_2**
Rating: –1 =2 +6; Selfconfidence.: 4; Children: 3; Memes: (3); Relevance: 3/10 = 30%
Theme: Komplexität (complexity)
Motivation: “unbeugsame Laune”

**fig. 14.10: thread leading to p_8_14_2 by space094 (F), group fr_4**
Rating: –1 =0 +10; Selfconfidence.: 4; Children: NA; Memes: NA; Relevance: NA
Theme: Eleganz (elegance)
Motivation: “Damit der Urs doch noch eine weitere Phase 8 hat :’”)
CASE STUDY A: PHASE(X)

p_4_16_17 by space050 (M), group fr_2

Compare figure 12.11 on color plate 12:

Rating: –7 =3 +4; Selfconf: 4; Children: 5; Memes: 16; Relevance: 26/134 = 19.4%
Theme: Dynamik (dynamism)
Motivation: “Sommer, Sonne, Sonnenschein”

The motivation of space050 (“summer, sun, sunshine”) suggests that he was more interested in the current weather conditions than in doing too refined a job in the assignment. It shows in his submission: there is something quick and dirty about how the parts are pretty much randomly rotated. The lack of care is also reflected in the peer rating the design achieved: seven negative ratings is rather bad. But on the other hand this approach is also very much in keeping with his theme of “dynamism”.

Phase(5): Wrap

The topic of phase(5) is the working with freeform surfaces. The rotated shapes from phase(4) are taken as the skeleton or inner structure around which a more organic shape could be constructed.

Some examples of phase(5) can be seen on color plate 13, figures 13.1 through 13.5.

p_5_17_12 by space061 (F), group fr_3

Compare figure 13.5 on color plate 13:

Rating: –2 =8 +6; Selfconf: 3; Children: 4; Memes: 8; Relevance: 11/88 = 12.5%
Theme: Ruhe (calm)
Motivation: “zweiter Versuch, da es immer noch regnet!”

Funnily, perhaps coincidentally, the motivation of space061 is also about the weather. It’s her second try, she says, referring perhaps to an aborted first attempt which she never submitted, and adds: “because it’s still raining!” Her design intent isn’t much clearer than the sunshine inspired one of her predecessor, but she does do better in terms of peer rating, getting mostly average ratings. There is something about the design that appeals to quite a few people, though. Possibly the mysterious quality that the relatively dark renderings give to it make it the second most successful of all offspring of p_4_16_17.

Phase(6): Library

The topic of phase(6) is the taking apart of an existing object to create a library of parts in the spirit of that object. The assignment called for four different parts, one linear, one planar, one node-like and one hollow.

Some examples of phase(6) can be seen on color plate 13, figures 13.6 through 13.10.

p_6_12_29 by space114 (M), group fr_5

Compare figure 13.10 on color plate 13:

Rating: –3 =2 +4; Selfconf: 5; Children: 3; Memes: 6; Relevance: 6/47 = 12.77%
Theme: Nervosität (nervousness)

Motivation: “ichwerdewieder einmalwahnsinnig, obschondersolidm odelerim solidmodelermodusimodelterimcm mitdiesenflaechenzum wahnsinnigerwenwindiese amerikanischetastrachunddeshalbistdiesearbeit ein nervous…!”

The motivation in this case was probably written after the model was completed (authors could edit their initial statements before submitting) as it is an untranslatable rant about problems that were encountered using the solid modeling program. The theme “Nervousness” according to the student was to be taken as an indication of his agitated state of mind and not one necessarily inherent in the composition.

Phase(7): Fractal

The topic of phase(7) is the self-referential composition with objects out of the library, creating compositions that are made up of parts that are themselves made up of parts out of the library of parts.

Some examples of phase(7) can be seen on color plate 14, figures 14.1 through 14.5.

p_7_29_14 by space078 (M), group fr_2

Compare figure 14.5 on color plate 14:

Rating: –1 = 2 + 6; Selfconf.: 4; Children: 3; Memes: (3); Relevance: 3/10 = 30%

Theme: Komplexität (complexity)

Motivation: “unbeugsame Laune”

The motivation which could be translated to “invincible mood” is rather mysterious in this case. The theme complexity is not surprising given the topic of self-referential structures. Actually the object only employs one of the elements in the library, but that one object is arranged at different sizes and with different color hues and transparencies creating indeed the impression of considerable complexity. Because the last phase was not mandatory only ten submissions were made. Three of them go back to this design, making it the most influential of phase(7).

Phase(8): Light

The topic of phase(8) is light. By using light sources, textures and precise viewpoints the goal was to provide an unexpected new reading of one of the models from phase(7). As mentioned, this phase was optional (only 7 phases were mandatory), so the results don’t display the variety of previous phases.

Some examples of phase(8) can be seen on color plate 14, figures 14.6 through 14.10.

p_8_14_2 space094 (F), group fr_4

Compare figure 14.10 on color plate 14:

Rating: –1 = 0 + 10; Selfconf.: 4; Children: NA; Memes: NA; Relevance: NA

Theme: Eleganz (elegance)
Motivation: “Damit der Urs doch noch eine weitere Phase 8 hat (:”

The primary motivation behind the creation of this optional submission here was sympathy with the instructor (“so that Urs gets another Phase 8”), as for some time there was only a single submission. This not altogether serious motivation notwithstanding p_8_14_2 received the highest popularity values of all the ten works that were eventually submitted. The theme elegance was well-chosen for the glittering light the rendering features.

This elegant submission thus concludes the story of p_8_14_2.

Collective Authorship of p_8_14_2

What can be learned from the series of design phases and transitions that led to p_8_14_2? Clearly there is no grand plan that guides or unifies the development. The comparison of the first and the last phase indeed shows hardly any similarity. What’s more: the similarities in color hue are pure coincidence. It is not a feature that survived throughout: the previous phase had orange hues. One would be hard pressed to identify a design intent in phase(1) that actually survived through all author changes and made it to the final phase. The different stages of the design development rather remind one of the “cadavre exquis”8, the game so popular with surrealist writers (Brotchie & Gooding, 1991, Breton, 1947, Corti 1989). Yet there is a difference to this obvious historical precedent. Unlike the stories of the surrealists that were written by different authors without knowing what the previous author had written, here the development not only is based on the complete knowledge of the preceding design and the choice of a precedent among all submissions available. The objects in the different phases are actually of the same substance, as they all started with an exact replica of the preceding phase. It is therefore quite likely that the first and the last stage share the same layer nomenclature or other settings of the CAD file. While seeing the results of the individual phases lined up next to one another suggests that they were added like the surrealist drawings on a piece of paper, every phase was actually not an addition to, but a transformation of the original.

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8 This is the definition given in the Dictionnaire abrégé du surréalisme (Corti, 1989): “jeu qui consiste à faire composer une phrase, ou un dessin, par plusieurs personnes sans qu’aucune d’elles puisse tenir compte de la collaboration ou des collaborations précédentes.”

Transl: “game which consists in getting a sentence or a drawing composed by several people without any one of them being able to keep track of the collaboration or of the preceding collaborations.” (transl. by the author)
6a.4 Phase(x) Evaluation

We set out to assess the teaching method used in Phase(x) quantitatively, now. The criteria and the assumptions that these evaluations are based on were described in chapter 3 in more detail.

The first one, ‘boundaries of groups’, takes on the question whether the large scale collaboration worked, that is whether the students really were part of a learning process that included the entire student population or whether their sharing and exchanging of files happened largely within their assigned group, with people they got to know personally.

The second one, ‘more objective assessment of designs’ is based on the assumption that it is better to look at a design uninfluenced by personal relationships, because that allows one to concentrate on the design aspects of a work more objectively. To test for this, the connections between the works are scanned for special patterns that could suggest a personal relationship between the authors as the basis for an exchange transaction.

Finally the ‘bias inherent in the websites’ is evaluated. What if the linking patterns can actually be explained by the way the website was organized? In order to be able to make anything of the results of the first two questions, this third one must be ruled out, as well.

6a.4.1 ‘Boundaries of Groups’ (color plates 15 through 22)

The design of the Phase(x) classes is based on the assumption that it is good to be exposed to the work of many other students in a design education, because one can learn from and be inspired by the work of others. The didactic goal of Phase(x) was to have students share their works among the entire student population. But it could be that this only worked in theory. Since the students were in a traditional classroom situation together with only a rather small group of students and with a particular teacher, it could well be that they used the website for submitting files but otherwise didn’t care much about it and selected only works from their own group to work with. If this were the case, then the whole effort of making the website and making the works visible and available to everyone would be rather pointless.

Thus the question whether the exchange behaviour in Phase(x) transcended the boundaries of the student groups goes right to the heart of this teaching experiment.

To study this question, the database records of the three Phase(x) courses was analyzed. The connections between the works were put into two categories: within the group or outside of the group. In the graphic version of the analysis charts, the connections within the group are in blue color, the ones that link works from people in different groups are in orange color.

To study the performance of the individual groups one also has to differentiate between connections ‘>IN’ to and ‘OUT>’ of the group.

Connections ‘>IN’ to the group are created by the group members by their active choices of projects to work with. It shows how many of their choices of works to continue working on were from outside their group. It therefore gives a good measure of how actively the students in the group looked around at what people in other groups were doing.

The findings of all three Phase(x) courses are surprisingly clear. The boundaries of the groups are statistically inexistent: the distribution of linking preferences over different groups is very close to the value that would result from a random choice. In the first and second Phase(x) projects, there were six groups, thus the likelihood that a randomly selected work will be from the same group is one in six, or 16,66%. The resulting value in Phase(x) ws96 was 16,33%, in Phase(x)2 ws97 it was 17,26%. In the third version, there were only five and relatively small
**Introduction to the Analysis Outworld Tool**

This is the default view of the Analysis Outworld tool*. It shows all submitted works of all authors in the third Phase(x) class from ss99. Each of the dots corresponds to one work, each horizontal line to one author. Dots are ordered in the sequence they were submitted. The connecting lines between the dots signify the exchanges between authors: the switching of authorship, when one work is taken up by a different author. Orange connecting lines stand for exchanges between authors in different groups. Blue lines signify exchanges within the same group.

In fig. 15.1, the default view is shown: all 292 connections are visible. There is a total of 60 authors and 353 works. In total there were 231 (or 79.11%) exchanges between members of different groups and 61 (or 20.89%) exchanges within the same groups. Taking over one’s own work was not allowed in phase(x), thus the count for self is 0 (0%).

The boxes on the left stand for the five different groups and for male or female gender (see color plates 16 and 17). All connections leading ‘>IN’ to or ‘OUT’ from works by authors in a certain group or with a certain gender can be activated by clicking on them. Members of the same groups are next to each other. Gender is color-coded: orange lines are female, blue lines are male, grey lines are undefined. Threads stands for the developments of works through different phases until they were not continued anymore. There are in total 212 unique threads. Patterns refers to threads in which the same author appears twice (compare color plates 23 and 24). In fig. 15.1 there is no author and no work selected, thus no images of either is shown on the right.

* available on the CD accompanying the thesis.

Note: The graphical evaluations on this and the following color plates have all been produced with the interactive Analysis Outworld tool. In some cases, parts of the interface have been cropped for better legibility. The evaluations shown only for phase(x)3 can also be performed on the two earlier phase(x) classes.
COLOR PLATE 16: Phase(x): Boundaries of Groups (part 1)

* lines going >IN to the group: lines indicate the choices made by members of the group, which works to use as starting points of their designs (shown in left column)
** lines going OUT> of the group to someone else: lines indicate the works of the group members were chosen as starting points by people in- and outside the group (middle)
*** >I/O> both lines, in and out, are turned on, also the dots of all works are turned on: shows how well integrated the works of a group are with those of the entire class (right)
<table>
<thead>
<tr>
<th>Gender</th>
<th>Authors</th>
<th>Works</th>
<th>Links Inside Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>32</td>
<td>200</td>
<td>22.16%</td>
</tr>
<tr>
<td>Female</td>
<td>17</td>
<td>89</td>
<td>9.72%</td>
</tr>
<tr>
<td>Undefined</td>
<td>11</td>
<td>64</td>
<td>35.71%</td>
</tr>
</tbody>
</table>

*lines going >IN to the group: lines indicate the choices made by members of the group, which works to use as starting points of their designs (shown in left column)*

**lines going OUT> of the group to someone else: lines indicate the works of the group members were chosen as starting points by people in- and outside the group (middle)*

***>I/O> both lines, in and out, are turned on, also the dots of all works are turned on: shows how well integrated the works of a group are with those of the entire class (right)*

fig. 17.1: Phase(x) ss99 connections by gender: >IN*/ OUT>*/*I/O>*
Two Surviving Designs from phase(1) in Phase(x)3 ss 1999. Fig. 18.1-2 show the only two designs from phase(1) that had any offspring in phase(8). The respective authors happen to have repeatedly taken up offspring of their own works, thus contributing to their success.
fig. 19.1: Phase(x) ss99: 60 authors, 353 works, 5 groups, links inside group: 20.89%
COLOR PLATE 20: Phase(x): Boundaries of Groups (part 5)

fig. 20.1: Phase(x)2 ws 1997: 141 authors, 759 works, 6 groups, links inside group: 17.26%

fig. 20.2: Phase(x)2 ws 1997: Detailed Statistical Summary
### Phase(x)1 WS96 (114 Authors, 807 Works, 6 Phases)

#### IN

<table>
<thead>
<tr>
<th>Author</th>
<th>Total</th>
<th>Avg. Works/Author</th>
<th>Works in P1/</th>
<th>Conn. To Inside</th>
<th>From Inside Group</th>
<th>From Outside Group</th>
<th>Total</th>
<th>Total %</th>
</tr>
</thead>
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<td>19</td>
<td>156</td>
<td>8,21</td>
<td>22</td>
<td>134</td>
<td>24</td>
<td>17,91%</td>
<td>110</td>
</tr>
<tr>
<td>do_2</td>
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<td>170</td>
<td>7,39</td>
<td>28</td>
<td>144</td>
<td>34</td>
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<td>110</td>
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<td>11,70%</td>
<td>83</td>
</tr>
<tr>
<td>fr_2</td>
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<td>146</td>
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<td>108</td>
</tr>
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<td>23</td>
<td>16,55%</td>
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<td>53</td>
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<td>18</td>
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</tr>
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<td>5</td>
<td>12,50%</td>
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<td>6,97</td>
<td>115</td>
<td>692</td>
<td>113</td>
<td>16,33%</td>
<td>579</td>
</tr>
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</table>

#### OUT

<table>
<thead>
<tr>
<th>Author</th>
<th>Total</th>
<th>Avg. Works/Author</th>
<th>Works in P1/</th>
<th>Conn. To Inside</th>
<th>From Inside Group</th>
<th>From Outside Group</th>
<th>Total</th>
<th>Total %</th>
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<td>156</td>
<td>8,21</td>
<td>22</td>
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<td>143</td>
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<td>124</td>
<td>692</td>
<td>113</td>
<td>16,33%</td>
<td>579</td>
</tr>
</tbody>
</table>

### Detailed Statistical Summary

**fig. 21.1:** Phase(x)1 ws96: 114 authors, 807 works, 6 groups, links inside group: 16,33%

**fig. 21.2:** Phase(x)1 ws96: Detailed Statistical Summary
fig. 22.1: space018 / 6w / 8c / 28off / 41rel / 26,83%
fig. 22.2: space025 / 7w / 11c / 67off / 71rel / 15,49%
fig. 22.3: space026 / 7w / 10c / 14off / 30rel / 20,00%
fig. 22.4: space077 / 8w / 18c / 62off / 78rel / 23,08%
fig. 22.5: space050 / 8w / 12c / 115off / 130rel / 23,85%
fig. 22.6: space051: 9w / 11c / 28 off / 65rel / 26,83%
fig. 22.7: space094: 8w / 18c / 26off / 47rel / 7,69%
fig. 22.8: space119: 7w / 14c / 27off / 45rel / 15,56%

fig. 22.1-8: Eight most successful authors of Phase(x)3 ss 1999 showing all connections >IN and OUT< (incl. branches), one work highlighted: authorname / w=works / c=children / off=total offspring / rel=total relatives / links inside group
groups, making it easier for people to get to know each other. But the resulting 20.89% is very close to the 20% odds of a blind choice from five groups.

Thus the web-environments in Phase(x) were obviously successful in broadening the reach of the students and in creating an awareness of what other students were doing outside of their own class.

**Gender-specific Behavior?**

Do the evaluations show anything besides this very clear and convincing evidence? The evaluation also tried to find gender-specific behavior. As social behavior among men and women differs in some ways, one might expect to see that reflected in the connection patterns. Indeed by looking at women, which were a minority in all three courses (about 1 to 5 in the first course, and 1 to 2 in the second and third courses), separately, some significant differences seem to emerge. In Phase(x)3 the female participants were choosing a work from their own group in only 9.7% of the cases (men took from their own group over 22% of the time). But in the other two courses this particular finding is not repeated. In Phase(x)2 the men take fewer works from inside the group than women (14.86% vs. 22.63%). In the first class their percentages were almost identical. So these variances cannot be attributed to gender, also because in no case the gender difference lies outside of the variability that could be found among the groups. In the first and third course, there is also a group that refused to declare their gender, using “other” instead. In Phase(x)1, this group performed significantly lower than the male or female group, finishing fewer assignments which were getting picked by fewer people. Thus, their not declaring their gender could be taken as a sign of not being very engaged in the class. But in Phase(x)3, this group got much better ratings. Their success rate was above average and they also performed better than the females. So, again, nothing significant can be deducted from these findings, other than that every class created its own dynamic. One interpretation is that in the first class not declaring your gender was mostly done out of a lack of interest in the class, while in the third class the majority of those not declaring their gender did so for other motives. Maybe their incentive was a playful way of treating the rules of Phase(x), of engaging in the game of reshaping their own identity through the dynamics of the collaborative process. In fact, some of the undeclared participants were among the top performers in the class, with the highest rate of works getting picked up by others. In Phase(x)1 there were no such stand-outs among the “other” group.

These speculations aside there are no gender specific patterns apparent in the three surveyed classes.

The ‘from’ connections are a measure of the success of the students in that they show how many times a work from that group was selected. There are no strong patterns evident in this category, either. Connections per author vary between the groups but not dramatically. A tendency that earlier or later groups have an easier/harder time getting picked can be found in the first Phase(x) course, but cannot be confirmed in the other two courses.

Thus the one major, but very clear finding is that the web-environments were successful in establishing a platform for students to go to in order to find out more about their colleagues’ works and that in checking out what works to select neither the boundaries of their own groups nor gender were relevant for the students.
6a.4.2 ‘More objective Assessment of Designs’ (color plates 23 through 27)

The findings of the pattern analysis show that the websites pretty much eliminated the notion of groups as a significant reason for the choice of works. This could point to the fact that the designs were assessed and selected for their design content only. But being in the same group is only one of the possible reasons for selecting a work other than the quality of the design. Students know each other even when they are not in the same class. They might even take the relative anonymity of the course environment as an opportunity to socialize with other students. Some way of flirting or remote communicating for which choosing a design by a particular author is but a pretext is certainly thinkable. Thus ruling out that the boundaries of groups have no influence is not enough to prove that the designs were assessed more objectively. We also have to show that the extent to which other social motives are apparent in the choices the students made is relatively insignificant.

The mathematical side of this assessment is more complex. To arrive at a precise measure of the statistical probability, one would need to take various parameters into account, like the fact that the number of works to choose from actually shifted, not only between phases, but also depending on when a student chose the work to develop further. Using a simplified mathematical model that assumes that the same number of works was available in all of the phases, the formula for binomial distribution delivers the probabilities listed in the table below. The formulas used are documented in the Appendix. Again, the surprising result is that the findings are quite close to the probabilities of blind choice. In fact, except for the first phase(x) course, where we have four students who chose a work from the same student three times, bringing the percentage of this statistically unlikely case to 3.48% (compared with a probability of 0.61% - actually, three of these four cases were doing the same assignment twice, and thus represent yet a special case), the findings are usually well below what we could expect in the case of blind choice. If anything, in Phase(x)2 it seems that there was a negative personal dynamic at work: people didn’t want to take from the same person more than once. But, again, actually the numbers suggest that no such personal feelings had any influence on their selections.

The fact that taking works from particular authors repeatedly didn’t happen in a statistically unusual frequency doesn’t mean that there are no personally motivated patterns. Rather, given the level of identification authors develop for their work, we should look for patterns where authors took up working on their own offspring. An algorithm to detect such patterns was built into the Analysis Outworld tool. They can be graphically analyzed and judged to decide how strong the narcissist drive to take up their own offspring was among the students.

Repeated choice of works from same author
Findings (using the Analysis Outworld tool):

<table>
<thead>
<tr>
<th>authors</th>
<th>Phase(x)1 ws96</th>
<th>Phase(x)2 ws97</th>
<th>Phase(x)3 ss99</th>
</tr>
</thead>
<tbody>
<tr>
<td>phases</td>
<td>115</td>
<td>141</td>
<td>60</td>
</tr>
<tr>
<td>2x</td>
<td>32</td>
<td>27.33%</td>
<td>16</td>
</tr>
<tr>
<td>2x two authors</td>
<td>8</td>
<td>6.96%</td>
<td>2</td>
</tr>
<tr>
<td>3x same author</td>
<td>4</td>
<td>3.48%</td>
<td>0</td>
</tr>
</tbody>
</table>

Statistical Probability (approximated using formula for binomial distribution):

<table>
<thead>
<tr>
<th></th>
<th>Phase(x)1 ws96</th>
<th>Phase(x)2 ws97</th>
<th>Phase(x)3 ss99</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x</td>
<td>32.68%</td>
<td>19.16%</td>
<td>29.69%</td>
</tr>
<tr>
<td>2x two authors</td>
<td>5.28%</td>
<td>2.01%</td>
<td>5.35%</td>
</tr>
<tr>
<td>3x same author</td>
<td>0.61%</td>
<td>0.28%</td>
<td>0.94%</td>
</tr>
</tbody>
</table>
Fig. 23.1: Four authors from Phase(x)3 ss99 with connections >IN and OUT> turned on. In this mode, the Analysis Outworld tool checks for repetitive direct relations between authors. In the bottom right corner, author names with links >IN resp. OUT> are listed. When names appear more than once, orange numbers are displayed. These cases are counted and compared with the statistical probability on page 114.

Fig. 23.2: 18 patterns with recurring authors in Phase(x)3 ss99. The algorithm detects as a pattern any thread in which an authorname appears more than once. In Phase(x)3 there are 18 such patterns, with eleven different authors. They can be seen individually on Color Plate 23.

**Fig. 23.1-2** show two different ways of detecting social patterns. In fig. 23.2 all threads in which an authorname appears more than once are shown together. In fig. 23.1 repetitive direct relations between authors are listed. Both can happen by accident, but constitute potential patterns.
fig. 24.1: **18 patterns with recurring authors in Phase(x)3 ss99** shown individually. For a list with the resulting patterns see color plate 26.
fig. 25.1: 60 authors from Phase(x)3 ss99 with threads to all their works. Preferences of all students can be studied individually and compared. Most threads go across the entire class.
COLOR PLATE 26: Phase(x): Detecting Social Patterns (part 4)

fig. 26.1: Phase(x) ss99: Statistical analysis of special linking patterns: This chart is compiled based on the analysis described on color plate 22. It lists all individuals with special connection patterns. Two of them, space025 and space050, qualify as systematic narcissists: they clearly and intentionally repeatedly selected works developed out of their own designs. This is of course no crime. It just shows that for them, their bias based on personal acquaintance was not eliminated by the website. Their assessment was not more objective.

fig. 26.2: profile of space025
space025 was one of the most successful authors. His average rating (-1.71 = 2.29 + 9.43) is among the best in the class (only three students scored higher on average). His phase(3) design has the most offspring of the whole course. It was itself an offspring of his phase(1) design, which ended up being one of only two survivor designs with offspring in phase(8). He himself promoted his own designs by consequently picking offspring of them. Only his phase(2) and phase(4) cannot be traced back to one of his own designs.

fig. 26.3: profile of space050
space050 is the author of the other survivor and also one of the most successful authors, although his average score is not as good as that of space050 (-3.75 = 2.75 + 6.25). Three of his designs can be traced back to his phase(1). That he cared more about his own ideas than about other people’s can also be seen from the spaceships he designed in phase(7) and phase(9) (see fig. 6.63 on Plate 13), which mocked the idea of making abstract compositions.

Fig. 26.2-3 show the profiles of the two systematic narcissists of Phase(x)3 ss99
COLOR PLATE 27: Phase(x): Detecting Social Patterns (part 5)

fig. 27.1: Phase(x)2: Statistical analysis of special linking patterns: This chart is compiled based on the analysis described on color plate 22. It lists all individuals with special connection patterns.

fig. 27.2: Phase(x)1: Statistical analysis of special linking patterns: This chart is compiled based on the analysis described on color plate 22. It lists all individuals with special connection patterns. In the first course, we found the most patterns, including three that can be labeled as systematic narcissists. In part this higher number is due to the fact that there were ten phases, which increased the chance for repetitive patterns by accident.
COLOR PLATE 28: Phase(x): Bias inherent in websites (part 1)

**fig. 28.1: Distortion chart of Phase(x)1 ws96**

*Time in pole position, pole position offspring: statistics of phase(x)1 ws96*

- **pole position offspring per phase:**
  
- **average ratio:** 17.4% (126 out of 724)
**COLOR PLATE 29: Phase(x): Bias inherent in websites (part 2)**

*fig. 29.1: Distortion chart of Phase(x)2 ws97*

**Time in pole position, pole position offspring: statistics of phase(x)2 ws97**

pole position offspring per phase:
- phase(1): 16.54% (22 / 133), phase(2): 11.21% (13 / 116), phase(3): 11.46% (11 / 96),
- phase(4): 20.00% (18 / 90), phase(5): 23.68% (18 / 76), phase(6): 7.14% (3 / 42),
- phase(7): 44.74% (17 / 38), phase(8): 52.00% (39 / 75) (nine phases total)

**average ratio: 21.17% (141 out of 666)**
**Time in pole position, pole position offspring: statistics of phase(x)3 ss99**

pole position offspring per phase:
phase(1): 13.56%, (8 / 59), phase(2): 5.17% (3 / 58), phase(3): 26.42% (14 / 53),
phase(4): 26.53% (14 / 49), phase(5): 23.26% (10 / 43), phase(6): 44.74% (17/38),
phase(7): 50.00% (8 / 16) (eight phases total)

**average ratio: 23.10% (73 out of 316)**

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**Fig. 30.1: Distortion chart of Phase(x)3 ss99**
Besides the built-in pattern search algorithms, the tool also allows for flexible interactive search modes. Among the patterns that are detected automatically, the first are back and forth exchanges of works: authors who take over each other’s works. Since this turned out to be very few, the search was extended to filter for threads that contain the same author more than once. Thus the search includes threads where there is no direct back and forth between authors, but where an author takes up an offspring of their own design two or more generations later. Clicking the patterns button in the application brings up an overview of all such patterns, which can then be scanned through one-by-one, showing the last author and the last work in the thread (with the possibility to look at authors and works of the entire thread). What this analysis shows is that there really aren’t too many such patterns and that many among them are by the same authors. Thus, there are some authors that repeatedly take up offspring of their own contributions. While this could be caused by their interest in these designs entirely and could be coincidence, it is not very likely. Rather, it seems that in these authors take pleasure in taking up threads that they themselves contributed to. In the statistical evaluation this behavior is termed ‘systematic narcissism’. This sounds negative, but in fact the narcissists are actually valuable in a variety of ways.

First of all: it’s important that they exist, because it shows that the web-interface made their behavior possible in principle. If there were no authors engaging in such narcissist behavior we would probably conclude that the way the database content was represented made it difficult to find threads some particular author contributed to earlier. But it was indeed very straightforward for people interested in their own design’s offspring to track them and to take them up again in turn. The narcissists show that it was.

The fact that their behavior was relatively rare might suggest two things. Either that it was more interesting to work on other threads or that most authors didn’t care enough and made their choices without reflecting much upon it. Indeed the fact that the narcissists did care is also apparent in the fact that they were among the top contributors in terms of their design’s popularity. Their carefully choosing what to work with and often opting to take up a thread of their own progeny shows that their involvement in the class and their pride in their own work was clearly higher than average. So, they were an asset for the classes and other authors benefited from their input. Narcissist in this case does not equal selfish.

Nevertheless the main question we set out to answer, whether the choices made by the authors were based on a more objective assessment of the designs, so far can be upheld. With a maximum of 22.81% (in Phase(x)1, percentages in the other two courses were 12.77% and 18.33% respectively) ever taking up a thread they themselves contributed to, the question whether they had contributed to a thread earlier was clearly of at best secondary relevance to most authors and the systematic narcissists made up only between 0.71% and 3.33% of the student population.

Thus, the vast majority of choices were not based on some social motivation. In the absence of social reasons we must conclude that the reasons for the selection had mostly to do with the qualities of the designs. That is, unless there was some bias inherent in the web environments, which is our third evaluation, coming up in the following section.

6a.4.3 ‘The bias inherent in the web environments’ (color plates 28 to 30)

In the last two sections we have been able to show that the selections made by authors in Phase(x) were in the vast majority of cases not based on reasons of group affiliation, social relationships or what we referred to as narcissism. Each of these reasons could have been
assumed to be an important factor in the selection patterns, but indeed they turned out to be all but negligible except for a few exceptions. Thus it looks like the information architecture of Phase(x) indeed manages to put the focus on the designs themselves rather than any external factor related to them. One thing that we have so far not investigated, however, is the role of the web environments themselves. Ideally they provide an even playing field for the designs. But maybe the way the works are presented to the authors actually distort the selection process somehow. Before we can claim that the choices were truly based on the qualities inherent in a particular design, we have to rule this possibility out as well.

This turns out to be rather difficult, because the database doesn’t offer a detailed click-history of the websites. The only data we can work with is the timestamp, when a work was selected. Since we know how many works were available to choose from at that time, we can also reconstruct what the website looked like at the time of the selection. But before we turn to this analysis, we need to clarify some assumptions and some implicit rules.

One constraint of the selection of the works through a website is the fact that the designs to choose from are presented with a small image on a computer screen. It’s obvious enough but we should still point out that the image and the file it represents aren’t actually the same thing. The image is just there to advertise the file. Of course it is a preview that was generated from an image of the design. In fact it’s the image, which, the author decided, represents the work best. In phase one this was simple: the work and the two-dimensional image were one and the same. But later on, students were asked to produce a variety of images and pick the one they felt represents the work best as the stand-in for the work. This is a rule that applies to all works alike. The students were responsible for making their works look good (or right, that is: true to its characteristics – as in all advertisement, there is room for a certain amount of deception.) This whole arrangement certainly favors designs that lend themselves well to be pictured, while designs with less picturesque qualities do not fare as well. But the question how fair it is to have a picture stand for a design and the type of preference or bias this introduces into the choices can’t be investigated, here. While verbal descriptions like mottos and slogans were used to some extent in Phase(x)3, they were a supplement, not a replacement for the preview images. So there are no alternatives to the small images, they are part of the rules the whole process operates under. Thus we shall not try to quantify the ‘picturesqueness’ of CAD files or ask in how far it might differ from its design quality. For the investigations we are making here, the image of the work and the work itself are simply treated as inseparable aspects of the same thing.

What can however be done is to investigate how the default sequences of the files when they were presented on the website, influenced the choices. As we know the time of submission and of the downloading of every work we can check how much greater the chance to be selected is, when a work is in what we shall refer to as pole position: that it shows up in the default listing without the need for the next author to scroll before they see it. Thus pole position is defined as the time a work is among the last ten works that have been submitted. Since the default listing was done showing the most recent entry first, the time in pole position depended very much on how many other students were submitting their works around the same time. Checking out the class website as part of their working routines, both students and teachers got a certain amount of familiarity with the works that stayed in the default listing for an extended amount of time. As this was not something that the students or the teachers had any control over individually, the differing exposure given to the works can be attributed to the design of the website.

That not all works could receive equal pole-position exposure was thus clear. The question was whether this different amount of exposure made itself felt in the popularity of the works as
measured by how often they were picked to work on with.

To investigate this question a graphic representation was created that visualizes all the works submitted in chronological order along the x axis and on two separate bars how long they remained in pole position (the blue vertical bar), respectively, how often they were selected (the yellow/red vertical bar). This second bar also differentiates between offspring during the pole-position period (in red) and how often it was picked when this pole position was already over (in yellow).

For this case the statistical probability of blind choice was not computed, because it was too complex: the total number of designs to choose from is shifting and so is the time in pole position of every design. That about a fifth of the designs on average were selected during pole position seems rather high, but if we look at the data phase by phase, in most cases the numbers are considerably lower. Especially in the first phases, which have the largest number of submissions and where therefore being in pole position represents the clearest advantage, the percentage is quite low, in some cases below what would be the statistical probability of blind choice for the simplified case that all designs were in pole position for the same amount of time and all were available to choose from the whole time - a number that is much lower than the real blind choice probability which, as mentioned above, was not computed. The percentage gets considerably higher in some later phases, but this can be explained by the fact that at this point the work load of the student’s design studios were starting to become a big burden and fewer works were submitted on time. Therefore the ones that were submitted remained in pole position longer. That they ended up being chosen more frequently also reflects a relative lack of alternatives: there were simply fewer files to choose from.

Furthermore, there seems to be no correlation between how long a work was in pole position and how often it was picked, especially in the early phases of the semester. As the semester goes on, there is a higher correlation between pole-position and getting picked. Still there was not a very great correlation between being part of the default listing and getting picked.

Thus we can conclude that the Phase(x) classes also pass this third test. We cannot rule out the possibility that there was some influence of the Phase(x) web environment on the choices. But while no display of information can be completely unbiased, the evaluation shows that in Phase(x) this bias produced very mild distortions at best.

6a.4.4 Phase(x) Conclusions

The Phase(x) websites thus passed all the tests we set up for them. They come very close to providing the level playing field to all works (or memes) we would ideally expect, thus providing a near perfect environment for memetic engineering. This is the most important finding based on statistical analysis that is made in this thesis.

The other three types of websites will also be evaluated, but for various reasons that will be discussed, the Phase(x) websites are best suited for the analysis and therefore provide the most valid and valuable results. We will get back to them, when we interpret the results of all case studies in chapter 7.
6b Fake.space

6b.1 Fake.space Description

Fake.space is the sibling course of Phase(x) and was offered in the framework of the same course offering (the elective Computer Aided Architectural Design course “Wahlfach CAAD”). Earlier texts about the fake.space projects include Hirschberg, 1998, Hirschberg, 2001c, as well as Hirschberg, 2002a, 2002b, 2003, 2006. Just like Phase(x) its concept rests on a custom made web-based communication environment. As we saw in describing the process of Phase(x), there is a way of looking at this process as a narrative: the evolution of a design as it goes through different phases and different hands has, if you will, an ‘epic’ dimension. This was a discovery that we tried to explore in more depth in fake.space, by turning the premises around. In fake.space the story isn’t an accidental byproduct of a design process. Instead the story is what actually drives the design: the entire process is about designing a story, or rather: many stories.

6b.1.1 Key Concepts

The name fake.space is intentionally both provocative and programmatic. It avoids the positivistic digital euphoria that resonates in terms like cyberspace or virtual reality. It was chosen to enable a fresh look at what it means to create spatial experiences with computer tools. The first fake.space course was taught in the summer semester of 1997. The course concept as well as the course environment were improved and refined for the other two implementations in the summer semester and the winter semester of 1998. The key concepts remained the same throughout the three installments.

Narrative Hyperstructure

In fake.space students and teachers are meant to form an online community which collectively create the fake.space node system, a narrative hyperstructure in which the individual contributions are linked and can be viewed and navigated through in various ways. These threads, the sequences of different linked nodes, are meant to each have their own logic as narratives. The individual nodes in fake.space deal with different aspects of space, or rather faked, that is virtual, simulated, make-belief, falsified, imagined space. As raw material, students create digital versions of their own homes: existing spaces that they know very well and are rich with associations and memories. The node system is the combination of the different renditions of these personal spaces in the way of a narrative. Thus the entirety of fake.space can be described as a multi-author, multi-threaded narrative structure - a space in its own right.

Discourse about Space

With story-telling taking center stage, using a Phase(x) vocabulary of just abstract geometric compositions that silently speak for themselves was not an option. In fake.space a verbal and theoretical level of discourse was established alongside with the language of digital architectural
representation. This discourse centered about the notion of space.

Space had been an issue in general philosophy and the natural sciences long before it entered the architectural discourse at the end of the nineteenth century, when different social and moral, but also scientific changes necessitated an increasing interest of the architect in theoretical discourse (van de Ven, 1978). Today space is at the heart of any architectural debate, but even within the architectural discipline the term assumes different meanings, depending on whether it is used with reference to a single building or at an urban scale.

**Digital Context**

Along with a short discussion of space in different scientific disciplines we put together a reader with literary texts about space. The students were made aware of the various aspects and connotations that space has in different contexts. The point is that space is not an absolute term, but can refer to different mental constructions which are valid within their proper context. Consequently, generalizations about space are, if not impossible, less interesting than particular observations in a given context. The same, of course, is true for any representation or simulation of space. The system we set up for fake.space applies this contextual idea. New nodes can only be added to the database by linking them to existing ones. So the students were forced to select a context for their works: another work by themselves or someone else that they wanted to react or relate to.

**Nodes as pipes or tanks**

Using the analogy to a physical distribution network we referred to the different types of nodes as either pipes or tanks, with pipes referring to the purely verbal nodes which could create connections and transitions between the various graphical and animated content in the tanks.

Building on our experience gained in the first Phase(x) course, fake.space was based on a custom web-interface to a relational database. Just like in Phase(x), there are no static pages in fake.space, all views of the database are assembled by scripts ‘on the fly’. The content of the nodes is displayed in a frame, showing the author and some information about the node, including links to its neighbors. To post a node was a very simple operation, comparable to writing email. It was performed exclusively via form input in a web-browser. Thus it was possible to post nodes from any Internet-client.

**The Connector**

At the center of the fake.space tree structure is the fake.space connector, a ring of eight predefined nodes. Each of them refers to one of the texts from the reader and is labeled with one keyword taken out of the text’s title. These eight nodes and the texts they refer to were the seeds from which all consecutive node-threads could grow.

**6b.1.2 Course Structure**

The course consisted of seven exercises in which important CAAD modeling and presentation tools and techniques were introduced. In every exercise a particular way of representing space was taken as the theme. The tools introduced were taken as the means to express a personal interpretation of this topic. Every exercise had a corresponding node-type that had to be submitted in order to complete the course. So on one side, the students got a step-by-step introduction into CAAD, while on the other this structuring in different topics was the score that guided the growth of the node system. As mentioned above, nodes can be either pipes (text) or
tanks (containers of graphic content like images, animations, three-dimensional models). The pipes link the whole network, making verbal arguments and transitions. The different tank-types are declared corresponding to the themes of the exercises:

**Node0 – Personal ID**

To become a fake.space agent, the students had to fill out a questionnaire about themselves, select a personal color combination, make a short statement about their idea of space and select a fake.name for themselves. The result of this warm-up exercise was a colorful array of all students’ IDs with their aliases and personal statements; a first chance to meet the other (faked) personalities taking part in the exercise.

**Node1 – Plan**

Students were asked to describe their own living situation with a plan and a written description of how to get there. With this task we also introduced the two basic node types available in fake.space: pipes and tanks. The pipe in this case was meant to contain a way description of how to get to their apartment, which was then described graphically as an architectural plan in the tank. The descriptions range from literal descriptions of which public transport to take and where to turn right and left in order to arrive at the apartment, to more poetic observations and associations to the topic of wayfinding. These initial pipes set the tone for the narratives that branched off from it. Most of the images submitted as tanks of type Plan in node1 play with the conventions of architectural plan representation rather freely. (see figures 32.1-4)

**Node2 – Views: In and Out**

The third dimension was added to the plan. The students produced simple views in and out of their rooms, mixing rendered computer models and photographs and posted them as tanks of type View. (see figures 32.5-8)

**Node3 – Circulation Space**

In the third exercise groups were formed of two to four students. As their first group exercise they were to design a circulation space that connected the rooms of the people in the group. Modeling stairs, corridors, etc. the goal was to explore the spatial rhetoric of these architectural elements. A sequence of views was posted as tank type Circulation. (see figures 32.9-12)

**Node4 – Animation**

After dealing with circulation elements, the next step was to explore movement itself. Using the VRML format the students created interactive three-dimensional scenes with realtime animations, in which not only the viewpoints, but also the objects in the scene could be moving. The scenes and a representative image that is displayed by default were posted as tank type Animation. (see figures 32.13-16)

**Node5 – Light**

The natural lighting situation in the students’ apartments was investigated with Radiance. While this program is capable of physical-based light simulation, it was used for the natural, sometimes impressionistic look it creates even in the rather unrealistic reconfigured homes the students now worked with. Radiance renderings were posted as tanks of type Light. (see figures 33.1-4)
Node 6 – Movie: Movement in Space

Short frame-by-frame animations through their circulation spaces were produced with Radiance and DIPAD, a program originally developed for architectural photogrammetry. As frame-by-frame animations produce large files, we asked the students to work with rather short sequences that could still be viewed as animated GIF images over the Internet. These premises generated a distinct, somewhat rough look in many of the tanks of type Movie. Some students also used other software and produced more high-res movies. (see figures 33.5-8)

Node 7 – Tour

As the final exercise, students were asked to play tour guide for visitors of fake.space. With a special editor, they put together tours, connecting whatever nodes they found inspiring or interesting in the whole structure and built new stories with them. They could also add comments for each one of their choices, which are displayed when someone follows the tour. The comments can both establish the logic of the new narrative and comment on the existing content. In this way, a second layer of connections and stories on top of the existing node-structure was established, resulting from the interpretation of the original one. (see figures 33.9-18)

6b.1.3 Stories

In the course of the semester, as the students’ modeling and presentation skills improved, the assignments became more and more open, leaving it up to the students to choose how to transport their ideas about the given topic.

All node types could be connected freely. As long as it made sense, any type of relationship could be established: continuation or rupture, detail or contrast. Sometimes one author produced a long sequence of nodes, sometimes a dialogue between authors with similar ideas evolved. At particularly interesting nodes, up to four new threads by different authors could branch off, in other cases a story just died because the author lost interest in it and no one else continued. In this fashion, fake.space grew almost organically into the most diverse and unexpected directions.

6b.2 Fake.space Design(s)

6b.2.1 Overview of Fake.space Courses

- **Fake.space SS 1997:** 145 students signed up, 99 students completed the first assignment, 50 completed the class. They were assigned to 5 groups and produced 1332 nodes. CAD-Software: AutoCAD. Teaching staff: Urs Hirschberg, Cristina Besomi, Fabio Gramazio, Bige Tuncer, Florian Wenz (see figures 31.1-2)

- **Fake.space2 SS 1998:** 116 students signed up, 73 finished the first assignment, 38 completed the class (not counting the 13 authors in a remote group from Kaiserslautern, which were graded there). They were assigned to 7 groups (including the one in Kaiserslautern) and produced 423 nodes. CAD-Software: Microstation. Teaching staff: Urs Hirschberg, Cristina Besomi, Fabio Gramazio, Maria Papanikolaou, Bige Tuncer, Daniel von Lucius (see figures 31.3-4)

- **Fake.space3 WS 1998:** Statistics: 98 authors signed up, 86 completed the first assignment, 51 completed the class. They were assigned to 5 groups and produced 1342 designs. From the
fig. 31.1-2 fake.space ss 97: author online id array (left) and connector node (right). Statistics: 99 students in 5 groups produced 1332 nodes. CAD-Software: AutoCAD. Teaching staff: Urs Hirschberg, Cristina Besomi, Fabio Gramazio, Bige Tuncer, Florian Wenz

fig. 31.3-4 fake.space2 ss98: Startup view with explanation and instructions (left) and startup view with online id’s (right). Statistics: 73 authors in 7 groups (including a remote group from Kaiserslautern) produced 423 nodes. CAD-Software: Microstation. Teaching staff: Urs Hirschberg, Cristina Besomi, Fabio Gramazio, Maria Papanikolaou, Bige Tuncer, Daniel von Lucius

fig. 31.5-6 fake.space3 ws98: Connector node(left) and startup screen with online id’s (right). Statistics: 103 authors in 5 groups produced 1342 designs. CAD-Software: Microstation. Teaching staff: Urs Hirschberg, Fabio Gramazio, Maria Papanikolaou, Benjamin Staeger, Bige Tuncer.
node1 - plan

fig. 32.1-4 examples from node1 in fake.space3 ws98: free interpretations of floor plans

node2 - views: in and out

fig. 32.5-8 examples from node2 in fake.space3 ws98: students took many liberties when producing the views into and out of their virtual apartments

node3 - circulation space

fig. 32.9-12 examples from node3 in fake.space3 ws98: the circulation space linked two virtual apartments - students now started to work in groups of two.

node4 - animation

fig. 32.13-16 examples from node4 in fake.space3 ws98: realtime animations made in the program Cosmoworlds.
COLOR PLATE 33: fake.space impressions (part 2)

**node5 - light**

fig. 33.1-4 examples from node5 in fake.space3 ws98: renderings made with the software Radiance

**node6 - movie: movement in space**

fig. 33.5-8 examples from node6 in fake.space3 ws98: frame-by-frame animations

**node7 - tour**

<table>
<thead>
<tr>
<th>water1</th>
<th>colbar3</th>
<th>more water, dive</th>
<th>night</th>
<th>vernetzung</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where wandering water gushes</td>
<td>From the hills above Glen-Car,</td>
<td>In pools among the rushes</td>
<td>That scarce could bathe a star</td>
<td>We seek for slumbering trout</td>
</tr>
<tr>
<td>air</td>
<td>strich</td>
<td>whirl1</td>
<td>gruener nebel</td>
<td>the cave</td>
</tr>
<tr>
<td>And whispering in their ears</td>
<td>Give them unquiet dreams; Leaning softly out</td>
<td>Ferns that drop their tears</td>
<td>Over the young streams.</td>
<td></td>
</tr>
</tbody>
</table>

fig. 33.9-18 example of a tour: a combination of nodes from the node-system, assembled with a new commentary, in this case a poem by W.B. Yeats. A second level of meaning is created, the underlying narratives, embodied by the original titles (shown above) are enriched by the new text and the new connections they are combined with.
U. HIRSCHBERG: MEMETIC ENGINEERING AND TRANSPARENCY

COLOR PLATE 34: fake.space navigation

fig. 34.1 fake.space3 ws98 inworld: the fake.space player at one of the central theme nodes: Questions of space (based on the text by Bernhard Tschumi). It can be reached from the central connector node, shown on the left. On the right, leading off it, there are only pipes: text-based nodes from which one can read the first couple words. The number of links that could be made from a single node was limited to four in fake.space2 and 3, as there were too many nodes linking to the central connector nodes in the first fake.space class (ss97).

fig. 34.2: fake.space3 ws98, moving along threads: A sequence of views of the fake.space player as if one were traveling along the threads. Starting at the connector node, two branches are followed: ‘Questions’ and ‘Personen’. Where one comes from and where one can go to is always visible left and right of the currently selected node.

fig. 34.1-2: fake.space3 ws98: inworld views. At every node four slots for possible continuations are available. When navigating with the fake.space player, users only see the current node plus its neighbors in both directions: left is towards the center, right towards the periphery, following the direction of the narrative.
fig. 35.1-4 fake.space2 ss98: Outworld view sky, shown with tours activated. Zooming in to the outworld view, the actual content of the nodes becomes visible. fake.space2 had fewer nodes than fake.space3. Thus the sky-map was faster to generate and more legible than in fake.space3.

fig. 35.5-10 fake.space3 ws98: Navigation using the different outworld views to operate the player (zoom into the sky, using outworld map, and outworld threads. finally a combination of threads and map.

fig. 35.1-10: fake.space3 ws98: different outworld views, used for navigation
fig. 36.1: *fake.space3 ws98 outworld sky* Growth of the node system, in six stages. Colors indicate the different topics, starting around the connector node.
third assignment on, they were put into 36 groups of two or three (see list in the appendix). CAD-Software: Microstation. Teaching staff: Urs Hirschberg, Fabio Gramazio, Maria Papanikolaou, Benjamin Staeger, Bige Tuncer. (see figures 31.5-6)

6b.2.2 Navigation

The navigation through fake.space was of key importance to the whole course concept. The growth of the system could only happen in a meaningful way if it was also navigated through and experienced by the authors.

We provided several navigation modes that go a long way towards explaining the entire information architecture. Using the terminology from earlier projects already mentioned in Phase(x), the different types of navigation aides were conceptually divided into in.world and out.world views. (see color plates 34 through 36)

In.world: Moving Along Threads (see color plate 34)

The standard navigation mode was to use the links leading to neighboring nodes. Every node is displayed with links leading to its neighbors: one to the parent node, backward to the connector and up to four nodes that continue the current thread. We limited the number of links to a maximum of four in the second implementation of fake.space, to create a certain scarcity and to strengthen the notion of context: As soon as a node has been built, it forms an ensemble with the ones that were there before.

Moving along threads is very straightforward. There is even an auto motion mode that randomly follows threads through the node system, creating an experience almost like watching TV. The auto motion mode will jump to a randomly selected place whenever it reaches the end of a thread.

In.world: Reviewing Threads

At any point, the thread of all the nodes, starting from the connector to the currently active one, can be displayed. This makes it easy to review the story one is currently reading and to go back to a previously visited node to take a different path.

In.world: Author Profiles

Every node is labeled with its author’s name. Clicking on the author opens the profile of this particular author with all of the works that he or she produced for fake.space. From the profile, one can jump to any of these other nodes or to the group that the author belongs to. To find a specific node or to get an overview of the whole structure, there are several so-called out.world views available for navigation.

Out.world: Map

The map is a listing of all available nodes in text form. To call a text a map may be surprising, but as visited links change color in the browser and fake.space node names cannot exceed 16 characters and therefore often use special spellings and cases to stand out from the crowd, this terminology does make sense. In the default mode, the map is sorted by node-types and shows the newest 25 of each type. But it also offers a complete list for every type, if required. The lists can be ordered according to different criteria: alphabetically, by submission time, or by popularity. A key concept of the map is that it autonomously reloads itself to reveal
new postings. The map thus kept everyone current of all new developments and allowed for immediate reactions.

**Out.world: Search**

To make it easier to access specific nodes (if one forgot how to reach them, or if it took a long time to browse to them in in.world mode) we provided a search mechanism, which is of course particularly useful for nodes that contain much text. It also allows checking whether and where certain keywords have been used in fake.space.

**Out.world: Thread**

There are many different paths that one can take in fake.space. The out.world mode Thread lists all possible threads for each of the eight start-nodes at once. They are displayed in comic book fashion, just like the thread that can be brought up for every individual node. The fact that most nodes, especially in the center, are part of many different threads allows comparisons between different outcomes that evolved from the same beginnings.

**Out.world: Sky**

The sky view is the graphic representation of the database, a clickable map that lets one access the nodes based on position within the system, and also provides an attractive overview of how the growth of the system evolved.

**Comments and Rating**

The different means of navigation and viewing made it possible for every author to stay informed about what everyone else produced. There were also tools available to give feedback to the authors. To express a spontaneous reaction or thought about a work, the comments page could be used. All comments about every work are listed there and the authorship of both the work and the commentator is revealed.

It was also possible to anonymously rate the works of one’s colleagues, by clicking on a plus, equal or minus sign that was available for every work. With only one vote per author, this method is very simple and effective, but most of all very democratic. These ratings could in turn be used as ordering criteria in the outworld map (for example: show all nodes of type View ordered by popularity).

**6b.2.3 Changes between Versions**

The fake.space user interface went through much more dramatic changes than the one developed for Phase(x). In the first installment, the interface was - in hindsight - rather a mess. Every viewing mode came with its own window, cluttering the screen and making it very difficult for students to keep an overview of all the different navigation possibilities. Especially because we kept on developing and expanding the interface during the semester. For the second version the interface was completely revamped, using some ideas that had proven to work well in Phase(x). The new version assembled the different views in one flexible frames document that could be dynamically configured to handle different navigation modes. The idea of opening a player window separate from that general website was maintained as an option initially, but then abandoned. Thus the multi-view idea that lets users see different visualizations of the data in parallel rather than in isolated views became the norm for fake.space as well.

From the second to the third installment, the interface was further refined and made consistent.
Most notably a threads view was added that allowed to view the narrative paths from the connector to the current node with small preview images side-by-side. These changes definitely improved the dynamics of the course and the rather high dropout rate of the second installment was not repeated, proving that fake.space, while certainly the more unusual class than Phase(x) because it demanded a lot of personal involvement from students, still could get a large following and be just as successful in terms of people successfully completing it.

6b.3 Fake.space Process

We have called fake.space an online CAAD community. The whole node system can in fact be described as a discussion about the nature of space. However, unlike ordinary Internet discussion groups, the exchange of ideas relied only in small part on text. Rather than with rational arguments, the growth of the system was guided by the multi-interpretable poetics of images and animated scenes.

If we now try to apply our terminology from memetics to this form of exchange, the first thing to notice is how much less clear-cut things are in fake.space than in Phase(x). In Phase(x) we have referred to the CAD files that were exchanged between the users as memes. While we noted that such terminology is under attack by the so called internalists among memetic theorists we maintained calling them thus for pragmatic reasons. Not least of all this terminology highlights the extraordinary nature of Phase(x) as one of the rare cases where such transfers, which, if memetic theory is correct, are the driving force between many cultural processes, actually can be tracked, mapped and evaluated.

In fake.space, there is no actual exchange of files. Instead, what it focuses on is what we found to be the impure aspect of the exchange in Phase(x). As was argued in chapter 6a.3 one problem with calling the works of Phase(x) memes is that they aren’t memes in the sense that they were ever stored in someone’s brain. Rather, between the design intent of one person that creates a computer model and some other person’s interpretation of this design intent based on just seeing the computer model there will almost always be quite a difference. In Phase(x) this was discussed as a theoretical problem because it puts the idea of memetic exchanges into question. This discussion ended with a call to ‘memetic pragmatism’: by referring to the files as memes, we can argue that these supposed differences in interpretation in the end don’t matter, because the passing on happens anyway.

In fake.space, however, this difference in interpretation is not the problem, it’s the whole point. Rather than the faithful copy, fake.space takes the creative re- or misinterpretation as its starting point. In order to continue a narrative thread and to make it fit with their own work, students had to come up with an answer, a reaction, to an existing node. This was almost always a new interpretation of the narrative, the offering of a new reading.

6b.3.1 Memetics and ‘The Open Work’

A well-known topic in twentieth century discourse about art is its openness, the focus on the role of the spectator or the reader in literature or on the role of the interpretation in music etc. In Umberto Eco’s ‘The Open Work’ (Eco, 1977) Eco quotes Paul Valery’s statement “il n’y a pas de vrai sens d’un texte” (Eco, 1977, p. 37). According to this line of reasoning, no interpretation of a work of art can ever be final or definitive and the reader is always part of the creation of a narrative, simply by reading and interpreting the text.

Eco makes these observations in 1962 in the context of new forms of composition techniques
that started to appear at the time by composers such as Stockhausen or Berio, which gave unprecedented freedom to the musicians interpreting their scores. But while Eco insists that these works explore the notion of openness in a new way, he also states that any great artwork possesses an openness that allows it to be reinterpreted time and again. This is true for any art form, but especially clear in the case of narratives. In storytelling, the readers’ active engagement is created through their interest in how a story will continue. If we don’t have any expectations about how it will continue, either because we already know how it ends, or because we don’t see what it has to do with us, we are usually not interested in a story. The interest arises out of an expectation of how it will continue and an uncertainty whether this expectation will be met. We enjoy it when they are, but our expectations are never final: a good story will change and redefine them along the way. The open work of art that Umberto Eco describes thus isn’t only a topic of contemporary discourse and art forms, it describes the active engagement that is and has always been the precondition for any type of appreciation of art. As another great thinker that has been frequently quoted in this thesis, Ernst Gombrich, famously put it: “There really is no such thing as art. There are only artists.” (Gombrich, 1950)

Instead of referring to this active engagement as expectations, interpretations or hypotheses, we can also use the memetic terminology that was introduced earlier. We can refer to the forming of interpretations of a text or a work of art as the creation of proto-memes in the reader’s mind. Because proto-memes are in fact not memes, just mental constructs with the potential of maybe becoming memes at some point (although most don’t), the forming of proto-memes is really not a memetic process. It only becomes memetic, the moment these proto-memes settle into a state where they can be expressed as memes. But, as we have shown earlier, while not memetic in and of itself, this forming of proto-memes is a necessary precondition of any memetic process to occur and thus has a lot to do with memetic theory.

6b.3.2 ‘Copy-the-instruction’ vs. ‘Copy-the-product’

When we discussed memetic terminology, we found that, according to Blackmore, there are two types: ‘copy-the-instruction’ and ‘copy-the-product’ (Blackmore, 1999, p. 61-62). While we initially claimed that Phase(x) was a case of ‘copy-the-instruction’, whereas fake.space was one of ‘copy-the-product’, we already put this into question when the processes in Phase(x) were analyzed. Now in fake.space we could concede that, in strict terms, there isn’t any memetic process. Rather than replication, the essential characteristic of memetics, there is only continuous re- or even misinterpretation along multi-author narratives. In fact, before this thesis was written, no one has ever tried to explain fake.space as a project based on memes or replication. It was always referred to as a project on online communication or digital storytelling.

Nevertheless, there is a strong link between the two projects. Both are based on interpretation – or, in the vocabulary of memetics we introduced: they are both based on the creation of proto-memes based on someone else’s work as the first step in their process. While in Phase(x) taking over projects from someone else resulted in a design development that can be understood as a narrative, the creation of a new story in fake.space is to a certain extent based on the taking over of an existing starting point. Thus, the two projects demonstrate that there is a common basis to both processes, that imitation and replication are not so fundamentally different from invention and creativity as it might seem.

Referring to fake.space as a memetic process is a bit of a stretch, but it makes sense in terms of the commonalities with Phase(x). Referring to the replication in fake.space as ‘copy-the-
product’ is acceptable if we regard the continuation of an existing story-line with new elements as an act of copying. After all there is a new story with a new ending, while the old one still exists as well. Whether the new node will be read or not is up to the readers, stories can branch at any point and any branching in some sense doubles (and thus copies) the existing story-lines.

The node from which these new story-lines depart is unchanged in the sense that the actual content cannot be altered once it has been submitted. But by changing the connections that are available from it, to a certain extent the node is also redefined. The neighboring nodes with which a node forms a storyline shape the way it is interpreted almost as much as its own content. Depending on the the text in the pipe leading up to it, the very same image can assume completely new meanings.

This was made particularly apparent through the tour functionality. By compiling a tour out of different nodes distributed all over fake.space, authors could introduce a new level of interpretation over the existing narratives.

6b.3.3 Space and Hyperspace

Any online community must have strong common interests and a need to share their ideas. Fake.space was a success because its main topic, “space”, worked in this respect. It worked because space is a topic close to the heart of architectural students and because it could be investigated relative to their own homes.

But fake.space also worked because it allowed a very tight coupling of medium and message. Visiting fake.space is a very spatial experience. Notably not only because in so many of the nodes one will find architectural plans, renderings and animations, but because of the narrative structure all of the nodes are placed in. Time, memory and movement are the essential prerequisites to experience space. Just as one cannot have any reliable spatial perception from one fixed point of view; we need to connect hundreds of individual impressions in our minds to come to an idea of a complex spatial system such as a city or fake.space.

Fake.space was an experiment in many ways. Technologically, it used state of the art possibilities for database-supported collaborative work. But fake.space was not about technology, it challenged the students to not only learn about CAAD, but also to use those tools to tell stories about their own lives and ideas. Some students got really hooked by this and created enormous amounts of input. The natural use of the CAAD tools as a means of expression in some cases quite surpassed our expectations. Interestingly, fake.space was also used as a communication medium for private messages by some, written in a code that only the addressee could understand. Such messages could have been sent via email as well, but apparently there was a certain thrill in posting them as nodes, comparable to spraying graffiti on public walls perhaps.

Of course, we had hoped that unforeseen events like this would happen. This kind of personal involvement was the prerequisite for the community spirit that can now be felt in parts of the node system, making it a public space in the best sense and much more than the sum of its parts.
6b.4 Fake.space Evaluation

Unlike in Phase(x), in fake.space the change of authorship between individual works was not mandatory. Authors were allowed to link to their own works and there was no limit on how long their threads could be. There was however a limit to how many links could be made to one node: from the second fake.space course on, only four slots were available from where the threads could be continued. This was a measure we introduced in order to force students to link to an existing thread rather than to start with a new narrative from one of the connector nodes as most people did in the first installment of fake.space. Thus we introduced a notion of real estate into the growth of the system. If students wanted to link to a particular node, they could reserve a spot for a limited amount of time, until their submission was ready. If all slots of the node they wanted to link to were already taken, they had to find a different place for it.

These rules made sense as a way to guide the growth of the narrative threads. But they make the statistical analysis we are about to engage in much more tricky. Therefore we have to be extra cautious about interpreting the results.

For fake.space the statistical basis is also smaller than for Phase(x), as only the second and third versions can be handled by the outworld analysis tool. The database structure of the first fake.space course for various reasons is too different from the rest. To give an example of this incompatibility: The outworld analysis assumes that nodes are fixed once they are submitted. But in fake.space1 students were able to edit their nodes as often as they wanted, which led to a peculiar dynamic as some students would reposition the content of their nodes, changing the context for the threads that had latched onto them. While this was interesting and fun at some level, this freedom led to various difficulties in assessing what was going on. The first course also didn’t categorize the different types of tanks, making it impossible to track what was submitted for which exercise other than by actually looking at the content of the submission. As, for reasons mentioned above, the conclusions that can be drawn from the much more compatible second and third courses are rather limited, too, the data from the first fake.space database are not included in the statistical evaluation.

6b.4.1 ‘Boundaries of Groups’

In the analysis graphics for Phase(x) the connections between the works were put into just two categories: within the group (‘group’, shown in blue) or outside of the group (‘other’, shown in orange). In fake.space there is a third category: the linking to an author’s own nodes, referred to as ‘self’. In fact, due to the story-telling nature of fake.space, ‘self’ is the most frequent type of connection, accounting for between 45% (fake.space2) and 55% (fake.space3) of connections. The ‘self’ type of connection is aligned with the horizontal author bar and therefore rather difficult to see, regardless of the color. To compensate for this, it is shown in red and with a thicker line.

To check whether linking patterns are in any way influenced or restricted by the boundaries of groups, the self-links are subtracted from the total and only the connections between different authors are considered.

In fake.space2 a group of students from the university of Kaiserslautern were included in the project, making this class the one with the most groups (7) and the smallest average group size (10.4 students).

The findings of the first course again almost coincides with the random distribution (14.72% vs. 14.29% for the random distribution with 7 groups). In fake.space 3 however, we find the
**Introduction to the Analysis Outworld evaluation of fake.space**

This is a view of the Analysis Outworld tool*. It shows all submitted works of all authors in the third Fake.space class, which took place in the wintersemester of 1998. Each of the dots corresponds to one work, each horizontal line to one author. Dots are ordered in the sequence they were submitted. The connecting lines between the dots signify the exchanges in the narrative threads, as one author continued the story begun by someone else. Orange connecting lines stand for exchanges between authors in different groups. Blue lines signify exchanges within the same group. Thick red lines signify narratives continued by the same author. In the current display, all 1342 connections are shown. There is a total of 103 authors and 1343 works. In total there were 749 (or 55.81%) links to ‘self’. If one excludes these self-links from the considerations over group boundaries, 158 (or 26.64%) of the non-self links were made between members of the same group. If self-links are added to the total, non-self links inside the group are merely at 11.77%. The boxes on the left stand for the five different groups and for male or female gender. All connections leading to or from authors in a certain group or with a certain gender can be activated by clicking on them. Members of the same groups are next to each other. Gender is color-coded: orange lines are female, blue lines are male, grey lines are undefined. Threads stands for the developments of individual narratives until they were not continued anymore. There are in total 474 unique threads. Patterns are threads in which the same author appears twice. As self-links were not forbidden and are very common, this function produces no relevant results in fake.space. These patterns are only relevant in the evaluation of phase(x).

* available on the CD accompanying the thesis. (compare also color plate 14)

Note: The graphical evaluations on this and the following color plates have all been produced with the interactive Analysis Outworld tool. In some cases, parts of the interface have been cropped for better legibility. The evaluations shown only for fake.space3 can also be performed on fake.space2.
COLOR PLATE 38: fake.space: Boundaries of Groups (part 1)

**fig. 38.1:** Fake.space ws98 connections by group: >IN* / OUT** / >I/O>***

* lines going >IN to the group: lines indicate the choices made by members of the group, which works to use as starting points of their designs (shown in left column)

** lines going OUT> of the group to someone else: lines indicate the works of the group members were chosen as starting points by people in- and outside the group (middle)

*** >I/O> both lines, in and out, are turned on, also the dots of all works are turned on: shows how well integrated the works of a group are with those of the entire class (right)
gender: **male**
64 authors
826 works
53.51% self-links

links inside group:
26.30%
(12.22% from all including self-links)

gender: **female**
29 authors
392 works
60.77% self-links

links inside group:
28.87%
(11.32%)

gender: **undefined**
10 authors
134 works
56.49% self-links

links inside group:
23.88%
(10.38%)

fig. 39.1: Fake.space ws98 connections by gender: >IN* / OUT** / >I/O>***

* lines going >IN to the group: lines indicate the choices made by members of the group, which works to use as starting points of their designs (shown in left column)
** lines going OUT> of the group to someone else: lines indicate the works of the group members were chosen as starting points by people in- and outside the group (middle)
*** >I/O> both lines, in and out, are turned on, also the dots of all works are turned on: shows how well integrated the works of a group are with those of the entire class (right)
### fig. 40.1: Fake.space ws98: 103 authors, 1342 works, 5 groups, links inside group: 26.64%

### Table: Statistical Summary

<table>
<thead>
<tr>
<th>Group</th>
<th>Authors</th>
<th>Total Works</th>
<th>Avg. Works/Au.</th>
<th>Self Incl.</th>
<th>Self Excl.</th>
<th>From Self</th>
<th>From Self %</th>
<th>From Inside Group</th>
<th>From Inside Group %</th>
<th>From Outside Group</th>
<th>From Outside Group %</th>
<th>Total incl. Self</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>fr_1</td>
<td>20</td>
<td>255</td>
<td>12.75</td>
<td>97</td>
<td>158</td>
<td>12,75</td>
<td>28</td>
<td>28,87%</td>
<td>69</td>
<td>71,13%</td>
<td>255</td>
<td>19.00%</td>
<td></td>
</tr>
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<td>13.68</td>
<td>140</td>
<td>161</td>
<td>13.68</td>
<td>48</td>
<td>34,26%</td>
<td>92</td>
<td>65,71%</td>
<td>301</td>
<td>22.43%</td>
<td></td>
</tr>
<tr>
<td>fr_3</td>
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<td>72</td>
<td>73.47%</td>
<td>256</td>
<td>19.08%</td>
<td></td>
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<tr>
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<td>281</td>
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<td>145</td>
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<td>20,99%</td>
<td>108</td>
<td>79.01%</td>
<td>281</td>
<td>20.94%</td>
<td></td>
</tr>
<tr>
<td>fr_5</td>
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<td>249</td>
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<td>122</td>
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<td>77,05%</td>
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<td></td>
</tr>
<tr>
<td>male</td>
<td>64</td>
<td>826</td>
<td>12.91</td>
<td>384</td>
<td>442</td>
<td>12.91</td>
<td>107</td>
<td>25.30%</td>
<td>283</td>
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| Statistical likelihood: 5 groups, effective average percentage |
| success per author inside | 20% | 26.64% |

### fig. 40.2: Fake.space ws98: Detailed Statistical Summary
### CASE STUDY: FAKE SPACE

**COLOR PLATE 41: fake.space**

**Boundaries of Groups (part)**

**fig. 41.1: Fake.space ss98:** 73 authors, 423 works, 7 groups, links inside group: 14.64%

**fig. 41.2: Fake.space3 ws98: Detailed Statistical Summary**

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<td>197</td>
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<td>423</td>
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**Success per Author inside: 19.62%**

**Success per Author Outside: 83.93%**

**Success per Author total: 100.00%**

**Success per author inside: 48.54%**

**Success per author outside: 51.00%**

**Success per author total: 100.00%**
fig. 42.1-8: fake.space3 ws98: **eight main topics around the connector node** with all nodes branching off of them. All topics refer to one of the texts the students were given as a reference for their work at the beginning of the semester. All groups linked to all topics.
fig. 43.1-18: fake.space: 18 most productive authors (18 to 43 nodes). Notice how most authors link to many different threads, while some link to very few others and one (fig. 43.17) linked exclusively to himself.
COLOR PLATE 44: fake.space: Boundaries of Groups (part 7)

fig. 44.1: 1460 by space057 (28)
fig. 44.2: 1497 by space087 (24)
fig. 44.3: 670 by space090 (24)
fig. 44.4: 1563 by space090 (23)
fig. 44.5: 1614 by space087 (22)
fig. 44.6: 1549 by space090 (20)
fig. 44.7: 1381 by nds9809 (20)
fig. 44.8: 1446 by space026 (20)
fig. 44.9: 1612 by space097 (20)
fig. 44.10: 1502 by space063 (19)
fig. 44.11: 1547 by space090 (19)
fig. 44.12: 1254 by space051 (18)
fig. 44.13: 1280 by space051 (18)
fig. 44.14: 1228 by space031 (18)
fig. 44.15: 1526 by space063 (18)
fig. 44.16: 1229 by space031 (18)
fig. 44.17: 1544 by space122 (17)
fig. 44.18: 1292 by space080 (17)

fig. 44.1-18: fake.space ws98: 18 longest narrative threads (between 17 and 28 nodes)
biggest deviance from this random distribution (26.64% vs. 20% as the random distribution for 5 groups). The reason is that we had students work in groups of two in the second half of the semester. The groups of two worked on assignments together, but only one of them had to submit them. Since many of them took turns in submitting, so as to avoid the appearance that either of them didn’t do anything, there are many cross-links between two authors that form a team. The pattern analysis in the next section will reveal them (see color plate 46). The group analysis does not take this into account and treats the links that the two team members created between each other (who most of the time were also part of the same larger group) as normal links rather than as a separate category. That’s why there are so many more links within the same groups in fake.space3 than in fake.space2.

Still the average value is not too far from the expected level. Thus we can state that even when there are groups of two within the groups, the boundaries of those larger groups do not influence the linking patterns very much.

This is also confirmed by the large variances between groups that we find in fake.space2. In some cases there were no links within the group, in others, for example in the Kaiserslautern group, who were physically in a different location and with whose teaching staff we had very little exchange, the ratio is above 50%.

As for gender specific patterns, there aren’t any clear tendencies apparent in the two surveyed classes. Still one can speculate a bit based on the available statistical evidence. Especially in fake.space3 female authors were linking more to their own nodes (over 60% of their connections were links to their own nodes). Thus women were on average creating longer narrative threads than the male or genderneutral groups. But the percentage of those two other groups was also rather high: 53%, resp. 56%. Thus, the presumed gender difference again was within the margin of difference that also occurred between different groups.

Another speculation can be made about the ‘undefined’ group. We noted that in the first Phase(x) class not declaring one’s gender was typically a sign of lack of interest in the class. Most that didn’t fill out the form completely also didn’t do very well in the class, with a high percentage of drop-outs. While there weren’t any non-declarers in Phase(x)2, in the third installment the undefined group had a number of stand-outs among them. We find the same pattern in the second and third fake.space class: the undefined group was in both classes the most successful group. Especially in fake.space3 they far outperformed their gender-declared peers. Their final success-rate (the indicator of how well linked their works became by people from both inside and outside their groups) reached an astonishing average of 9.8 (versus 6.0 for the males and 3.9 for the females). This might again hint at the fact that there are some students who enjoy the relative anonymity the class provided for them. Without giving away too much of their personality, they instead focused on their design skills and defined themselves through the works they produced and the narratives they contributed to the system.

6b.4.2 ‘More objective Assessment of Designs’

Checking for social patterns in the connections between works to prove that the assessment of the works is more objective makes less sense in fake.space than it did in Phase(x). While in Phase(x) we could assume the social relationship to be something unrelated to the design quality of a work, in fake.space the connections were based on the idea of storytelling. Linking back and forth between different authors is typically a sign of a particularly successful narrative thread. As the task was to produce good designs in order to tell successful stories, one would be hard pressed to argue how these two contrasting tendencies could be kept apart in a statistical
Since we have the means ready to perform pattern searches of the type we did for Phase(x), we can just try them on fake.space, knowing full well, that the results will not be nearly as meaningful.

Rather than checking for back-and-forth patterns (of which there were plenty), we shall look at the most prolific students and see if their patterns are similar: whether the way their stories are integrated into the whole of fake.space follows particular patterns and how much variance there is in them.

Color plate 43 shows the top 18 students in terms of the nodes they submitted. Their productivity is not always matched by the degree of integration into the class. This difference is highlighted on color plate 45, where four students are shown with three graphics that are displayed next to eachother. The first one shows all the works and all the threads that they contributed to up to their last contribution to them. The second one shows the single branches leading off of these nodes and finally the third one shows all branches they started up to where they end. As can be seen very vividly on these charts, some students worked pretty much on their own (see fig. 45.1-3 for an extreme case, but also fig. 45.10-12). Others placed their nodes more spread out over the node system (see fig. 45.4-6 and fig. 45.7-9). What’s interesting, though, is that while some of the ones that would link to themselves only were ignored by the community and received hardly any links (see fig. 45.1-3), others became the hub for very long narratives (see fig. 45.10-12). Conversely, placing nodes in many different places was no guarantee for getting well integrated. The by far most productive student (fig. 45.7-9) was rather average in terms of how many narrative threads his nodes started, even though his nodes were spread all over the node system. For others, however, placing the nodes in different contexts worked well (see fig. 45.4-6): they became very much integrated into the whole community through the many narratives that branched off them.

What these juxtapositions make clear is that fake.space allowed for many different strategies. It also made loners possible. If students wanted to do their own thing and not link to anybody else, they could do so (fig. 45.1-3). This is visible as relatively simple patterns in the left most graphic showing just their own contributions and not the links that branched off them. There were loners who actually became inspirers - even in cases where the students pretty much worked on their own thing and linked to few other students, their work - if it had qualities the community appreciated - could become a hub for many stories (fig. 45.10-12). But there were also networkers who were inspirers (fig. 45.4-6), as well as extremely prolific networkers who failed to do so (fig. 45.7-9). Nevertheless, with either strategy the average case was a rather high level of integration into the fake.space system as well as the community – visible as connections going to authors from all groups.

With completely different rules that don’t allow for the statistical analysis used in phase(x), fake.space nevertheless was clearly successful in creating a high level of exchange and integration between its many authors.

6b.4.3 ‘The bias inherent in the web environments’

For the bias inherent in the web-environments, our way of testing is to compare the time a submission was in ‘pole position’ (among the last ten nodes submitted and therefore appearing in a special listing) with the number of links made to it, either while it was in pole or later on. In Phase(x) the correlation between the two was not very strong initially and the fact that it became stronger in later phases can be explained by the relative lack of choice available.
fig. 45.1-3: fake.space3 ws98, author profile of space027: the extreme case of a loner. space027 posted 18 nodes, all in self-referential sequence. Only two links off of his nodes were made.

fig. 45.4-6: fake.space3 ws98, author profile of space029: reached a high level of integration. His 17 works were linked to 17 times by others, leading to a total of 142 nodes of others going back to one of his nodes.

fig. 45.7-9: fake.space3 ws98, author profile of space051: With 43 postings by far the most prolific author he spread his nodes far and wide, but had few people linking to him: only 7 nodes by others link to his work and a mere 9 nodes other than his own branch off his postings.

fig. 45.10-12: fake.space3 ws98, author profile of space083: the most highly integrated author. While posting only 17 nodes, 22 direct links to his nodes were made by others and an amazing 190 nodes by others go back to one of his postings.

**fig. 45.1-12: Four different author profiles from fake.space3 ws98:** >IN / OUT< / OUT< with complete branches. (Compare also color plates 38, 39 and 43. The four profiles show how different the linking patterns of a person and of the community reacting to it can be.
fig. 46.1-3: fake.space3 ws98, group profile of group ‘372391’ (space011 and space014), >IN mode: big chart shows their nodes combined, small chart their individual profiles, all charts in >IN mode.

fig. 46.4-6: fake.space3 ws98, group profile of group ‘372391’ (space011 and space014), >I/O> mode: big chart shows their nodes combined, small chart their individual profiles, all charts in >I/O> mode with complete branchings turned on.

fig. 46.1-6: Profile of ‘372391’, an exemplary ‘group of two’ in fake.space3 ws98: The charts on fig. 46.1-3 show the links between the group members as part of their combined efforts. They are counted as ‘within the group’ leading to a skewed statistic with regard to the boundaries of groups. When all branchings off their works are turned on (fig. 46.4-6), their profiles look very similar. This is a logical consequence of the combined efforts of the group members and the connections between their individual works.
fig. 47.1: Distortion map of fake.space3 ws98 (result: 48.81% poleposition links)

Distortion maps for fake.space show all nodes in the sequence they were submitted, with three bars on top of them: the blue bar shows the time in ‘poleposition’ (=part of the default listing), the black bar shows the hits (number of visits) a node received, the red/yellow bar shows the links that were made to the node (red=link was made while in poleposition, yellow=afterwards).

In fake.space3, 655 out of 1342 links were made during pole position (48.81%), but this is mostly due to the story-telling nature of the course. See following plates for more detailed views.
The detailed views indicate that, while there was a very large proportion of poleposition links, the number of hits is mostly independent of the time in poleposition. As most of the poleposition links are indeed self-links (authors would typically post a sequence of nodes at once), what seems like a strong distortion at first actually is much more well-balanced. A PDF version of this chart, which can be zoomed into and studied in more detail, can be found on the CD accompanying the thesis.
The distortion map of fake.space2 confirms most of the findings of fake.space3. Of the 423 submissions, 154 (36.41%) happened during pole position of the node the submission was linked to. But, just as in fake.space3, one also notices in fake.space2 that time in pole position and number of hits are not always parallel and that some nodes received many links without being in pole position very long. A PDF version of this chart, which can be zoomed into and studied in more detail, can be found on the CD accompanying the thesis.
In fake.space the first thing to note is that the advantage of being in what we refer to as pole position was not very great. There was a listing of the most recent node names that came up in the default version of the menu (in text only, without images). The students were aware of it, but it wasn’t visually very prominent and didn’t advertise the content other than by nodename. The real pole position was the connector node, which, surrounded by eight literary topics that one could contribute to, was the designated beginning of every thread and always the first node that came up upon opening the fake.space player. Which brings us to the other important difference to Phase(x): with much of fake.space revolving around narrative threads rather than single works, it is quite obvious that the relationship between pole position and links will be high. Threads typically will be posted in sequence, one after the other.

So we can note two things up front: First of all, if we apply the analytical pattern from Phase(x) we are almost certain to find a ‘bias’ in the web environments. Indeed there is: around 50% of connections are made during pole-position and there is a high level of correlation between long time in pole and number of connections. But this bias doesn’t have so much to do with the web-site (the pole-position listing really wasn’t so prominent), but rather with the fact that fake.space grew in the way of a narrative, where people will often post entire threads of nodes in quick sequence, thus skewing the statistics.

The second thing is that fake.space has a strongly hierarchical structure. The central connector node is much more prominent than nodes posted at the periphery. So, checking whether fake.space offered a level playing field to all nodes is a bit silly: its very hierarchical nature makes it clear that that’s not the case.

There is however also another way to analyse fake.space: unlike in Phase(x), the hits, that is the visits to a single node, were also counted. If the relationship between pole position and hits is also very strong, then we can conclude that indeed random factors in the website listings influenced greatly which parts of the database people were more likely to visit.

In the graphical evaluation, hits are shown as a black vertical bar. In fake.space2 they range between 3303 hits for the connector node and a single hit for the completely undiscovered ones. In fake.space3, the numbers are much higher (the scaling in the graphic evaluation is reduced by a factor five to make it fit to the page) and the distribution is far more even, ranging between 24'435 for the connector node and 626 for the least visited node (which is also the only one with a score of less than 1000 visits).

Again, there is a simple explanation. In fake.space3 we had already found out about the problem of nodes in remote places that didn’t get many hits and had reacted by making more navigation aids available. Among them was a self-player mode that could be used to browse through fake.space automatically, following threads at random. Using that mode was a bit like watching tv. There was even a preview-size version available that could be active in a corner of the screen. the students would turn it on while they were doing other things, like checking their email or rendering, observing the nodes only with limited attention. If they saw something that interested them, they could click on it, whereupon the same node would open in the big window.

Having this random play mode certainly helped in making the remote nodes more known, but even though the preview-size player didn’t register any hits we don’t know how much attention was paid to them. Therefore the hits become less reliable as a way to measure their accessibility or popularity.

Of course the distribution of the hits can not only be attributed to this random play mode. There were many improvements in the design of the site, many new modes that gave different
types of overviews of everything that had been produced. Over all it’s rather astonishing how little correlation there is between hits and time in pole position. Of course there are factors such as Christmas break that gave some nodes time in pole position but hardly any additional exposure that one should not take into account.

Still the main impression we come away with is that despite the extremely hierarchical structure of fake.space and the big difference between the hits at the connector node and the nodes at the periphery, the hits were actually spread rather evenly, especially in fake.space3 which used a more complete set of navigation modes than its predecessors.

6b.4.4 Fake.space Conclusions

While fake.space in some ways doesn’t fit with our evaluation criteria it demonstrates the importance of navigation and visualization strategies to cope with large amounts of data very well. The title of this thesis contains the expression ‘large scale creative collaboration’. The problems we ran into trying to give exposure to peripheral nodes in fake.space shows that ‘large scale’ is a very relative term. The size of groups that can engage in a creative discourse using traditional face-to-face discussions and meetings is very limited. It usually only works productively and efficiently with groups of up to maybe twelve people.

Compared with such small groups, the hundred or more people engaged in a creative discourse in fake.space is indeed large scale. But the structure for fake.space also pretty much reached its limit and started to become difficult to handle at this scale. The narrative structure can only grow in a meaningful way, if users can keep an overview of the development. The outworld views took relatively long to process and keeping an overview of everything that happened in the system became harder the more the system grew. In order to develop some of the fake.space ideas further in future classes, which we did, it was clear that we needed to change many things. At the same time, the success that the new navigation modes we introduced in fake.space3 had in creating a relatively even spread of hits show that the answers we tried to find to these challenges were well chosen in principle. They just didn’t go far enough.

In some ways, fake.space was ahead of its time. In the eleven years since its inception (which is almost an eternity in internet time), there have been many important developments in this direction: social networking sites, blogs and various other internet-based ways of communicating and interacting (flickr, youtube, etc.) that are commonly referred to as Web 2.0 have become widely popular. In a sense, fake.space was a multi-media news-group about space and a story-telling site about adventures in virtual architecture. It’s interesting to compare it to the open discussion fora that have since been developed. We shall get back to this topic again in the conclusions.
6c Virtual Design Studio

Since the early 1990’s, several architecture schools around the world have been experimenting with temporal and geographically distributed collaboration, often referred to as Virtual Design Studios (VDS). In making use of the synchronous and asynchronous communication that the Internet offers, time lags involved in sending physical plans can be eliminated and geographically distributed meetings become possible. With the advent of the World Wide Web in 1994, the access to these means of communication has become almost ubiquitous and videoconferencing has lost its novelty appeal. Today, the challenge is no longer primarily a technical one, but rather whether computer networks can open up entirely new modes of collaboration. In this sense, the two VDS presented in this chapter go beyond what earlier VDS attempted. By applying the exchange mechanisms developed for the Phase(x) courses to an international setting, and adding some of the lessons learned from fake.space, they introduce a new form of collective authorship to a setting that bridges time and space. Earlier texts about the VDS projects include Hirschberg et al. 1999, Kolarevic et al., 2000, Hirschberg, 2001b, as well as Hirschberg, 2002a, 2002b, 2003, 2006.

6c.1 Virtual Design Studio Description

After our positive experiences with the first Phase(x) and fake.space courses, we were asked to join a Virtual Design Studio (VDS) project that involved groups of students of three continents. We were eager to develop this mode of collaboration and exchange further and also to apply it to actual design projects rather than just abstract compositions.

Since the VDS system, just as its predecessors Phase(x) and fake.space, is entirely web-based and works with any web-browser, it also works for collaborating groups on different sides of the globe. The VDS environment both manages and displays the works of all participants at all times. Just like in Phase(x), the design process is split up into phases with clearly defined design tasks. In each phase, all works by all authors are placed in the database. By acting as a showcase of all work produced and of the file exchanges taking place, the website becomes an essential part of the student’s working environment. These results can be further developed by different authors in successive phases. As students are free to choose which model they want to work on (excluding their own designs), the whole body of student works can be viewed as an organism where, as in an evolutionary system, only the ‘fittest’ works survive.

There were two Phase(x) type VDS projects: Multiplying Time (1997) and one year later Place2wait (1998). While the VDS projects are more closely related to Phase(x), they also take over some aspects of fake.space.

6c.1.1 VDS: key concepts

Extending the Phase(x) System

In the original Phase(x) course, the system was used to browse through and exchange abstract formal exercises in geometric modeling. For the VDS, the system was extended to
allow the presentation of design content. In addition to submitting the models of their designs, students could also use an unlimited number of template pages to make a presentation of design goals using text, sketches, and additional images as they felt appropriate. Thus the idea of the narrative we had worked on in fake.space was taken up in the VDS.

**Modeling with Sculptor**

In a collaborative situation that involves the exchange of data, it is beneficial to use a common modeling program. This avoids the need for exchange formats, which often lead to some loss of information. The program Sculptor (Kurmann, 1995) that was used on all sides was a project developed at the CAAD chair at the time. Sculptor is especially designed for supporting the early stages of design and its intuitive interface makes it very easy to learn. Since it was new to all of the students, their initial levels of expertise were quite similar. Most importantly, Sculptor was a suitable tool for this project because of the visual and immersive modeling it supports. In fact, one of the students noted that by exchanging Sculptor models throughout the project, they felt they could communicate in a universal architectural language.

**6c.1.2 VDS 1997: Multiplying Time**

The Virtual Design Studio titled Multiplying Time was a one-week long collaborative effort for which our group at ETH Zürich joined forces with three other academic institutions – the University of Hong Kong (China), the University of Washington, Seattle (USA) and the University of British Columbia in Vancouver (Canada). The group in Hong Kong was coordinated by Prof. Branko Kolarevic and Marc Aurel Schnabel. The coordinator in Seattle was Prof. Brian Johnson and in Washington Prof. Jerzy Wojtowicz. The particular geographic and temporal constellation of these partners – on three different continents and in three different time zones, roughly eight hours apart – made it possible to “multiply time” by continuously working around the clock on one common design task.

The preparation was a collaborative effort in itself. Hong Kong provided the design brief: The students were to design a house for a Swiss writer and a Chinese painter on a small island near Seattle, bringing the cultural aspects of the three participating places into the design process. Seattle prepared the information and documentation about the site in the form of plans and pictures, which also gave a sense of the climate and vegetation on the island. Our group in Zurich provided the two primary tools of the project: the modeling software Sculptor and the common database environment. While many established means for synchronous as well as asynchronous communication (email, talk, whiteboard, videoconferencing, etc.) were used throughout the project, the use of Sculptor and the database environment in a VDS was unprecedented.

**6c.1.2 VDS 1998: Place2wait**

In 1998, we organized another Virtual Design Studio. The same partners in Hong Kong and Seattle, resp. Vancouver took part again, but this time, no students from Zürich were involved. Instead, a group from the Bauhaus University Weimar represented the middle European time zone. Prof. Dirk Donath from Bauhaus University, who had been part of the first VDS in 1997 as an academic guest in Seattle and invited the author to set up the system and teach the workshop with him in Weimar.

The task of place2wait was to design a folly as a place to wait. The site was not specified. Traditionally, a folly is an exotic structure, often in the form of a small pavilion, placed in a park or garden. Rather than using famous follies as formal precedents, we gave the students
COLOR PLATE 51: VDS: Overview

fig. 51.1-2: Virtual Design Studio Websites: VDS 97 ‘Multiplying time’ (left), VDS 98 ‘place2wait’ (right).

fig. 51.3-4: Virtual Design Studio 97 ‘Multiplying time’ Website impressions: Main view with works of phase(s) lined up in bottom frame (left), using 3D outworld view as navigation aid with bottom frame turned off (right).

fig. 51.5-6: Virtual Design Studio 97 ‘Multiplying time’ collective authorship with authors around the globe (left). Impression of the final video conference of VDS 98 (right).
fig. 52.1: Multiplying Time VDS1 ws97: 26 authors, 129 works, 3 groups, links inside group: 31.37%

(note: the works of the fourth group from Delft, in the top right, are not considered, because they were created as part of a workshop after the initial VDS project.)
**COLOR PLATE 53: VDS: Boundaries of Groups (part2)**

**fig. 53.1: place2wait VDS2 ws98: 39 authors, 186 works, 3 groups, links inside group: 26.9%**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Total Works</th>
<th>Avg. Works/AUTH.</th>
<th>Works in P1</th>
<th>From Connections</th>
<th>From Inside Group</th>
<th>From Outside Group</th>
<th>Total</th>
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**fig. 53.2: place2wait VDS2 ws98: Detailed Statistical Summary**

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**VDS2 WS1998 (39 Authors, 186 Works, 5 Phases)**

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</table>

**fig. 53.2: place2wait VDS2 ws98: Detailed Statistical Summary**

**VDS2 WS1998 (39 Authors, 186 Works, 5 Phases)**

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</table>
fig. 54.1: VDS1 ws97: Statistical analysis of special linking patterns: Considering that there were only five phases, there were many patterns and a large number of systematic narcissists.

VDS ws97
Pattern Evaluation

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Pattern  Work Thread
---  ---  ---
1 VDS002 p_5_2_1 p_2_29 6
2 VDS003 p_5_11_7 p_3_25_17
3 VDS012 p_3_25_10 p_1_0_10
4 VDS016 p_3_29_10 p_1_0_10
5 VDS026 p_5_10_5 p_1_0_10
6 VDS027 p_5_17_16 p_3_14_2
7 VDS028 p_3_5_4 p_1_0_29
8 VDS029 p_3_20_5 p_1_0_1
9 VDS034 p_8_6_6 p_6_14_4
10 VDS035 p_5_7_7 p_6_16_3

VDS ws98
Pattern Evaluation

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<td>Systematic Narcissists</td>
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</table>

Pattern  Work Thread
---  ---  ---
1 VDS007 p_5_9_8 p_2_12_9
2 VDS008 p_5_25_5 p_3_20_10
3 VDS010 p_5_13_46 p_3_14_1
4 VDS025 p_5_19_17 p_2_6_14
5 VDS031 p_5_29_22 p_1_0_27
6 VDS044 p_4_22_29 p_1_0_27
7 VDS053 p_5_22_1 p_3_38_32

fig. 54.2: VDS2 ws98: Statistical analysis of special linking patterns: Compared with the first VDS, the second one had much fewer patterns. No systematic narcissists could be identified.
background information about surrealist art. Surrealism is focused on the expression of the non-physical world, of thoughts, which can be freed from all reason. Surrealistic structures can be contradictory, deformed and non-rational. They can communicate a strong message but still be difficult to understand. The reference to the famous surrealist game “cadavre exquis” (Brotchie & Gooding, 1991, Breton, 1947, Corti 1989), which is, as was noted earlier, similar to some extent to the changing authorship in the Phase(x) system, also played a role in choosing surrealism as a reference. The concept of surrealism thus helped support the early stages of the design process, where thoughts wander and many different approaches can be considered yet a certain fuzziness or uncertainty is maintained. Most importantly, surrealism presents a means of expression that is not based on a common graphical language – as are construction drawings or technical documentation, but is aimed at freeing the mind from preconceived notions and evoking feelings rather than rational thinking. As a result, presentation skills and means became essential for collaboration in the early design stages and construction and technical information was significantly downplayed in this VDS.

6c.2 Virtual Design Studio Design(s)

The VDS websites were in most relevant aspects very similar to those of phase(x). For a detailed review of its features one can therefore refer to the Phase(x) chapter. The only feature not available in Phase(x) is the fake.space-like narrative thread that students could use in their submissions, allowing them to mix text and images to make a short presentation of their design intent.

6c.3 Virtual Design Studio Process

True to the Phase(x) principle, after each phase, the authors had to put their design into the public realm of the database where it could be picked up and developed further by any of their colleagues. The fact that they were not allowed to take their own designs was known to students in Zurich, but came as a shock to some students in the other groups. It prompted some to cheat. Cheating is in fact very easy. Any author can download the file of someone else, but continue working on their own design. There is no way to prevent this and in hindsight it is surprising that it was done so rarely. Considering the pride and close identification most architects develop for their creations, it is indeed a rather cruel measure to forbid continuing to work on it. But even in this international setting, students picked up on this procedure very quickly and actually found it rewarding rather than frustrating. Students enjoyed observing how the VDS community reacted to their input, whether their designs were chosen by others and what the next authors turned them into. In some cases, authors of early phases selected one of the descendants of their work again. Others were glad they did not have to continue with their model because they saw more potential in someone else’s proposal.

6c.3.1 Collective authorship – around the globe

Just as in Phase(x), the database environment made the selection process transparent so the line of development could be traced. The profiles and the collected works of the authors were linked with all designs. Lists could be generated which ordered the works according to number of offspring or relevance to the overall development, but which could also single out the numerous unsuccessful dead-end designs. Designs were hardly ever selected because of
personal reasons. We will verify this statistically in the next section, but it is also apparent from the fact that so many intercontinental selections were made. Due to the tight time schedule and the time difference, it was very difficult to establish any kind of personal relationships between the students outside of the rather short videoconferencing sessions. Some students complained about this. On the other hand, this lack of communication on a personal level was compensated through a more intense reading of the designs in the database. In the end, the database could display virtual design teams for all works produced in the VDS – unintentional design teams, one might say, as most students were not aware of the different team constellations they had lent their creative powers to. For the most part they were also international design teams, with members from around the globe.

6c.3.2 Cross-Cultural Discussion

Unlike phase(x), the VDS projects also had an argumentative component – we have referred to it as the functionality borrowed from fake.space: Students presented their designs not only in computer renderings, but could make use of sketches, pictures and written explanations – in short, they told little stories about them. This certainly enriched the discussion about the designs, but it had surprisingly little impact on the selection patterns.

In terms of memetics, we could again engage in the discussion as to what is the unit of the meme, since we essentially have a mix of ‘copy the product’ and ‘copy the instructions’ types of memes. Again we’ll pragmatically refer to the whole submission, the entire design documentation, as the meme, as all of it was passed on to the next author.

We should note, though, that the story telling added a new quality to the exchanges in that they also involved cross-cultural topics. The first VDS was less successful in this respect, even though we tried to introduce a cross-cultural discussion by combining the clients and site in a rather far-fetched example of globalization (a Chinese painter and a Swiss writer build a house off the coast of Seattle). During the video-conferences, most students were a bit inhibited in front of the video cameras and not too confident about their English (this was true for students in Zurich and Hong-Kong, though not for the ones in Seattle). Given those difficulties, the discussion about cultural differences as they might inform the designs was not very deep. From the designs, there was no telling that the painter was Chinese. The students were much more preoccupied with the spectacular site, the views and the massing.

In contrast, the themes of VDS 1998 – surrealism, folly and waiting – were consciously chosen for superceding cultural stereotypes. These themes allowed us to establish a larger common ground for the exchange of ideas. The students, in turn, dealt with them in a very personal way, exposing much more of their cultural background than they were aware of.

An example: One of the most successful designs of the second VDS was a courtyard with openings on all sides and a group of irregularly placed elements standing within. Created by a student from Weimar, it was recognized as successfully embodying the notion of waiting and continued by many others in the consecutive phases. In the third phase, a cover was put onto the open court by two students, one in Hong Kong and one in Seattle, turning it into a “more spiritual place” and, respectively a “coffin”, or so they said. One could speculate that this change could have been influenced by the fact that the piazza-like building form is much more common in European cities than in Hong-Kong or the States, which have different traditions of public spaces. Interestingly the two ‘covered’ designs were the most successful ones in the later phases of development and reached the highest score for relevance in the third phase.

In comparison with the results from 1997, the designs from our last VDS project generally
seem to be more coherent, yet at the same time prone to more unexpected developments. Students seemed to take each other’s ideas more seriously, even when they were about dreams or fears and were also ready to risk more and try out more unusual solutions. For example, in one instance the design of a previous phase was simply turned upside down, which prompted the original author to take up his design again in the next phase, keeping it upside down.

It may be that this playful side of the VDS was the most remarkable development. By the end students really knew each other by their designs and commented on each other’s talents. After the five intense days, despite the few exchanges they had had, there was a real sense of community that could be felt in the final video conference.

6c.4 Virtual Design Studio Evaluation

6c.4.1 ‘Boundaries of Groups’ (color plates 52-53)

In both VDS projects, the boundaries of the groups were virtually inexistant. If anything, the fact that the number of exchanges within the group was, especially in VDS2, significantly lower than the random distribution, suggests that students felt compelled to take a work from their transcontinental partners rather than from their immediate peers. The male-female differences didn’t produce any consistent patterns.

Despite the differences to Phase(x) we pointed out, the results look very consistent with the Phase(x) results. Given the rather low number of participating students and of phases any possible differences couldn’t really be substantiated.

6c.4.2 ‘More objective Assessment of Designs’ (color plate 54)

As for social patterns, there were relatively more than in phase(x), but still not very many. Nevertheless, the smaller number of people and the workshop character of the classes did result in a stronger bonding in the group. To a lesser extent that was also true for the transcontinental relationships, especially in the second VDS, where there was even the occasional instance of some online flirting we instructors noticed. Despite all this, by and large the choices of the designs lack strong patterns that would suggest that they weren’t based on genuine interest in the design rather than social reasons. This also has to do with the relatively small number of phases we can observe. There were only five phases in the VDS projects and while in the first VDS there was an add-on workshop in which a single group from Delft took up the designs from the database to develop them further, bringing the total up to 8 phases, those last three phases obviously can’t be considered here, as all the exchanges happened within that single group only. In VDS98 there was an intense group dynamic and a certain amount of discussion about the selections based on the personalities on the other end. Statistically these discussions don’t seem to have had much relevance. And we couldn’t find a single case of systematically narcissistic behavior.

6c.4.3 ‘The bias inherent in the web environments’

This last category can’t be tested for, because the groups were simply too small and the time the class lasted, too short. There were between 25 and 39 authors (resp. author-groups) involved in the project. Therefore it was very straightforward to keep an overview of the submitted works, especially since, due to the time-difference, only about a third of these were submitting works at any one time. Therefore works very naturally were in pole position for as long as it
mattered and the graphical evaluation we performed for the Phase(x) and fake.space projects does not make any sense for the VDS. What’s more, the much more loaded Phase(x) sites already provided ample evidence about the bias the websites can produce.

We can therefore skip this question and move on to summarize the VDS findings.

6c.4.4 VDS Conclusions

Very similar to Phase(x), but with some narrative elements of fake.space, the two Virtual Design Studios Multiplying Time and Place2Wait were remarkable for their global scale and for the fact that they tried out the memetic mechanisms of those two earlier projects for an actual architectural design task.

As the number of participants involved was significantly lower than in the other case studies that have been described so far, the statistical analysis isn’t as telling as in the other projects. However, we could confirm just how valuable such a database driven exchange platform can be, especially when person-to-person communications are limited by distance and language problems.

Thomas Kvan, professor was at the University of Hong Kong at the time the first VDS was conducted, attended the final video-conferencing-review as a guest critic. He had this to say at the end:

“The results here are remarkable in that they demonstrate far more close integration of the work of the students step-by-step and place-by-place. But the other area in which you can [say] I think this is remarkable is the lack of communication between the students as they progressed step-by-step. It actually demonstrates a very interesting design situation, that the finished designs are highly coherent, even though there has been very little communication. And that’s a very interesting result. The ability to trace genealogy and evolutions of designs is a wonderful tool. It’s going to take several months of close study to pick apart these results and to understand what happened.” (Kvan, 1997)

Actually, as it turned out, ‘several months’ was a bit of an understatement. The VDS projects helped to spread the ideas of Phase(x) and Memetic Engineering among the CAAD community and inspired a number of other projects (Kolarevic et al., 1999, 2000, Matsumoto et al., 2000). Even before the detailed analysis, the VDS projects made it quite clear that the implications of these exchange mechanisms went beyond the CAAD teaching they had been invented for.
6d EventSpaces

EventSpaces is a web-based collaborative teaching environment we developed for our elective CAAD course after Phase(x) and fake.space. It is different from those because it isn’t intended as an introductory class, but instead concentrates on fewer topics that are investigated in more depth. It also goes beyond Phase(x) and fake.space in its collaborative aspects. Its goal is to let the students collectively design a prototypical application -- the EventSpaces. Game. The work students do to produce this game and the process of how they interact is actually a game in its own right. It is a process that is enabled by the EventSpaces.System, which combines work, learning, competition and play in a shared virtual environment. The EventSpaces.System allows students to criticize, evaluate, and rate each other’s contributions, thereby distributing the authorship credits of the game. The content of the game is therefore created in a collaborative as well as competitive manner. In the EventSpaces.System, the students form a community that shares a common interest in the development of the EventSpaces.Game. At the same time they are competing to secure as much credit as possible for themselves. This playful incentive in turn helps to improve the overall quality of the EventSpaces.Game, which is in the interest of all authors. The system thus intends to promote an evolution of collaboration (Axelrod, 1984). The whole, rather intricate functionality, which also includes a messaging system for all EventSpaces activities, is achieved by means of a database driven online working environment that manages and displays all works produced. It preserves and showcases each author’s contributions in relation to the whole and allows for the emergence of coherence from the multiplicity of solutions.

6d.1 Beyond Phase(x) and fake.space

In the wintersemester of 1999, when EventSpaces was taught for the first time, all eligible students had gone through two years of CAAD fundamentals during their basic architectural training at ETH. Therefore we knew that we could address more specialized subjects in our elective class. We also knew that it would no longer be flooded with people. So an important question arose during the preparation: should we take the trouble and develop another collaborative environment, if the main original incentive for doing so, the large numbers of students, were no longer to be expected?

6d.1.1 Taking Stock (EventSpaces key concepts)

The preparation for EventSpaces forced us to take stock of what was important about our way of teaching, what was independent of large numbers and introductory content and of how we might be able to go beyond some of the shortcomings of our previous teaching.

We have summarized our point of departure for the development of EventSpaces as follows: “The role of the computer in the architectural profession is by no means limited to that of design tool. When it comes to computer support in architecture, computers as a social media are just as important. So much so, maybe, that one could argue that both aspects should be addressed as separate subjects. After all the modeling and rendering programs commonly used nowadays
are very complex and take longer than ever to learn. The whole issue of networks, virtual and information architecture on the other hand provides ample topics to explore in its own right. However we feel that it is precisely the double role of producing and sharing, of learning and doing that holds the real magic of the computer for a creative discipline such as architecture. It is precisely at this intersection of tool and media that we’d like to situate our courses. Therefore we continue developing web-based environments for our skill and design oriented classes. The fact that there are now fewer and more advanced students actually lets us go several steps further and produce more particular, specialized environments. The EventSpaces course, described in this paper, was the first class environment we have developed in this spirit.” (Hirschberg, 2000)

Obviously we could build on our prior experiences for this task, but we also wanted to go further in some of the open aspects of Phase(x) and fake.space. These are the conceptual goals we came to:

**Continue to explore creative collaboration**

As we saw in the case of the Virtual Design Studios, creative collaboration is also interesting for smaller groups. The different types of exchanges that are possible, the various social and creative processes that took place in the case studies made it clear to us that it is a huge topic, which should be explored further.

**Establish a common project for all**

Phase(x) and fake.space were primarily learning engines. They can be described as collaboration just for the sake of collaboration, because the exchange of ideas this collaboration triggers leads to effective learning and to interesting and coherent individual results. Fake.space may be the exception in this respect, as it also doubled as an overall project that can be explored as a whole. But it still put the individual contributions first.

For EventSpaces we wanted to explore what is generally the rule for collaborative projects: that the activities of the individual contributing authors all add up to a common goal, an overall project.

**Computer Games**

Playfulness was important in the previous courses. Now we wanted to address the topic of games more directly: games both as a topic for design and as a way of establishing a dynamic online community.

**6d.1.2 EventSpaces.Game: connecting architectural scenarios**

In EventSpaces, students collaboratively design a computer game. Not just any computer game, but a computer game about architectural space. The game is developed around the notion of architectural scenarios. A scenario is here understood as a set of hyperlinked architectural images or 3d models, referred to as nodes, that coherently describe an architectural situation, somewhat like a stage set. Later in the semester, these scenarios become loaded with interactive functions – the events, consisting of actions and switches allowing the development of game interactions within these scenarios. Developing their scenarios, students deal with essential architectural topics such as light, material and movement and learn to use modeling and rendering software in a playful way.

All scenarios are staged in the same building, the villa Savoye by Le Corbusier. We provided
COLOR PLATE 55: EventSpaces impressions

fig. 55.1: **EventSpaces1**: Virtual Villa Savoye as a collaboratively designed Interactive Game

fig. 55.2: 3386 by space021 (‘the liquid tunes’)

fig. 55.3: 3306 by space043 (‘spritz’)

fig. 55.4: 2397 by space044 (‘follow’)

fig. 55.5: 3268 by space023 (‘Séjour’)

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COLOR PLATE 56: EventSpaces impressions

fig. 56.1: EventSpaces Editor and Player: Hot-spots, actions, sounds and messages could be built into the images. They were linked to become scenarios that could be navigated through interactively.

fig. 56.2: EventSpaces Concept: Different Scenarios created by different groups of authors are joined to become one collective hyperstructure. The game logic (switches) is distributed across the different scenarios.

fig. 56.3: EventSpaces Applet showing the entire hyperstructure of EventSpaces1.
a rough CAD model of the villa at the beginning of the semester that was subsequently changed and refined by the students. But it is not only this model they worked with: because of the prominent role this villa played in the development of modern architecture, because of the ‘cinq points’ that it is a built manifesto for, and also because of the polemics that surround its history, all the students had their own experiences and feelings about this building to bring into their work. The choice of the villa Savoye thus charged the architectural aspects of the scenarios. They were a possibility to explore the modernist ideal of space with today’s digital tools, but also a possibility to take a very personal position towards this icon of modernity. Another thing that is curious about the villa Savoye is, that it was never inhabited for a longer period of time. When the groups of students selected different rooms of the villa to work on during the semester, it seemed like they were moving in, so that finally something would happen there, some events could take place in those pure spaces.

Besides developing their own scenarios, the students were asked to establish links from their works to the other scenarios, thereby creating one coherent hyperdocument. By using a common building for all scenarios, a spatial relation between all scenarios was given that could then be used or intentionally disregarded when connecting the individual scenarios (figure 1).

**6d.1.3 Levels: the structure of the semester**

The semester was made up of several stages, which we referred to as levels. In these levels the teaching and the work were always focused on a particular topic. There was a progression in the levels, going to more advanced topics in the production of the game and towards increasing collaboration in the course of the semester.

**Level 0: online ID**

All authors enrolled in the course get a chance to define their online identity, selecting an image, colors and a statement about games to become part of their EventSpaces business card. They were also asked to form teams in the first week. The following levels were performed in groups of two or three people.

**Level 1: scenario**

The first production level was about setting up a scenario, essentially a set of renderings, linked in a consistent way so as to allow them to be navigated through naturally (see color plate 55). Students learned how to use Lightscape to create the renderings and were introduced to the action-editor (see fig. 56.1), to link the renderings and create active areas on them.

**Level 2: object**

The model of the villa we provided was empty. At this level, students were asked to produce or find models of objects to be placed in their rooms. If they wanted, students could make their objects available to everyone else in a library as part of the website. To incorporate them into their scenarios they were asked to create variations of their renderings that contained the objects.

**Level 3: interaction**

The 3D node-type was introduced that contains VRML worlds. 3D nodes were placed at special points within the hyperstructure and allowed for a different way of interaction.
**Level 4: animation**

Different types of animations were introduced: GIF-Animations in the 2D nodes (placed as overlays over parts of the existing renderings), VRML-Animations in the 3D nodes.

**Special Interest Groups**

For the rest of the semester, students no longer worked in their groups only, but formed what we called special interest groups that students could sign up for: MOTION, LIGHT & FORM, SCRIPT & SOUND. These groups could get into more depth with a topic, exchange notes on it, while in different ways still contributing to the overall project. The MOTION group addressed the 3d nodes, LIGHT & FORM dealt with modeling and rendering and SCRIPT & SOUND addressed the overall linking of the hyperstructure, the gaming narrative, as well as the sound.

### 6d.2 EventSpaces Design(s)

#### 6d.2.1 EventSpaces.System: online collaboration

The novel aspect of the course does not lie in the technicalities, nor in any of the individual levels, described above, but in the fact, that all these activities contribute to the same product, the EventSpaces.Game. While in previous semesters we used database-driven websites to transparently present and exchange students’ works, those were still individual projects, displayed in the context of all other works. In EventSpaces we went a step further in that we wanted to have cycles of refinement, rather than just an accumulation of works through the semester. These cycles of refinement, which also included feedback mechanisms through rating and discussion, were achieved in the EventSpaces.system, using ways to provide feedback, control and self-regulation.

#### 6d.2.2 Feedback: the messaging and rating system

In the EventSpaces.System, there are authors and owners. The scenarios are owned by the groups that develop the initial plot for them, but the nodes can be produced or improved by all EventSpaces authors, as all the working material (model, radiosity solution, material descriptions, rendering settings etc.) are available for download for every single node.

All changes made are instantly visible to the community. But while every author can contribute to any scenario of their choice, it is up to the owners to decide about the definite version of their scenario. They can select between different versions by different authors for all nodes. They are likely to take the best versions, though, as their scenarios are rated once a week by the whole community. The rating translates to so-called EventSpace Units (ESU), which are distributed among the contributing authors by the scenario owners. The ESUs are used to measure the contribution of a single author to the whole game.

The earning’s ranking, updated weekly, is an important feedback mechanism. As teachers, we also gave our feedback to the students, for example by showing and discussing certain scenarios in the lectures. The advantage of the rating system was however, that it was outside of our control, as it reflected an entirely democratic voting process. While a bad ranking in this type of list is still not pleasant, students can accept it as an objective feedback more easily.

#### 6d.2.3 Control: outworld views

The control that the owners exert over their own scenarios did not only manifest itself in the
rating. Essentially they were also in charge of governing the development of their part of the whole hyperdocument. Counting all the variations and versions, EventSpaces consists of almost 3500 nodes. To allow for a good control over the complexity of the emerging hyperdocument, we provided, among other things, a mapping mechanism, that displays all the works and the connections between them at once (see fig. 56.2-3). As it can also be structured hierarchically (scenarios can be displayed as boxes or with all its individual nodes), it provides a possibility to analyze and control the connectivity and the logic of the hyperdocument in a straightforward way. At the same time, no individual author could authoritatively change any link outside their own scenario. They could only post nodes as their suggestions and explain them with the messaging system.

6d. Motivation and Self-regulation

EventSpaces is built on two essential underlying suppositions: firstly, that the creative development of a complex system can be done in a distributed way without a central authority and secondly that in order to function properly and efficiently and produce a satisfying result, such a distributed collaborative setting must have the proper checks and balances, i.e. means for motivation as well as self-regulation, built-in.

Motivation

The first motivation for everyone in the class is to be part of a larger enterprise that produces a good game in the end. Therefore they collaborate and discuss the project with the other authors. The second motivation is to have their name and their personal input manifest in it. This entices them to produce work that is popular among the other authors. If they are successful, they get more points for their work and more recognition in terms of authorship percentage.

Self-Regulation

Of course there are ways to beat the system. If a group decides to use the rating mechanism to give many points to themselves and none to their collaborators, this will win them many points quickly. As rating habits are transparent, though, in the long run, this habit will probably lead to a bad reputation, to fewer points and fewer collaborators for their scenario and consequently to a less favorable rating. We are essentially creating a situation not unlike the prisoner’s dilemma, which has been explored by Axelrod (Axelrod, 1984) and Dawkins (Dawkins, 1989) in EventSpaces, it pays to be “nice”. Along these lines, students learned that reputation and responsible behavior is important in cyberspace, too. At the same time, EventSpaces was “just a game” and a bad rating didn’t discourage people too much.

6d.3 EventSpaces Process

EventSpaces was certainly the most sophisticated website and maybe also the most ambitious of the case study projects. Did it all work the way we expected? And of course the main question: how good a game is the EventSpaces game the students produced collaboratively? To answer the second question first: We were indeed able to give a CD-ROM of the whole game to every participant at the end of the semester. However, EventSpaces probably wouldn’t have done well on the game-market. Not surprisingly, in structure it is more a bazaar than a cathedral (Raymond, 1998), and therefore as a game it lacks an overarching, compelling plot. It does contain many beautiful, sometimes poetic, sometimes funny episodes and parts of it are truly
immersive and engaging. So, if one does not expect just a game-game, but is prepared for a rather surreal journey through unexpected interpretations of the villa Savoye, one will probably find it rather entertaining. The dynamic group interaction that went into its making can be felt when playing it.

Still, we have to admit, it did not all work as we expected. For one, the messaging system was too complicated, and didn’t really support the discussion. Also the possibility to make variations in other scenarios was not taken advantage of often enough. In many places the navigation is very linear rather than complex and quite generally not consistent enough.

We nevertheless considered the first class to have been a success. The feedback we got from the students was positive and encouraged us to take this development further. Based on the initial EventSpaces system, two follow-up projects were set up: EventSpaces II: neighborhoods at the Harvard Graduate School of Design and EventSpaces III: urbanity at ETH Zürich. The author was mainly involved in the class at Harvard, which will be discussed in chapter 6e.

6d.4 Evaluation and Outlook

EventSpaces allows diverse forms of exchanging ideas and encourages partners to build on each other’s insights and contributions. It provides new means to make design processes transparent and coherent, to augment group negotiation and to foster a collective intelligence (Levy, 2002), so as to integrate diverse concepts and requirements into a single composition. If some parts of the first EventSpaces system were overly ambitious and didn’t quite work as planned, later versions of the class reached a point where it ran very smoothly. As we will discuss in the next chapter, the core of the EventSpaces code is still in use to this day at TU Graz.

In the context of the case studies that form the core argument of this thesis, EventSpaces represents the next generation of collaborative environments. In fact, it is so different in structure from the other case studies, that the visual analysis procedures we have developed for phase(x), fake.space and VDS can’t be used on it. So there is no statistical and graphical evaluation of EventSpaces in this chapter. But conceivably such evaluations at this point wouldn’t add much beyond what we have already been able to prove.

What can be learned from EventSpaces is something else. EventSpaces was a game about creating a game. As it evolved, we felt that this project raised more questions than it provided answers. The questions are the basic questions of memetic engineering: How can we build a society of ideas, all gaining strength from other ideas? And how can we cultivate the “best” solutions from the field of possibilities and constraints? We shall return to these questions in the conclusion of the thesis.
The case studies we have described in this thesis took place within four academic years at ETH Zurich (respectively, in the case of the VDS, at collaborating architecture schools around the world). The last one, EventSpaces, was held in 1999/2000.

The rather unique pedagogical approach that these case studies pioneered didn’t end there, though. As these projects received considerable attention (a first prize at the “die besten 1998” awards by Swiss TV and the design magazine Hochparterre, an honorary mention at “Ars Electronica”) and were the subject of a number of papers, also by our VDS-partners, there are a number of places which conducted classes in ways inspired by Phase(x). Some were quite direct, such as some of the projects by our VDS partners in Hong Kong and at Bauhaus University (Donath et al., 2000, Kolarevic & Ng, 1999, Kolarevic et al., 2000). Others were developments that were at least in part inspired by the case studies, as the references in the papers that were published about them attest. (Matsumoto et al. 2000).

While the ideas developed in Phase(x), fake.space, etc. are developed further in many places and different settings that we have no direct influence on, they were also continued in the work of the author. The following paragraphs are meant to give an overview over the follow-up projects the author was involved in after leaving ETH in 2000.

6e. EventSpaces @ GSD

The first and most important follow-up project was the EventSpaces class that was taught for three consecutive years at the Harvard Graduate School of Design (GSD). A collaborative effort between researchers at ETH and at Harvard, EventSpaces was probably the most ambitious and complex of all case studies. The class was directed by the author together with Prof. Jeffrey Huang. It has been described in an extensive study made at the Harvard School of education, who were investigating its pedagogy, making interviews with students and teachers involved etc. (Wiske et al., 2000). As giving a full account of this project is impossible within the context of this thesis, only an overview of its main features will be presented, here.

6e.1. Fundamentals of Computer Aided Design

The Fundamentals of Computer Aided Design class, also referred to as the ‘fundamentals’ class, was mandatory for all architecture students at Harvard. Even though there were fewer than at ETH, the class still had to cope with a student population of over sixty. The collaborative aspect was first viewed critically by other Harvard faculty. After all the networking among students is so strongly a part of the Harvard Design education, it is actually built into the layout of the school’s building, Gund Hall, where students work all under one common roof on the so-called trays. Therefore it seemed superfluous to recreate this intense level of exchange also in the digital world.

The more one talked about it, though, it turned out that teachers felt the networking on the trays wasn’t working as well as it used to anymore. The informal exchanges that constantly happened on the trays, because design artifacts such as models, plans and sketches were piled
up on every student desk, were getting less. Professors as well as fellow students were starting
to have a harder time figuring out what students were currently working on and to give them
feedback about it. The reason was simple: with students more and more working on their designs
on the computer, fewer of their intermediate design products appeared on their tables. Thus,
opening up new exchange platforms in the digital world actually made a lot of sense.

When we introduced EventSpaces as the way to learn about Computer Aided Design, we did
not actually try to remedy the networking situation on the trays. Rather, the class was meant to
exemplify a particular type of exchange of ideas in a set context.

In contrast to the situation at ETH, where the class could have a rather narrow focus for
students already well versed in digital media because the fundamentals was already behind
them, the EventSpaces version we developed for the GSD had to cover a much broader range
of techniques and methods, more like Phase(x) and fake.space had.

The solution we came up with borrowed some concepts from all these classes and mixed in
new ideas as well. Just as in the @home and fake.space classes (Jeffrey Huang was actually
teaching at ETH at the time the @home class was developed), we had students document their
own homes. The documentation happened in a two-step cycle and included a switch in authorship
every second step. Thus in the very first exercise, students would document their own homes
with digital photographs which they would arrange in a simple home-page, thus learning some
first things about image processing and web-design. In the second phase, image processing
was dealt with more in depth and they learned about various montaging techniques they would
apply to altering the images of one of their peers’ home. They could act as home-improvers
on each other’s student rooms, something that was done in a very playful way. Similarly there
were two sessions about CAD drawing, where they first drew their own apartment’s plan and
then redesigned someone else’s, and later about 3d modeling, where the same happened in the
third dimension.

After these six exercises we had a collection of digital versions of all students’ homes along
with their estrangements. These models were then the basis for getting into the second part
of the semester, where students collaboratively developed the interactive EventSpaces game.
It was aptly called neighborhoods, because instead of working on the digital version of Le
Corbusier’s Villa Savoye, the game was about the virtual neighborhood of student homes.

6e. Community Spirit in EventSpaces.neighborhoods

The extended “EventSpaces engine” we used in the Fundamentals class incorporated features
from Phase(x) (individual phases in which students can take over each other’s design’s) and
fake.space (narratives about digital versions of their own homes) that went beyond the first
EventSpaces version. In other ways, the website was actually simplified and some of the features
were dropped. The messaging system which was integrated with the design submissions in
EventSpacesI was dropped in favor of a more conventional messageboard which became widely
used. Also the commenting function was simplified and integrated with the works, leading
to extensive discussions about them. The trading and distributing of credits that made the
production of the game a game in its own right in EventSpacesI was significantly downplayed.
To the GSD students who are much more aware of grading (the classes at ETH were pass or
fail) this peer-rating mechanism felt threatening. Therefore it was simplified and only used as
a sorting mechanism (sort by popularity would show the works with the highest rating first). It
was not, however, used as a score that the students received.

In a way it was a kinder gentler version of the class. Taking away these competitive functions
COLOR PLATE 57: EventSpaces neighborhoods @ Harvard GSD

fig. 57.1-2 Eventspaces neighborhoods website: Startup view (left) and messageboard with student faces (right).

fig. 57.3-4 Eventspaces assignments 1 and 2: Students acted as architects for each other, remodeling their apartments in montages.

fig. 57.5-6 Controversial montage (left) with long commenting discussion (right)
fig. 58.1-2 Eventspaces assignments 5 and 6: After a sequence of assignments students had to use their material in order to start developing the Eventspaces neighborhoods game.

fig. 58.3 Excerpt from the EventSpaces neighborhoods game, visualized by Gramazio and Hoeger in (Gramazio & Hoeger, 2001)
didn’t make it any less playful. The playfulness was certainly also the result of a stronger sense of community than any of the previous classes ever enjoyed. This was especially the case during the final development of the game, when students were competing in coming up with ever more sophisticated twists and plots and beautiful sceneries as part of their common hyperspace.

At the GSD, students know each other very well: from the intense classes they take together and from working on the trays in Gund Hall. This certainly made a difference. As did the fact that we promoted various peer-to-peer learning mechanisms in the way the class was conducted. During the game development phase there were different so-called ‘special interest groups’. In parallel there were groups teaming up to create a sub-section of the neighborhood with a common theme. Finally these groups were coached by two types of teaching assistant, dubbed “gurus” and “godfathers”. All of this certainly helped in creating this community spirit. As did the spatial situation in Gund Hall. In the three EventSpaces classes we held at the GSD the interaction in virtual and in real space was happening intensely in parallel. Students were posting nodes, linking to designs of their colleagues while those colleagues, who were engaged in the same work, were actually sitting at their desks in the same space, only a couple of yards away. They could yell and cheer loudly or they could post a comment in the website: both ways of communicating were possible.

EventSpaces thus could very well be described as a social networking system. Such systems have since become a large internet industry. At the time it was just a logical consequence of our quest to develop a good collaborative learning platform.

6e.1.3 Memetic Engineering vs. Social Networking?

We have seen instances of community building and social networking also in the ETH case studies. Whenever this community spirit emerged, for us teachers it was a sign that the class was working. The student’s personal engagement in the class to us was a direct measure of its success.

The fact that the networks also assumed an intensely social dimension seems somewhat paradoxical given the fact that we have been able to show in the statistical evaluations that these same networks could actually strip certain social inhibitions like group pressure or personal acquaintance from the selection patterns.

But then again, this is really not so surprising. The success of social networking sites like mySpace or facebook is in part also rooted in a redefinition of social rules. There is a code of conduct, but it’s different from the one in the real world. (For basic discussions of this general topic see Turkle, 1984 and 1995, or Smith & Kinnock, 1999.)

Twelve years ago, when the first one of the case studies was conceived, social networking was not the big thing it is today. This is the main reason why social networking hasn’t been an important part of the discussion so far. Nevertheless it is interesting to compare the two terms, memetic engineering and social networking. In social networks, the individual takes center stage, whereas the premise of memetic engineering is that the individual’s expressions and contributions can get separated from their authors and become a free commodity. Obviously that’s much less comforting. The success social networking has had would have been difficult under the banner of memetic engineering. Yet, the mechanisms behind the two are very much related, even largely the same. We shall return to this relationship in the conclusion of this thesis.
6e.2 Other classes at Harvard and at TU Graz

A number of additional classes at the Harvard GSD were conducted using some version of the EventSpaces engine: Visualizing Information, Advanced 3D modeling and Animation, Advanced Digital Media, Databases in Design.

As one can guess from their titles, these classes were very different in content. Of course not all of these classes were geared towards producing an interactive game in the end. Rather their use of the EventSpaces engine was limited to its basic functionality as an open collaborative exchange platform.

6e.2.1 EventSpaces as a general purpose platform

The classes using the EventSpaces engine as an exchange platform have the following commonalities:

- **Phases**: the classes are structured in individual assignments
- **Online Submission**: students have to produce works in digital format which have to be submitted online.
- **Online Discussion**: the participants have access to online discussions and can comment on each other’s work.
- **Peer Rating**: the participants can rate each other’s work anonymously. The rating is used for sorting the works by popularity.
- **Instant Archiving**: all works of all participants are labeled and timestamped and the whole development can later be analyzed and evaluated.

It’s easy to see that these commonalities could be useful in many types of academic teaching situations. Essentially the EventSpaces engine was thus stripped down to become a general purpose exchange platform.

Upon leaving the GSD to take on a professorship at TU Graz, the author also used the same basic approach in many teaching projects, there. The shorthand for the names of these classes is DM: Digitale Methoden, numbered from 0 to 4. Many of the various ‘Digitale Methoden’ classes have been conducted using the same basic database driven technology as their backbone. They actually still use the same code (or a continuously updated version of it) that was developed at ETH and at the GSD for use in the EventSpaces game class.

In its stripped down version the system’s functionality is quite modest, but the advantages of using it are almost independent of the topic of the class. For all their simplicity these advantages are quite compelling. Students can share and discuss their work easily and everyone can be kept current on what is going on in the class. Therefore, even when the exchange of files and to continue working on someone else’s work is not part of a classes agenda (usually it is), the students can still learn from and be inspired by the work of the other participants. Furthermore the classes that are conducted in this way are instantly archived and can later be analyzed. Our experience shows that these advantages easily outweigh the somewhat tedious aspects of using the system: that one has to put the work into a certain format for the submission (actually that’s not a big deal, as any type of file can be submitted, if the site is properly configured) and that the system needs to be maintained by someone, usually the teachers.
6.2.2 Evaluation of classes at Harvard and TU Graz

Given the more loose approach to memetic engineering that was taken in most of the classes following the ETH case studies it would not have made much sense to carry out similar evaluations on those later database records. One could decide to do so at any point, since they are all archived. At TU Graz they are even still online. The Harvard GSD unfortunately ended up shutting down the class websites some time ago (as did ETH, where only a non database-driven version is still active that is virtually unusable). But the patterns to look for would be different from the ones we investigated in the case studies of this thesis.

The later classes have introduced some new features that have not been dealt with, yet. The most important topological difference is that it is now possible to give distributed credit. The connections in the case studies were all singular. A work in phase(x), fake.space or VDS could only have one precedent. In EventSpaces we first implemented a more sophisticated versioning system that also allowed giving credit for different aspects of a node to different authors. But this very complicated structure never worked and was soon abandoned. The functionality to give credit in the current generation of DM classes is much simpler: There is still one main reference that needs to be given as the precedent. But on top of that, students can give credit to as many other works as they like. This is a much fairer system and also a more realistic one. We often get our ideas from many different sources and then combine them in our work.

For our memetic considerations and evaluations, however, such a distributed credit system creates many problems. Not only will our system that is based on the idea of imitation or replication have to yield a more complex model of synthesis and fusion. The mentioned fairness also depends on students actually being honest and conscious about from where they got their inspirations. As only the definition of the main reference can happen quasi-automatically, all other credits are given due to an author’s own judgement. If he or she claims that an idea was his or her own and didn’t come from somewhere else, it’s hard to dispute it. So by moving our system more towards a fairer and more realistic model, we have also abandoned some of its main advantages. This is yet another question that needs to be dealt with in the interpretation and conclusion section: the question of freedom versus responsibility.
7 Interpretation

Based on the evaluations of the case studies and on the theoretical premises outlined in the first chapters, we now arrive at the point of this thesis where we can interpret our findings. In this section the results are summarized once more in order to gain a broader overview of the subject matter that has now been analyzed in some detail. Given that there is quite a bit that we were able to show objectively, we can take the liberty to make our interpretations a bit more speculative.

7.1 Summarizing the Evaluation

The discussion of the case studies showed that there are some things that can be stated objectively about them. They were successful in creating an exchange mechanism that transcended the boundaries of the teaching groups. This opened up a larger specter of works to which the students were exposed and from which they potentially could learn. We have argued that this type of peer-to-peer learning is particularly important in a creative discipline such as architecture, where working in studios and being surrounded by artifacts have traditionally been hallmarks of successful teaching and learning environments. Thus if one accepts the premise that exposure to more other works and ideas is a good thing in an educational situation in architecture, this finding in itself can be seen as proof of an improvement in the quality of the teaching.

To be sure that the groups weren’t just replaced with a different set of social constraints, a second pattern analysis was defined in order to check whether there were other interpersonal patterns guiding the selection of works. It turned out that such patterns, especially narcissistic ones, can indeed be found, but that they were not by any means the norm. Rather, the evaluations confirmed that the selection of the works by and large were independent of interpersonal patterns. Given that in a traditional setting taking over someone’s idea openly is usually very awkward and even judging someone else’s work cannot be thought of as being independent of social constraints, this finding is important. It shows that through the mediation of the networked platform, in which authorship is still visible, but less prominent, a more objective assessment of other people’s works is possible.

Finally we tested whether in the absence of biases based on group affiliation or other social relationships, other biases were introduced by the mere quality of the web-environments. Checking for this third question was important. After all the other findings would be useless if it turned out that they were simply the result of the way the websites were designed. If the way the works were presented online could also explain the majority of the selections that were made by the authors, then the results of the other evaluations become simply meaningless. From the evaluations that were made, in phase(x) the findings don’t suggest a distorting influence of the website on the authors’ choices that would put the other findings into question. In fake space, however, a strong relationship between the presentation on the site and the selection patterns could indeed be found. While this relationship can largely be explained by the content of the class, which was based on the idea of storytelling, the finding nevertheless points to the
importance of investigating this influence. Both cases also showed, that these patterns become more relevant, the larger the number of choices is.

If we accept that an absolutely unbiased graphical representation of any content is not possible and that one can only strive to keep the distortion introduced by the representation as limited as possible, then the fact that the bias was relatively small in the case studies must be seen as a success. Thus we can go further and ask what the qualities were, which, in the framework of the case studies, enabled this virtually unbiased presentation of works. The findings of this last category suggest that there are some qualities in the surveyed websites that could provide hints as to how one might reach such a limitation of bias.

But the discussion and evaluation of the case studies did not only focus on the aspects that could be investigated quantitatively. They also provided grounds for a discussion about how memetic processes and creativity go together. Before we draw any conclusions about what can be learned from the way the case study websites were designed, we need to summarize the findings about the relationship between memetic engineering and creativity.

### 7.2 Memetic Engineering and Creativity

In chapter 4 we introduced and discussed the theory of memetics at some length. Focusing primarily on the version of memetics made popular by Susan Blackmore in her book “The meme machine” (Blackmore 1999), we also discussed rival versions and critics of her approach. Stating that most discussions about memetics are mostly concerned with replication and fidelity rather than creativity, the construction of proto-memes was introduced as a conceptual bridge between memetic and non-memetic forms of learning and creativity. Now that we have looked at all the case studies from a memetic point of view, how can we summarize our findings, how does our memetic theory of creativity hold up?

First of all: the discussion showed that despite the clear structure of the case studies that create quasi laboratory conditions for the study of memetic processes, as soon as one looks at the processes in more detail, the terminology becomes tricky and to some extent inadequate. Because the case studies possess this clarity and the two processes that they enabled can be analyzed and evaluated at some detail, they may create the illusion that the database records fully captured the memetic processes. Yet, as was pointed out, some important aspects are missing. There was no way for the students to give credit to more than one precedent, nor to show from where the ideas came that were not embedded in the work they received from someone else. In current classes at TU Graz, there is a possibility to give credit to more than one precedent available to the students. But this still doesn’t eliminate the basic problem. For one, the students’ inspirations cannot be limited to the works inside the class. Secondly, even within the class the question how such voluntary giving of credit to more than one precedent can be controlled or mandated is unclear. Thus it can’t be denied that all mappings and outworld views that faithfully show the development of the digital artifacts are necessarily incomplete renditions of the creative processes that brought them about.

Does this put the premise of our theoretical approach into question? Are the processes we enabled and monitored really not memetic processes, but something else? As was pointed out before, there are facts about the processes that so clearly fit the bill of memetic theory that we need not waver, now. Rather, what seems to be somewhat impure about the processes should be understood as the very nature of both creativity and memetic processes. We feed off other people’s ideas when we are creative. Yet we do so by making these ideas our own, by integrating
them with our own existing thoughts and ideas. The proto-memes that form in our heads are influenced in large measure by our environment, by our communications and exchanges with the world. But they are equally shaped by what’s already there, by the existing structures, the memes and proto-memes in our minds. As we showed in our discussion of memes as creativity killers, it is reasonable to assume that the memes we already possess shape, that is: limit or enhance as the case may be, the production of new proto-memes. This leads to the uncomfortable fact that we sometimes can know too much about a subject and thereby lose the ability to approach it with an open mind. In a discussion of the ‘creating mind’ as one of the ‘Five minds of the Future’ (Gardner, 2006), Howard Gardner quotes a wit about Camille Saint-Saëns: “he has everything but he lacks inexperience” (Gardner, 2006, p. 83).

For our context the memetic theory of creativity just makes it clear that the memetic processes we witness in the case studies aren’t pure in the sense that all changes to the memes are derived from the methods introduced in the class, but rather are deeply personal contributions of the authors involved in the process.

In Gardner’s discussion of creativity, as in many theoretical treatises on the subject, the examples used are usually geniuses like Mozart or Einstein or Marie Curie. Creativity is seen as the exceptional achievement of highly talented individuals. While Gardner acknowledges the role of the environment in which the creativity can happen, and also mentions the creativity of groups, his view of the subject largely relies on the notion of the individual creator, even though, as he contends “the limits of this focus on the individual are becoming clear” - citing examples from science or Hollywood productions in which the creativity of a collective is at work (Gardner, 2006, p. 96).

In Susan Blackmore’s view on the other hand, creativity is the result of “a bunch of memes”, a view that seemingly leaves no room for notions such as individuality or talent (Blackmore, 1999, p. 240).

The view of creativity the memetic engineering of the case studies opens up offers a compromise between these two extreme ways of conceptualizing creativity. On the one hand, the processes can be described as memetic processes. People simply copied from one another. But in copying they appropriated these works of others, they brought in their own talent, turned them into new designs that were clearly theirs. Some of the students’ works were remarkable. And the remarkable ones always stood out for being truly unique and individual expressions. Thus the case studies strongly suggest that copying and the unfolding of individual talent need not be thought of as opposites.

7.2.1 ‘You are supposed to plagiarize!’

That this ‘compromise’ view of creativity is not new can be illustrated with two anecdotes Julius Posener tells about the legendary German architect Hans Poelzig (1869-1936). Poelzig was, as many accounts of his students attest, a charismatic teacher (Posener, 1970). An architect widely recognized for his bold and unique designs, he certainly wasn’t suspected of lacking creativity or originality in his own work. Yet he got very annoyed with students that tried too hard to be different. One day he is reported to have yelled at them: “Ihr sollt plagiieren! Mozart hat es getan, Händel hat es getan und denkt ihr etwa ich tue es nicht?” (Transl.: “You are supposed to plagiarize! Mozart did, Handel did, and do you really think I don’t?”) (Posener, 1981, p. 51). Clearly he felt that copying works from others was in no way opposed to being creative, rather a prerequisite for it. But in his view this was only part of the story. About his historicist colleagues whose designs seemed to be all caught up in the formal vocabulary of the
past Poelzig joked that they take in all these forms from the old masters, but then are unable to digest them. Therefore they just simply have to spit them out again when they design something themselves (Posener, 1970). It is this ‘digestive’ act, which we called the appropriation of works of others. This is where the difference to mere copying is made, where individual talent as well as all the many memes and proto-memes that make up the individual person’s mind come in.

So, while our description of memetic processes and creativity seemed like an unclear compromise, it actually represents a plausible concept of creativity. It is again the relationship between the individual and the collective process, between copying and individuality, where the case studies provide many interesting insights. They shed light on the very nature of creative processes.

### 7.2.2 Selfish memes and selfish authors

In Phase(x) and VDS students were not allowed to continue working on their own works. Therefore the close relationship between author and work was intentionally broken in favor of a free flow of ideas in the student population. Students had no choice and once they were in the right mindset, they quite obviously enjoyed working in this way.

In fake.space, which was about story-telling, it was left up to the students, whether they would link to their own or to someone else’s works. The analysis showed that over fifty percent of the links were made to people’s own works. While this can in part be explained by the narrative content, it still is indicative of the strong role personal involvement and pride plays in creative processes. In phase(x) we called individuals who regularly worked on offspring of their own works ‘narcissists’. Incidentally, the individuals we identified as ‘systematic narcissists’ were among the most successful authors in phase(x) (see color plate 26). They were the authors of the only designs that had any offspring in the eighth phase (color plate 18). While they weren’t the most highly rated, they also ranked among the top of the class in terms of their designs’ popularity.

What lessons can be drawn from this? The motivation of the students is a prime component of such processes. The projects worked best when the identification with their own works as a motivation was matched by a playful interpersonal dynamic in the online community. From the statements of the students we know that they were most productive whenever this playful spirit was strong. This was the case in the EventSpaces classes carried out at the GSD, where the community spirit was further promoted by the fact that students were contemporaneously in the same space offline and online. But it can also be read in the comments and postings in the later fake.space and Phase(x) courses (the earlier ones didn’t have these commenting mechanisms.)

It is a surprising outcome of the analysis that the systematic narcissists were not more numerous and that the traces of social ties we could detect in the linking patterns were so few. Nevertheless, as fake.space reminds us, the selfishness of authors is an important creative force and must be taken into account when such memetic systems are designed. While Phase(x) did not allow people to continue working on their designs, they were nevertheless clearly identified as the author, thus benefitting from the works’ popularity and proliferation even when they couldn’t themselves directly contribute to it.

### 7.2.3 Group thinking

Since new forms of creative processes and collective authorship are of particular interest here, we should discuss whether the projects resulted in something we could describe as group thinking.
Treating the whole community of authors rather than an individual author as the subject, we can describe the evolution of narrative threads or designs as decisions that the collective made. Looking at the projects in this way we could attribute certain qualities or attitudes to these communities: they exhibited a certain personal style, manifest in the choice of works that were developed further over several generations and in the ones it didn’t care about. This backwards way of looking at the case study projects is interesting, but at the same time not very revealing because we cannot compare these choices with some set goals or with the same choices made by other projects, conducted in parallel. Thus it is impossible to judge the value of these examples of group thinking. Only in the EventSpaces project where the set goal was to produce one overall project, the EventSpaces.Game, there are some such criteria. We can ask whether the EventSpaces.Game produced by the students is a good game, whether it has an interesting plot, whether it works. Again, though, the answers that can be given to such questions are very relative. While there are some games on the market that use a similar hyperstructure mechanism, in the end there is no commercial or other project that it can be directly compared to. The main features, the rather episodic narrative cannot be seen as the result of group thinking, but rather as the consequence of the set-up.

There are numerous open source projects that have proven that such approaches can produce convincing results, not only for the common good, but also results that are competitive and successful in the marketplace. Linux and Wikipedia are the classic examples, but a huge number of them could be listed (DiBona et al., 1999). What’s more, such massively collaborative approaches are being employed more and more not only in developing software, but in any research context when the stakes are highest. Whether it’s about the decoding of the human genome, missions in space or investigations of climate change: large scale collaborative approaches are used whenever the best talents and the broadest and deepest testing are needed. Gardner refers to certain kinds of collaborations as “Hollywood style” (Gradner, 2006, p. 93) - pointing out that the creative output of very large numbers of people in a short timespan is also at work in the production of blockbuster movies. If it seems a stretch to compare the case studies with such large scale collaborations, one should keep in mind that the case studies were, after all, classroom projects, with the special constraints and possibilities that come with that. In how far they were successful in terms of establishing group thinking on a level that is competitive with other approaches, for lack of such a competitor, cannot be answered. Nevertheless the case studies provide many relevant insights into the special mechanisms that are at work in large scale creative efforts. What’s clear is that successful strategies for large scale creative collaborations are today more important than ever. This is also true for design, where the synergies between collaboration and learning and the possibilities of digitally enhanced forms of sharing are now explored at many leading architecture schools (see for example Steele, 2006 and other texts in Hight&Perry, 2006).

7.2.4 Memetic Engineering as an easy recipe for creativity?

The term memetic engineering suggests a cold, mechanized process. While we might be relieved that human creativity and individuality finds a place in it, we still might be disturbed by the implication that creative processes can somehow be set up to happen almost automatically.

When we introduced the term proto-meme, we argued that among the many strategies that memes may have to secure their survival, one could be to act as ‘creativity killers’, that is, to keep rival proto-memes from forming. And we suggested that there may be ways around such barriers, as we argued that such filtering mechanisms are usually limited to a specific domain.
As strategies to go around such barriers we mentioned analogies, concepts borrowed from other fields, metaphors and objet trouvés: existing objects that are inserted into a new context. We also pointed out that this fits well with ideas about creativity put forward by theorists such as Schön or Koestler (Schön, 1967, Koestler, 1964). Gardner, while not mentioned, then, also makes arguments that support this notion (Gardner, 2006).

The case study projects can be described as environments that put this idea to work. They systematically expose the students to the thought processes of other people. Rather than coming up with designs from scratch, they were asked to start from an existing work from one of their colleagues. In most cases we can therefore say that there was an objet trouvé situation: rather than just their own ideas and convictions about design, students were forced to cope with an object, which they could choose, but which nevertheless would limit their creative freedom. Our theory would have it, though, that the very existence of that object would actually free up new ways of designing.

It might well be that the creativity of people acting within the case study projects was enhanced. The author certainly hopes that this was the case. But it would be hard to prove it. As was pointed out in the beginning, we have no parallel groups to compare the results with. When comparing them with the results of the earlier Wahlfach courses, there are stylistic differences that can clearly be found. But we cannot prove that it resulted in any more creative solutions. What we can safely say is that the results were different. So the most important finding with respect to this theory is that it works.

It works in the sense that one can design an exchange platform that systematically makes use of this ‘trick’. It works in the sense that students in the case studies didn’t mind, but rather enjoyed the process. The statistical evaluations show that they didn’t try to fight it or use workarounds, but rather made use of the exchange mechanisms to the full amount possible. They enjoyed the greater freedom they had in those classes when compared to their design studio. And they enjoyed picking up designs from other people and manipulating ideas and forms that they themselves would never have come up with.

This last statement, that the designs are different from anything that an individual student could have come up with, can also be made objectively. While it is not a sign of quality and could in fact be considered the opposite, if we define creativity as a technique to come up with something genuinely new, then the statement that the designs could not have been developed by any individual alone, does have some relevance.

Does this suggest that there is an easy recipe for creativity? There is no reason to jump to such conclusions. It would be great if we did, but in fact it is not very likely. Our doubts that there could be such a thing as a fool-proof recipe for creating creative processes is actually confirmed by the theory of memetics. Following the pattern of expert knowledge we discussed before in this context, we can expect that as soon as such processes become the norm, the novel impulses they exert will wear, the production of proto-memes will follow standard procedures and the creative forces that can be reaped from them will ebb. For true creativity, there is no free ride.

7.2.5 Memetic Engineering as an ambivalent term

We have referred to these exchange processes as memetic engineering, arguing that they make practical use of memetic theory. Setting up a platform where more people can see and use the designs of other people is in itself an example of memetic engineering. And so is the systematic avoidance of pre-defined ideas in favor of reactions to a context someone else produced, that
these platforms led students to do.

Describing the case studies in such terms is not very nice, though. It sounds cold and manipulative. While we’re at it, so does the whole idea of memetic engineering. It suggests that there was a small group of teachers, using the students as guinea pigs in some large experiment, trying out new types of creative processes with them. This was not what the students experienced, nor was it what actually happened. But it cannot be completely discounted as a possible outcome of such a setup. So it’s good that memetic engineering doesn’t have a more positive ring to it. It’s good that it is a bit ambivalent. Any technical application of memetic theory should be met with a good dose of skepticism. Memetic engineering is only a good thing if it is combined with the other half of the title of this thesis: transparency.

7.3 Transparency in Information Architecture

In the following section we will discuss some possible ways how one might arrive at a definition of transparency in information architecture. One main reference of our considerations will be the well-known essay about transparency in architecture by Colin Rowe and Robert Slutzky (Rowe & Slutzky, 1997). As we have argued in chapter 5, there are good reasons to try whether architectural theories might be helpful to give us a better understanding of information architecture. Out of the broad spectrum of architectural theories that could be possible candidates we chose the essay on transparency, which we categorized as phenomenological. We will try to find out, whether there is an equivalent to Rowe and Slutzky’s phenomenal transparency in information architecture.

Before we look at transparency from this very particular angle, we take a more straightforward approach. The problem we arrived at on the basis of the case study evaluations was that it is not easy to create a level playing field for all designs in the course website. We recognized that the larger the websites get, the harder it is to keep an overview and to give equal exposure to the works it contains. If we want to enable memetic engineering without introducing unintended distorting effects, we have to tackle this very pragmatic problem. This is not a unique problem, but one that is very common and widely discussed in the web-design community. Thus we shall consider the course websites as ‘infoware’ and look at good practice models from the field of information visualization. Then we shall define and discuss the difference between transparency and usability. The case study websites will serve as examples to illustrate the different arguments.

7.3.1 Infoware

... And once you start thinking of web sites as applications, you soon come to realize that they represent an entirely new breed, something you might call an “information application”, or perhaps even “infoware”.
(O’Reilly, 1999)

The fact that there is something we might call ‘infoware’ as proposed by O’Reilly, is no longer news. Much of the research in the field of information visualization is focused on developing such interactive applications that give easy access to information. Information applications abound – on the internet and elsewhere.

There’s a wayfinding aspect to using such infoware, as there is to much of what we do online. So it’s not an accident that spatial metaphors about the Internet abound. It’s apparent in
the names of browser software (explorer, navigator), and in the way we describe the way we
‘surf’ the web: we visit websites, we go to forums, chat rooms. And of course: inexperienced
users easily get lost. In part this is due to the very nature of the internet, which doesn’t afford
the equivalent of complete maps or directories. But as far as it applies to individual websites,
users’ tendency to get lost has much to do with poor infoware design, or – as it’s also referred
to: bad usability.

Needless to say, the success of online ventures depends on good usability and there are
plenty of books about this topic. „Don’t make me think’ is the title of one such book (Krug,
2000). Do the obvious. Stick to conventions, standards. That’s what this title implies.

Much of the research about usability echoes this sentiment.

It’s probably safe to say that it’s a sign of good usability when users don’t get lost. But when
referring to applications of information visualization in a more general sense, not making users
think might not be the ultimate goal. There is a type of infoware that is successful precisely
when it does make one think, when it engages the user to learn and to come to new conclusions
by exploring different relationships between data.

For such applications transparency, rather than usability, is key.

7.3.2 Transparency vs. Usability

The two terms transparency and usability need not contradict each other. Often times they
are almost synonymous. Letting users concentrate on content rather than distracting them with
graphic bells and whistles usually serves well to achieve both transparency and usability, as
does placing links and buttons in obvious and predictable locations. Still there is a difference.

To optimize usability, the most important concern is to safely guide users along a path – say
from finding a book to ordering it online – as directly and easily as possible.

To optimize transparency on the other hand, the most important concern is that the users
don’t just follow a path, but that they understand the path they’re taking.

Let’s try a definition:

An infoware is transparent if it is structured in a way that makes it perfectly clear to
the user which types and quantities of information they can get out of it and how this
can be done.

This is a reasonable definition, but a rather general one that is not limited to infoware: by
this standard any ordinary phonebook would qualify. So it is hardly a definition we can be
content with. Can we make it more specific? Are there rules or first principles in the design of
information applications which allow us to make sure that they meet the above requirement
of transparency? Clearly, this is a question of design and as such one where easy recipe-like
answers are hard to come by. But we can turn to successful designers for advice.

7.2.3 The infoviz mantra

In their book on Information Visualization (Card et al., 1999), Card, Mackinlay, and
Shneiderman give a list of functions of information visualization that are essential in supporting
the foraging of data as part of the process of knowledge crystallization: “Overview, Zoom,
Filter, Details-on-demand, Browse, Search query” (Card et al., 1999, p. 10).

The list is complete and it has proven its value – it captures the essential wisdom they could
derive from their most successful projects. We will refer to it as the infoviz mantra.
The mantra is sound advice, something to keep in mind when approaching a new visualization project: Provide an overview first, let the user apply zooming and filtering mechanisms and display details only when needed, so they don’t clutter the view unnecessarily. Finally allow for browsing as well as search queries. It’s easy to see that this will make sense in a large variety of applications.

If we test the mantra on the case study websites, we find all of the functionalities listed in the mantra, though not necessarily in the same sequence. The websites start up with an overview not of all the works, but rather of the course, including schedule, background information, lists of teachers and students, exercise description, etc. Our focus will be on the display of the students’ works. To see the way these are shown in the different case studies, we have to consider the websites individually. In each case we will only look at the last (and most evolved) version of the websites.

**Phase(x)3 (see color plates 7 through 10, p. 85-88)**

- **Overview:** All assignments are listed in the horizontal menu bar. For each assignment all submissions are lined up in the bottom frame. Complete overviews of all works are provided with three different types of so-called outworld views. There is a 2D (fig. 9.1) and a 3D version (fig. 9.2-8) and a stand-alone outworld applet (fig. 10.1).

- **Zoom:** Zooming can be done in the 3D outworld view. Klicking on the small assignment previews in the bottom line-up or in one of the outworld views brings up the large version in the main window – this could also be considered as ‘zooming’ as this view also contains the neighboring works, but is rather a case of details on demand.

- **Filter:** The default bottom frame provides different sorting options, including time, popularity and group. Additionally there is an outworld.index (fig. 10.2), featuring a larger variety of listing modes: including by popularity, by keyword, by group, by assignment, by self-confidence. They all provide ways of arriving at individual works that can be shown in the main window. One can also list the authors and see all works of an individual author.

- **Details on demand:** The individual works in the main window, which can be accessed from all the mentioned viewing modes can be seen as the most detailed version of the works. It also offers a link to the comments made about the work and to the author and group it belongs to. The information about the individual authors in turn contains details about the authors performance throughout the semester (number of works, number of offspring these works had in subsequent phases, etc.)

- **Browse:** All of the viewing and filtering options are at the same time browsing mechanisms. As is the detailed view of an individual work which contains the links to its ‘parent’ and its ‘offspring’.

- **Search query:** As there is very little in the way of full text (only the comments and the keywords), no search query tools were available as part of the Phase(x) interface, only predefined searches for the different keywords. (fig. 10.2)

**Fake.space 3 (see color plates 31 and 34 through 36, p. 131-136)**

- **Overview:** The nodesystem (Player) is entered at the connector node. There are links to various other views, among them the outworld.map, outworld.sky, outworld.thread and
comment. Outworld.map starts with the most recently posted nodes, outworld.sky shows all
nodes in a radial array, outworld.thread lists all paths like in a comic. All of these views give
direct access to individual nodes that are shown in the player.

- **Zoom:** Zooming can be done in the outworld.sky. One can zoom into the graphical view of
the node system up to the point that the content of the individual nodes is shown (fig. 35.1-4,
fig. 35.5-7)

- **Filter:** The most diverse filtering mechanisms are in outworld.map, where filtering can be
done by time, node-type, topic, and alphabet (fig. 35.8-9). Outworld.sky also allows filtering
for different authors or groups which are highlighted in the overall view.

- **Details on demand:** Details of each node including statistics such as ratings and hits are
shown in the player, which also provides links to the author of the current work and the
previous and following nodes (fig. 31.5).

- **Browse:** The player is the primary browsing option, it also comes with an auto-play mode
that travels autonomously through the nodesystem. All of the viewing and filtering options
are at the same time browsing mechanisms, as they provide links to particular nodes that are
then shown in the player.

- **Search query:** There is a search query tool built into the outworld.map which makes it easy
to find particular texts in the pipe-nodes.

**Other Case Study Websites**

The VDS used a less sophisticated site, but has the same basic features as phase(x) (see
color plate 51, p. 163). EventSpaces has a rather more complete set than the other case studies.
Especially its messageboard and commenting function are more integrated (color plate 57, p.
181). To gain an overview of the evolving hyperstructure, we developed a java applet that can
show parts or all of the hyperlinked scenario-nodes (color plate 56, p. 174).

**Summary**

With some minor exceptions we find all the functionalities mentioned in the infoviz mantra
also available in the websites. Many of these browsing mechanisms aren’t self-evident and we
had to explain students how to use them. It’s safe to say, that they would not have scored very
high in a traditional usability test. But they incorporated the functions postulated in the infoviz
mantra very completely.

As we can see from testing it on the case study websites, the list of functions in the infoviz
mantra is comprehensive and general and can serve as a helpful checklist. But we also realize
that it doesn’t provide any rules or design guidelines. We can’t use it to detect design flaws.
What’s more: there are certain aspects it doesn’t address. Specifically it excludes any notion of
relationships between data, which can be seen as the structural aspects of information.

**7.3.4 Relationships between data**

We have seen that all the outworld views of the case studies in various ways give an overview
of the works or the nodes in the database. But more importantly they show how they are linked.
The case study websites are really remarkable for the many ways in which they let a user
explore the relationships between works, between people, etc.
This is particularly apparent in the various graphic outworld views, in which the lines connecting the individual works are visually at least as important as the nodes themselves. In the EventSpaces outworld applet the nodes can actually be rearranged by the user. They can be dragged around the screen so as to get a better overview. The only structurally fixed thing in this visualization is the connections between the nodes. This is not always an advantage. In fake.space we chose to fix the positions of the nodes in the outworld view, so as to make it possible for people to remember their positions. Since fake.space was so much about space and memory we also wanted to make it possible for people to visually remember a place in the outworld view. As a general strategy this is questionable because the nodes in a hyperstructure can theoretically be mapped in many different ways and there is no one single spatial arrangement that could claim to be the correct one. In both cases though, the one thing that does stays fixed is the connecting lines between the nodes. These connections can be said to be the primary providers of orientation.

Given the importance these relationships have in the case studies it seems curious that they are not mentioned in the infoviz mantra. So: is the mantra not complete after all? In the intention of its authors, the list we called the infoviz mantra is about the foraging of data during the process they refer to as knowledge crystallization. Since knowledge crystallization is about discovering relationships and patterns in data, it may make sense that the highlighting of relationships isn’t mentioned as part of this process, although one might actually argue about this. In the fake.space outworld when also the so-called tours, the second level of relationships between the data, are turned on, the legibility of the visualization suffers, yet these connecting lines add an evocative visual component. They make us aware of the additional patterns that may appear and can be visually explored, when related bits of information are displayed simultaneously.

7.3.5 “Patterns inherent in data”

Chapter 5 mentions Richard Saul Wurman’s three definitions of the new profession of information architect that he proposes in his 1996 book of the same name (Wurman, 1996). One of them is “the individual who organizes the patterns inherent in data, making the complex clear” (Wurman, 1996, on the jacket). In the introduction, Wurman also paints a vivid picture of why this new profession is so much needed: “There is a Tsunami of data that is crashing onto the beaches of the civilized world”.

The organization of the inherent patterns Wurman describes has to precede the design of information displays: only when the inherent patterns are found can an overview be given, can relevant and irrelevant information be separated, can the Tsunami of data start to have any meaning for us. The structuring of information is the prerequisite of its interpretation, one might say. But this opens up a classical hen and egg problem: the structuring is in itself already an interpretation. So the structuring has to be transparent as well.

The structuring of information, as Wurman defines it, is an architectural task. Therefore it is straightforward to turn to architectural theory for hints on how transparent information structures may be defined.

7.3.6 Phenomenal transparency

The term transparency has a tradition in architectural theory. In their famous essay “Transparency: literal and phenomenal” that was first published in the Yale Architectural Journal perspecta 8 in 1964, Colin Rowe and Robert Slutzky make what they refer to as the ‘perhaps pedantic’ attempt to ‘expose the levels of meaning with which the concept of transparency has
become endowed’ (Rowe & Slutzky, 1997, p. 22) in contemporary architecture. Their primary reference, however, is not from architecture, but from painting. They quote Gyorgy Kepes’ book ‘Language of Vision’, in which Kepes defines transparency as follows: “If one sees two or more figures overlapping one another, and each of them claims for itself the common overlapped part, then one is confronted with a contradiction of spatial dimensions. To resolve this contradiction one must assume the presence of a new optical quality. The figures are endowed with transparency; that is they are able to interpenetrate without an optical destruction of each other. Transparency however implies more than an optical characteristic, it implies a broader spatial order. Space not only recedes, but fluctuates in a continuous activity. The position of the transparent figures has equivocal meaning as one sees each figure now as the closer, now as the further one” (Kepes, 1944, p. 77).

Rowe and Slutzky write about the above quote: “By this definition, the transparent ceases to be that which is perfectly clear and becomes instead that which is clearly ambiguous.” They then go on to distinguish two types of transparency: the literal, or ‘see-through’ type, which they refer to as ‘a quality of substance’, versus the phenomenal one, which they call ‘an inherent quality of organization’ (Rowe & Slutzky, 1997, p. 23).

It should be rather obvious that the latter, phenomenal definition of transparency is of primary interest here. The literal or “see through” transparency is a topic in computer graphics, where photorealistic rendering and light simulations are concerned with calculating the ‘qualities of substance’. Literal transparency is also common in image processing, as well as in interface and screen design, where overlapping elements can be given an opacity value of less than 100%. Other than that, transparency as a quality of substance is of little interest for the organization of information in the digital world. Phenomenal transparency on the other hand, especially as defined as an inherent quality of organization, is interesting in our context.

Rowe and Slutzky first explain their distinction between the two types on transparency with respect to different paintings. In the second section, they move on to consider ‘architectural rather than pictorial transparencies’ (Rowe & Slutzky, 1997, p. 33). This invites confusion, as they contend, because “[…] while painting can only imply the third dimension, architecture cannot suppress it. Provided with the reality rather than the counterfeit of three dimensions, in architecture literal transparency can become a physical fact. However, phenomenal transparency will, for this reason, be more difficult to achieve; and it is indeed so difficult to discuss that generally critics have been willing to associate transparency in architecture exclusively with a transparency of materials.” (Rowe & Slutzky, 1997, p. 33)

Rowe and Slutzky show that phenomenal transparency can indeed be defined very rationally and clearly. Despite the esoteric sounding definition as ‘clearly ambiguous’, they manage to explain and define phenomenal transparency by way of example as a principle of spatial form-organization. To put it simply, Slutzky and Rowe show how cubic (or otherwise regularly shaped) forms and spaces can be overlapping and interpenetrating, so that zones and areas are created that are at the same time part of several spatial orders. In transparent organizations one can experience a “conflict between a space which is explicit and another that is implied.” (Slutzky and Rowe, 1997, p. 43) They also mention “equivocal sensations which derive from phenomenal transparency” (Slutzky and Rowe, 1997, p. 43). While the examples they use pit works by Gropius (particularly the Dessau Bauhaus) as bad examples against works by Le Corbusier as the good examples (a fact that almost prevented the text’s publication), these polemic aspects are not so essential.

As Bernhard Hoesli who was particularly fond of their essay and used it as the basis of his
pedagogy at ETH Zurich, puts it, the main importance of Rowe and Slutzky’s definition was its general nature: “To ask if there is transparency in a form-organization is like applying a piece of litmus paper” (Hoesli, 1997, p. 85). Hoesli also argued that it should be considered as a precise way for the study of architecture (Hoesli, 1997, p. 59) an instrument of design (Hoesli, 1997, p. 97).

Hoesli’s fascination with (and hope in!) the concept of transparent form-organization becomes manifest in the following quote:

“Since a transparent organization invites and encourages the fluctuation of multiple readings, and suggests individual interpretation, it activates and involves. The spectator remains not the observer “on the outside”, he becomes part of the composition through his participation. He enters a dialogue. He has to decide and in reading a façade, choosing one of several possible readings of the composition he is, at the same time, in his imagination, engaged in its creation.

If thus supremacy of the visual and its individual interpretation over the subjectmater is assured, then meaning could be a quality that comes into being through accruing, through sedimentation, and not “attached” to certain forms or motifs to which meaning is thought to be attributable by association or is believed to derive from precedent. Meaning can thus consist in the adhoc or repeated identification of the beholder with the object. Meaning then blossoms from personal involvement, it is created from the act of focusing on one of the possible readings of form relations that are latent, inherent or implied in the form-organization.

It is for these reasons that at a time of presumably pluralistic expectations, of contradictory wants, of individual needs and demands and the mannerist penchant for inversion and allusion, transparent form-organisation might be of particular value and should enjoy considerable favor where the desire to create inclusive form under contradictory conditions persists.”

Bernhard Hoesli in Rowe and Slutzky, 1997, p. 99

In our context it is obvious that the openness for individual interpretation and involvement that Hoesli describes is very much a quality that we seek to achieve in a transparent information-organization. Rowe and Slutzky derived their theory from the two-dimensional field of painting and applied it to the inherently three-dimensional field of architecture. The challenge is whether the concept could be further expanded to become meaningful in the multidimensional realm of information architecture.

7.3.7 “Clear ambiguity” in information architecture

Rowe and Slutzky’s definition of transparency as the condition of “clear ambiguity” can be understood as an openness of reading architectural spaces and elements as being part of multiple conceptual configurations. An equivalent of the multiple spatial readings of transparent architecture in the realm of information could be defined as the quality of providing “multiple simultaneous readings of the same information”.

Such multiple simultaneous readings are essential for information applications that are meant to give new insights, that present data in a way that new knowledge can be constructed and unforeseen conclusions can be drawn from it.

From discussing the qualities of the case study websites we have seen that one of their more
remarkable qualities is that they present the relationships between data, that they provide the works, which we have referred to as nodes or designs, with a context. On a simpler level we might say that the very fact that each of the projects has such a wide array of different viewing modes available is in itself remarkable. It is remarkable not as an end in itself, because, as we have pointed out many times, digital data can be displayed in countless ways, and the sheer quantity of different versions should not be seen as a quality of particular merit. What is however worth mentioning is that these various views of the data are available at the same time. Using the so-called frames-functionality of HTML, which allows several documents or data-views to be displayed side-by-side in one window, links from one window typically open up in another window next to it. For example if a design is displayed in the main window, with links to (among other things) its author above it, then clicking on this author-link will open the portfolio of this author, showing all the other works he or she produced in the menu-frame on the left, while the work and its parent and offspring are still visible. Clicking on one of those other works will in turn open the other work in the main window, with its parents and offspring left and right. So a user can navigate between the various views and always see the same information in several contexts: as works by an author, as the work in a sequence of successive designs or of a narrative, next to precedent and successors, as answer to a particular assignment definition, next to the works produced in this same assignment by other authors, etc. By navigating between these and other view of the database, switching between analytic overviews and detailed design views, the users can come to their own conclusions about the various qualities of a particular work.

Using HTML frames as a way to make these simultaneous views possible is obviously not something that the case studies can claim as an invention. While frames technology is rather uncommon in commercial websites, because it makes setting bookmarks confusing to people, using multiple parallel views is nevertheless a well-know and often used principle. In the information visualization (‘info-viz’) community it has become recognized as a specific field of investigation, commonly referred to as multi-views. Multi-views are particularly popular for exploratory applications. There is an IEEE conference on “Coordinated and Multiple Views In Exploratory Visualization”. In info-viz applications, such multi-views are typically coordinated and don’t contain hyperdocuments, but rather different types of visualizations that can be interactively controlled. So, multi-views aren’t exactly equivalent to the way frames are used in the case studies. But they clearly share some basic principle.

Similar approaches can also be found in software design. For example the makers of the program Maya describe their animation and special effects software as built on the principle of “nodes with attributes that are connected”. A hallmark of Maya’s interface is the possibility of viewing these nodes in many different ways, side-by-side. As this and other similar programs make clear, the principle of multi-views can not only be useful for exploratory, but also for design-oriented tasks.

7.3.8 Design guidelines for transparent online environments

The evaluations of the case studies made in this thesis showed that the online environments that were developed for these projects possess certain characteristics that qualified them as effective and unbiased exchange platforms. They enabled the exchange between students to transcend the boundaries of groups and the selection of works as part of this exchange happened in an objective fashion, as no evidence was found that either personal acquaintance or the design of the web-environments themselves did influence the selection students made in a
statistically relevant way. With reference to the definition of transparency in architecture given by Rowe and Slutzky, this quality of information-organisation is described as transparency in information architecture. The hypothesis put forward in this chapter is that if transparency is one of the key prerequisites in enabling large scale creative collaboration in architectural education, then with the help of the case studies, it is possible to define by way of example, what the nature of this transparency is or must be.

Based on the analysis of the relevant design features of the case study environments, the following tentative guidelines for the design of transparent online environments can be put forward. The information architecture of such online environments can be called transparent if it

- supports **multiple simultaneous readings** of the same information which can be configured interactively
- supports **outworld views** that give an overview and allow to visually analyze relationships between data
- states **authorship or source** or additional ways to contextualize data
- allows **custom filtering** of information
- **minimizes centralized editorial control**

**Guideline 1: Provide multiple simultaneous readings of the same information which can be configured interactively**

This guideline is directly derived from the phenomenal transparency as defined by Rowe and Slutzky. It is the most important guideline because it points out that information isn’t just there, it has to be read. This act of reading is actively performed by the user. The fact that there are multiple simultaneous readings available shows that transparency must have to do with openness and complexity and with individual interpretation. Providing multiple simultaneous readings is something that can be achieved by design, for example by using multi-views that can be changed and configured independently by the user. While Hoesli argued that providing these simultaneous readings could be an instrument of design and sometimes almost made it seem like a recipe that could be followed, the “equivocal sensation” that Rowe and Slutzky attribute to this act of reading also reminds us of the artistic aspects of phenomenal transparency. There is only so much that one can read simultaneously, thus multiple is not a call for making overly complex interfaces. Also the word simultaneously, which focuses on the temporal aspects, suggests an ease of use. The act of reading must happen fluently and at the pace of the user.

**Guideline 2: Provide Outworld Views that give an overview and allow to visually analyze relationships between data**

All case studies used outworld views. Their role was twofold: they were meant to give an overview and to provide specific analytical tools to explore the relationships between data. These relationships are primarily the links between the nodes or works. But other attributes such as size, color, position, proximity and datum, which are visually present can provide additional relational readings. Maybe with the exception of fake.space where the views were meant to be maps with memotechnical qualities rather than just information displays, the outworld views in the case studies were always one of many alternative ways in which the data could be viewed concurrently to comply with guideline 1.
Guideline 3: State authorship or source of any data and/or provide additional ways to contextualize data.

Tracking the changing authorship and source of the individual works was a key aspect of the case studies. Without it, the new models of collective authorship would not have become apparent. One of the advantages of the case studies was, that when a work was taken over from someone else, credit was given automatically. In the more recent courses at TU Graz, where a more complex model of giving credit has been implemented, the system has become more reliant on the students’ honesty. This is less perfect, but also a more realistic model. It can only work if a general standard of honesty and fairness is adhered to and if the community collectively watches over participants that don’t meet these standards. Besides fairness, stating the source of any work and its components is also an effective mechanism for quality control. When the works are contextualized, that is, when it is clear how they relate to the existing works in the database, it is much easier to judge their contribution. Ideally, thus, the stating of source and giving credit should be part of a self-regulating process that makes more objective assessment possible and that promotes responsible behavior.

Guideline 4: Allow custom filtering of information

All case studies offered various ways to filter the data: showing only the work for a particular assignment, of a particular author or group, or containing a certain term. In some cases, the filtering was also available as part of a graphic outworld view. The bigger the amounts of data to sift through, the more important effective filtering becomes. The most sophisticated filtering mechanisms of the case studies were implemented in the third fake.space class, as the students could choose between over a thousand nodes where they wanted to link to with their new narrative thread. In Phase(x) the number was at the most between a hundred and a hundred and fifty, so that filtering was much less essential.

Guideline 5: Minimize Centralized Editorial Control

This fifth guideline may sound like a call to anarchy, but it really has to do with trust and reliability on one hand and the free emergence of collective intelligence on the other. It points to the role the maintainers of such exchange platforms have to assume and again stresses the important role of the individual participant that was mentioned in the first and third guidelines. Ideally the users should feel in charge, they should never get the sense that they are being manipulated or controlled in ways they are not perfectly comfortable with. This is a challenge, because in fact it is inevitable that someone be given the system administrator’s rights and thus gain control over the student data. In a classroom setting, the right level of control is not so difficult to achieve. After all students expect a certain amount of control from their teachers. But even there, since the amount of data we were able to gather about the students was much greater than in any normal class, we had to communicate to the students that we did not intend to take advantage of this. Funny though it might sound, the fact that we were developing the websites during the classes and occasionally experienced bugs and malfunctions, actually seemed to build trust among the students. When we were struggling with the functionality and reacted to their suggestions how the website could be improved, it communicated that we were in the same boat, that we were ourselves learning, too. Had the websites been fully developed and running smoothly from day one, the perception might have been different.

Nevertheless, the danger that such websites can be used for surveillance and to intrude on the student’s privacy is real. We dealt with these questions in a playful manner in phase(x)3, where
Guideline 1:

*Provide multiple simultaneous readings of the same information which can be configured interactively.*

Fig. 59.1 *Fake.space* Interactively navigating the website with multiple simultaneous readings

Fig. 59.2 *Comparison: Understanding the works of Phase(x)2 with or without the Phase(x) interface*
**Guideline 2:**

*Provide Outworld Views that give an overview and allow to visually analyze relationships between data.*

fig. 60.1 Phase(x)2 3D Outworld view

**Guideline 3:**

*State authorship or source of any data and/or provide additional ways to contextualize data.*

fig. 60.2 Phase(x)2 2D Outworld and collective authorship

**Guideline 4:**

*Allow custom filtering of information.*

fig. 60.3 Fake.space3 Outworld.sky with highlighted group

**Guideline 5:**

*Minimize Centralized Editorial Control*

fig. 60.4 Eventspaces Outworld.applet
we evaluated the student’s performance graphically only to let them find a partner (someone with a similar success-profile) among the student body. The only time we received serious complaints from students was in the first EventSpaces class at the GSD, where students felt threatened by the peer-rating system we had introduced for them to compete for the credits of the final game. This event has mostly anecdotal character and was mainly caused by the fact that unlike their colleagues at ETH, the Harvard students received grades for their work in the class and therefore didn’t take this rating systems so lightly. Still it suggests that the more intricate and complex the working of a website, the more important it is to give a good explanation how it works.

While self-regulation can be a good thing in some cases, in others a clear responsibility is actually appreciated. Much like police on our streets, which most people take comfort in knowing that they wouldn’t be too far in case a crime happened, but whose presence they otherwise don’t want to feel, the keepers of such websites should themselves follow strict rules and use their power with utter restraint. Yet, whenever they would have to use it, the rules and the reasons why had to be clearly communicated.

The EventSpaces class was the one in which we took the open source idea of creating a common project collaboratively furthest. Minimizing centralized editorial control in that case meant also giving all individuals the possibility to gain an overview and thus to act responsibly for the whole.

Sharing information freely, yet responsibly, and giving a human face to the software developments we were undertaking, by discussing and explaining them during the classes, helped in creating a good atmosphere in the classes. As did the fact that we tried to make the websites as transparent as possible. To establish a collaboration among equals that take part in a collective process as self-confident designers, it is imperative that these authors are treated with much respect.

In order to make the students act independent and self-confident, the centralized editorial control should be as limited as possible. But when it is necessary, its actions should be quick and clear and shouldn’t disrupt the work flow of those unrelated to it. Clearly, it is something every website that promotes the personal expression of its users must wrestle with. Ideally as much of its editorial power as possible should be delegated to the social control mechanisms of the group. But finding the right measure between too much and too little control is not easy.

While we didn’t have any of the problems with profanity, pornography or illegal software distribution etc. that commercial social networking sites constantly have to deal with, and never had to set any strict measures, we nevertheless were always aware of the balancing act that being in the position of sysadmin represents in this case.

### 7.3.9 The dangers of transparency

If not to the same extent as ‘memetic engineering’, also the term ‘transparency’ can be seen in a negative light. This topic was just touched upon in the last section when the fifth point in the guidelines was discussed. If the transparency exists only for one side, it cannot claim to be phenomenal transparency in the sense it was introduced in this chapter. And just pointing to the fact that the students benefited from the transparency, like we did in the case of the fever curve applet, is hardly enough. To illustrate this point with a prominent example: The company Google is currently the leader in online search engine technology to the point that one might consider Google’s marketshare almost as a monopoly. Google can theoretically create detailed profiles of its users based on their search queries etc. Google claims that it is ‘not evil’ and
collects such data only in the benefit of the users, who will see adds that fit their personal profile etc. But who’s to say that that’s all they do with the data? Maybe a sixth guideline should take issue not only with centralized control, but also with the sheer quantity of data that one side – however well-intentioned and ‘not evil’ – should ever be allowed to access and control. But that would be a topic for another dissertation.

The definition and the guidelines for the development of transparent information architecture for creative collaboration needs to take power structures into account. Indeed, phenomenal transparency as a means of organising information can be characterized as strengthening and empowering the individual user as the weaker side in such a power struggle. True transparency, as it was defined here, cannot be established with a simple recipe. Just as true, that is unbiased and unmanipulative memetic engineering will not just come about automatically. Setting up and running environments for large scale creative collaboration via networks will always be a continuous balancing act and a struggle. But one of the hallmarks of transparent memetic engineering is that while enabling us to learn faster from each other and to have new ideas as a collective, it is always in line with the needs of the individual.
8 Conclusion

This thesis discussed case studies that were carried out with over 600 architecture students between 1996 and 2000. The work that started then has continued since. The thesis spans across over twelve years of continuous work and across a variety of academic fields, ranging from computer aided architectural design to information visualization, from memetics and psychology to architectural theory. To bring all these topics together was daunting and at least in part responsible for the long time it took to complete it. Throughout the work, the author was aware of the danger such a trans-disciplinary undertaking that touches on so many different fields entails. No doubt, some arguments made in this thesis will seem rather simple minded or primitive to the respective specialists. They might even take offense at the ignorance or the cursory way their field is treated. It is hoped that the reason why all these different topics needed to be brought together however imperfectly in making what the author believes to be the coherent argument of this thesis for a social understanding of creativity and for the application of architectural thinking when dealing with information, is, as a whole, convincing enough.

There is much that remains to be done. As we enter the age of ubiquitous computing and people can share and exchange information ever more rapidly and easily, the possibilities for creative collaborations are becoming greater than ever. The greater the possibilities, the greater also our awareness needs to be of both the potential benefits and of the ways in which these developments could go wrong. By providing and analyzing workable, concrete examples of successful memetic engineering and of transparency, it is hoped that this thesis indeed provides some of both types of awareness.

Memetic engineering, understood here not as the manipulative shaping of ideas in other people’s heads, but as the pragmatic application of what we know so far about how ideas can spread and evolve in a culture, is a topic not only of popular debate, but of utmost relevance for the globalized information age economy. The case studies that were analyzed in this thesis are quite old by computer science or Internet age standards. But they are still rather unique in their approach and scope as practical applications of memetic engineering. Most of the discussion is about the flow of the memes, the way they are handed on from person to person, rather than their content and how that content changed over time. Thereby this thesis stands in contrast to most writing about memetics, which tends to focus on what memes are and how they shape the way we think. While these questions were also addressed to some extent, the main basis of the arguments made was the empirical evidence gained from the case studies. By focusing on the empirical evidence of those propagation processes, the thesis aims to bring hard facts and statistical findings to a field that so far has been mostly speculating and arguing about its own existence. Memetic engineering of the type that this thesis presents can be described in pragmatic, technical terms as methods in information architecture. More work is needed to refine and expand these methods. More experimental applications of the theory, more rigorous evaluations of its results, so that ultimately indeed the content of the memes can take center stage.

Transparency, the other half of the title of the thesis, likewise needs future research. The design
guidelines that were derived from the case studies’ information architecture need to be tested and possibly refined or extended in an evolving technological arena. Creative collaboration as a special case of memetic engineering will continue to gain importance as a method to create genuinely new things. And transparency in information architecture is a prerequisite of any creative collaboration that takes the individual contribution seriously. A special twist may be that in the age of ubiquitous computing the distinction between transparency in architecture and transparency in information architecture that this thesis makes might actually get somewhat blurred.

What has fascinated the author about the theory of memes as well as Rowe and Slutzky’s essay on transparency in architecture is the simplicity and clarity and the neutrality that both concepts possess. They open up a way to see the world that is compelling and yet does not get in the way of other ways of seeing it. But their clarity is not only evocative and intellectually intriguing, it is also productive. Both are theories that can be applied to read and interpret as well as to plan and change the world. How digital technology can be employed to make us more creative, how computers can help us to think up and create new things collaboratively, whether we can develop these possibilities further while keeping them in tune with humanist ideals – these are some of the deeper questions and concerns behind the thesis.

Finally one more issue should be brought up. In describing and discussing the works in the case studies the author was taking on the double role of co-creator and critic. This is unusual and not an ideal scenario. While every attempt was made to bring scientific rigor and objectively testable criteria to the evaluations, there is no question that this double role had some influence on the way these evaluations were set up and interpreted. On the other hand no one but one of the projects’ authors would have been as qualified to carry out these evaluations. While they were process evaluations after the fact this time, the tools and methods developed for these evaluations might well become truly formative instruments in future projects. Given the richness of the results the evaluation yielded, maybe this double role is not so problematic after all?

One of the author’s intentions as an architect and a teacher was to write about the reflective application and testing of what can broadly be called a theory of design. The thesis was meant to demonstrate that the holistic thinking of our discipline is, while not limited to, also not adverse to rigorous scientific discourse and statistical analyses. The results of these analyses add meaning and substance to their object of study. They can enrich and broaden our understanding and inform future acts of design. Yet one should not forget that such analytical enquiries owe their very existence to the act of design that preceded them. Had we not set out and applied our ideas in concrete projects, by trying things out and making them work, there simply wouldn’t have been anything to analyse. Ironic though this might sound at the conclusion of a thesis that was all about dissecting and analysing, the author would be happiest if the thesis encouraged others to develop projects along these lines, if it would inspire more frogs to get built rather than dissected.
Acknowledgements

When the topic is large scale creative collaboration, the contributions of many people need to be acknowledged and thanked. While largely unrelated to the work presented in this thesis I first want to thank my colleagues at the institute of architecture and media at TU Graz who have had to put up with my being absorbed in finishing this thesis. Likewise my family has not seen so much of me lately. My double obligation of being a professor and a doctoral student has not been an easy experience for those around me. I thank both my family and my colleagues for their patience and support and pledge to be more available again from now on.

As for the work described in this thesis, my thanks go to the team that made up the chair for Architecture and CAAD back then. The chair was extraordinary in its international diversity of talents and backgrounds, but even more so in its enthusiasm and ‘just do it’ mentality. I always felt privileged to be among this group and am deeply indebted to all of them, especially to Gerhard Schmitt, whose farsighted leadership and guidance of this creative group can hardly be overestimated and to Maia Engeli, Bharat Dave and Leandro Madrazo, who were my inspiring teachers before they became my colleagues.

For writing this thesis, I am most thankful for both the clarity of his criticism as well as the nagging insistence to get my act together and finish of my mentor Gerhard Schmitt. Equally invaluable were the comments and suggestions of my correferent Edith Ackermann. I don’t know whether this dissertation is as good as she thought it could be, but it certainly is much better than it would have been without her.

For the inception of the projects presented in this thesis, especially Florian Wenz and Fabio Gramazio must be singled out. Florian Wenz took the lead in developing the first websites of Phase(x) as well as fake.space. The whole memetic approach was his idea more than anybody else’s. Fabio Gramazio’s clear thinking and creative spirit were a main driving force behind all further developments of the projects. Among other things he programmed the fake.space outworld.sky and the Phase(x) outworld.applet, which won us an honorary mention at Ars Electronica 1999. The idea of applying Slutzky and Rowe’s text on Transparency to these projects he and I developed together. All the other co-teachers made invaluable contributions to the development as well. Patrick Sibenaler programmed the first versions of the outworld views in Phase(x). Maria Papanikolaou developed the websites of Phase(x) and fake.space further, bringing in contextual information like motivation and themes, as well as the commenting functions. Bige Tuncer, Cristina Besomi and Daniel von Lucius developed and contributed to the content of the courses and assignments and were competent teachers. David Kurmann’s legendary program Sculptor was an important asset for the VDS projects, but also for many other teaching projects of the chair. Without Eric van der Mark’s wizardry, the complex multi-location video-conferences and recordings of the first VDS project would just not have happened. Among our VDS partners, Branko Kolarevic, who initiated the first project and brought the international partners together and Dirk Donath, who initiated the second one for which he invited me to Weimar, deserve special mention. Kerstin Höger joined the team for the EventSpaces courses, where she quickly established herself as a highly motivated team member with many fresh ideas. Benjamin Staeger and Michele Milano programmed the bulk of the EventSpaces website, the most ambitious of all of the projects and did so admirably. Benjamin Staeger is the author of the EventSpaces outworld applet as well as the fevercurve applet of Phase(x) and he developed the intricate javascript functionality behind the EventSpaces game editor and player. Some of Michele Milano’s solid database programming code for the EventSpaces project is still in use.
at TU Graz, today. The two of them were most memorable as the proficient ‘ETH taskforce’ at Harvard. Also Harvard-ETH connections (or connectors?), George Liaropoulos-Legendre and Jeffrey Huang both added their distinctive contributions to the development of the projects. Special thanks also go to Albert Wiltsche for helping me with the probability calculations. Besides these key contributors there were many more who helped bring these projects about. They include all the other members of the chair who provided assistance and valuable inputs and suggestions – much more than could be listed, here.

It is especially important to include the students in this acknowledgement. This is more than just a symbolic act. Without their work and talent these projects simply wouldn’t exist. The students were the reason for the development of these educational experiments, but they also provided their very substance. More than a few of them have since built impressive careers and become well-known. I don’t want to insinuate that any of their later successes have much to do with their enrollment in these courses. But I am proud to have once been their teacher and grateful for the work they have done with us.

The following listings include only the main case study projects, not the follow up projects that are only briefly touched upon in the text. Here they are, students and colleagues, project by project:

**Phase(x)**

- **Team:** Prof. Gerhard Schmitt, Urs Hirschberg, Fabio Gramazio, Florian Wenz, Patrick Sibenaler, Maria Papanikolaou, Bige Tuncer, Cristina Besomi, Benjamin Staeger, Daniel von Lucius


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Luca, Kevin Luginbuehl, Marco Malacarne, Christof Messner, Andre Meyerhans, Maja Mileticki, Bruno Moser, Blanka Klara Oplatek, Vito Pantalena, Luigi Piogia, Reinhard Prikoszovich, Cornelia Quadri, Jürg Rauser, Roger Aldo Reibke, Ayanah Rosenfeld, Philipp Rössl, Gian Enrico Salis, Barbara Schicktanz, Robert Schneider, Irene Schutz, Oliver Schwartz, Sandrine Schweizer, Sonja Verena Seibel, Nadja Shui Hwa Tan, Samuel Sieber, Anita Simeon, Andreas Skambas, Veronika Steiger, Marcel Studer, Martin Teichmann, Allemann Thomas, Cordula Todtenhaupt, Marco Tondel, Andrew Vande Moere, Peter Völki, Anders Wadman, Peter Wehrli, Thomas Weiss, Marc Wiedmer, Sacha Wiesner, Oli Winkelr, Luca Zaniboni, Miriam Zehnder, Martina Zumühle.

**Students Summer Semester 1999:** Angela Adam, Nicol Appelmann, Franz Äschbach, Enis Basartangil, Daniel Baur, David Belart, Matthias Berke, Christian Binda, Michael Bruttel, Alex Buechi, Andreas Buschmann, Corina Cadisch, Tanja Dilger, Aimee Fach, Tamara Fontana, Stefan Gantner, Marc Gerber, Jens Giller, Sebastian Greim, Henrik Hansen, Verena Hartmann, Adrian Hatzfeld, Valerie Heider, Roland Herpel, Georg Hümbelin, Brigitte Hutter, Fabienne Kienast, Erhard An-He Kinzelbach, Steffi Knebel, Harald König, Anna Locher, Jeannette Luehne, Robert Munz, Sabine Panis, Philipp Reichen, Roland Josef Rossmaier, Stephanie Sandmanzer, Eva Schäfer, Markus Schietsch, Marcus Schmitz, Andreas Schröder, Oliver Schwartz, Dade Serwalzer, Marc Sigrist, Tom Stemmer, Bence Szerdahelyi, Majo Todorovic, Daniela Tomaselli, Gilberto Von Allmen, Ulrich Hofmann Von Kap-Herr, Stefan Winkler, Beatrice Wölner-Hanssen.

**Fake.space**

**Team:** Urs Hirschberg, Fabio Gramazio, Florian Wenz, Maria Papanikolaou, Bige Tuncer, Cristina Besomi, Benjamin Staeger, Daniel von Lucius


**Students Summer Semester 1998:** Haag Anton, Daniel Appenzeller, Oliver Bachmann, Sybille Baur, Regula Bosshard, Christian Brost, Maud Tamara Cassaignanu, Tim Delhey, Daniel Dittmar, Andrzeig Egli, Beat Ferrario, Barbara Frei, Michelle Friederici, Yvonne Fung, Anique Fung, Piogia Gigi, Beate Grulich, Markus Haas, Tim Häberlin, Bettina Halbach, Sascha Hottinger, Manfred Huber, Simon Kempf, Irene Kessler, Thomas Kovari, Jan Kujanec, Kevin Luginbuehl, Christa Marx, Helmut Matterne, Oliver Menzhi, Mathias Neumüller, Joerg Nix, Franka Oelmann, Martin Otto, Torben Pundt, Ayanah Rosenfeld, Daniela Saxer, Caspar Schärer, Barbara Schlauri, Marc Wilke, Markus Wyremblewsky.

**Students Winter Semester 1998:** Jean-Pierre Anderon, Mirjam Artho, Urs Brändlin, Stephan Britschgi, Matthias Bürgel, Christoph Burkhardt, Alba Carint, Pascal Cavegn, Savvas Ciriacidis, Benjamin Cortesi, Daniel Dalla Corte, Marco Dell Aquila, Michael Dom, Maria Dziguelewski, Dirk Feltz-Süssenbach, Hartmut Friedel, Antoine Frieders, Gallus Gächter, Peter Gallas, Tobias Geissbüher, Andr Gerber, Sebastian Greim, Andrea Gubler, Isabel Gutzwiller, Tim Häberlin, Hanjo Hautz, Verena Henne, Ulrich Hofmann Von Kap-Herr, Christine Hölzel, Dominique Huber, Rebekka Huber,
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Georg Hümbelin, Robert Hunziker, Hans Rudolf Jegerlehner, Nicole Karagiannidou, Erhard An-He
Kinzelbach, Steffi Knebel, Megumi Komura, Ivana Kordic, Stefanie Losacker, Nicole Mader, Lins
Maria, Negussu Mengstu, Michael Mix, Volker Mosch, Karin Mousson, Jörg Müller, Frank Müller,
Robert Christian Munz, Ingmar Nebel, Luigi Piogia, Marc Pointet, Robert Pompe, Christina Reschke,
Hanna Rybarczyk, Stephanie Sandmann, Tobias Schaffrin, Marcus Schmitz, Stephan Schöller, Annika
Schröder, Stefan Schwarz, Davide Servalli, Marc Sigrist, Judit Solt, Annette Spindler, Marion Spirig,
Tom Stemmer, Anna Maria Tosi, Christian Verasani, Reto Vincenz, Pantalena Vito, Philipp Vogt,
Gilberto Von Allmen, Hanns-Jochen Weyland, Esther Wicki, Julia Wienecke, Barbara Wild, Monika-
Ewa Wisniewska, Christoph Wyss, Yumiko Yamaguchi, Michael Zwygart.

Virtual Design Studio

• **Team ETH:** Prof. Gerhard Schmitt, Urs Hirschberg, Fabio Gramazio, David Kurmann, Eric van der
Mark.

• **International Partners:** Branko Kolarevic, Marc Aurel Schnabel, Hong Kong University, China. Brian
Johnson, University of Washington, Seattle, US. Jerzy Wojtowicz, University of British Columbia,
Vancouver, Canada. Dirk Donath, Ernst Krüfjff, Bauhaus Universität, Weimar, Germany.

• **Students VDS Multiplying Time, November 1997:** Hong Kong: Siu Man Michael Au, Sze Wang
Frankie Chan, Wai Man Cheung, Pak Hon Eric Leung, Chi Hang Yvonne Luk, Siu Hong Ryan Ng,
Yee Hang Arthur Tong, Lai Kei Yeung, Chi Kwong Timothy Au, Wai Kwong Colin Chan, Yuen Ming
Mary Chan, Chi Kit Benson Lee, Hing Ponl Jimmy Luk, Wai Leung Danny Wong, Kei Yau Jason
Yung. Zürich: Spiro Margaris, Steffen Lemmerzahl, Thierry Musy, Immanuel Dan, Reneta Arpagaus,
Reneta Deubelbeiss, Boris Dudesek, Silvia Weibel, Andrea Doeberlein, Anton Haag, Angela Deuber,
Claudia Salzmann, Daniela Haeni, Isabella Aurich, Ernst Krüffjff, Heinz Rempfler, Alex Vucenovic,
Vancouver/Seattle: Joost Houwen, Ali Shakarchi, Agata Malczyk, Antonieta Rivera, John Curtis,
George Hideg, Yagi Kentaro, Brandon Nicholson, Delft: Bart Akkerhuis, Paul Amoksi, Axel Karcher,
Martijn Stellingwerff, Roland Herpel, Jan Pieter Den_Hollander, Victor Voogd, Amin Amin, Paul De
Ruiter, Henry Jg, Ernst Kiksen, Thomas Wim Struobach,

• **Students VDS place2wait, November 1998:** Hong Kong: Chung Yan Ricky Chan, Kin Kwok
Stephen Chan, Shek Lun Conan Chan, Siu Chuen Vincent Chan, Wing Chuen Edmond Fung, Sze
Man Celia Hsin, Lai Yip Jerry Kwok, Lucy Lee, Lo Ming Leung, Chi Luen David Lok, Chi Fai
Jeff Ma, NgaY Audrey Mak, Ka Yiu Yo Yo Ng, Wai Lam William Wong, Yu Wai Henry Wong.
Weimar: Timo Riechert, Robert Grapentin, Stefan Friedrich, Albrecht Glaeser, Bastian Nowotnick,
Frauke Dirkens, Holger Gaumitz, Jan Sandleben, Maren Protz, Mona Steinke, Klaus Grether, Katja
Seydel, Astrid Roenicke, Albrecht Glaeser, Ina Wegmershaus, Mandy Weiser, Ramona Sernow, Sandra
Juwig, Christian Hoeiger, Joerg Burkhardt, Astrid Roenicke, Sandra Juwig. Vancouver/Seattle: Joost
Houwen, Ali Shakarchi, Todd Ethan Ashton, Judy Cheung, Ge Wang, Susanne West, Doohhee Zhong,
Chris Macdonald, Sora Key, Misun Chung, Ruediger Karzel, Brant Fetter

EventSpaces

• **Team:** Urs Hirschberg, Fabio Gramazio, Kerstin Höger, Michele Milano, Benjamin Stäger

• **Partners/Co-Teachers:** George Liaropoulos-Legendre, Jeffrey Huang, Harvard University Graduate
School of Design.

• **Students EventSpaces I, ETH Zurich:** Claudia Bauersachs, Jeanette Beck, Matthias Berke, Dominik
Bossart, Philippe Bürgler, Katrin Büsser, Petr Chrysta, Christa Diener, Elisabeth Dill, Thomas Fässler,
Karin Fehr, Lukas Fehr, Nils Fehr, Susanne Fritz, Martin Fuchs, Ueli Gadient, Andreas Germann,
Daphne Gondhalekar, Henrik Hansen, Arndt Jagenlauf, Dimitri Kaden, Silke Lang, Oliver Luetjens,


**Illustration Credits**

**color plate 4**

4.1 Alexander Zumbrunnen  
4.3 Leo Bierry  
4.5 1_01_41 by space118 (Yves Guggenheim)  
4.7 1_03_16 by space09 (Momoyo Kaijima)  
4.9 Patrick Chladek  
4.11 Daniel Marc Overhoff  
4.13 3_01_45 by space100 (Thomas Schmid)  
4.15 3_04_2 by space114 (Michele Malfanti)  
4.17 Patrick Deschwanden  
4.19 Armin Vonwil  
4.21 5_01_11 by space22 (Lukas Marti)  
4.23 5_03_19 by space27 (Oliver Leder)  
4.25 2_01_90 by space09 (Momoyo Kaijima)  
4.4 Leo Bierry  
4.6 2_03_12 by space107 (Michel Cordey)  
4.8 2_03_16 by space100 (Thomas Schmid)

**color plate 5**

5.1 Benjamin Geebelen  
5.3 Daniel Marc Overhoff  
5.5 7_03_16 by space02 (Florence Leemann)  
5.7 7_01_7 by space100 (Thomas Schmid)  
5.9 Peter Habegger  
5.11 Benjamin Geebelen  
5.13 Maximilian Ofner  
5.15 Dorthe Nielsen  
5.16 9_04_3 by space09 (Momoyo Kajima)  
5.18 9_03_25 by space113 (Julian Cotton)  
5.20 p_10_04_23 by space89 (Ch. Loppacher)  
5.21 10_03_29 by space22 (Lukas Marti)  
5.22 6_01_17 by space104 (Sabine Kaufmann)  
5.24 6_03_43 by space72 (Christoph Reinhart)  
5.25 8_03_2 by space106 (Christoph Heck)  
5.26 8_04_3 by space05 (Pascal Voillat)  
5.28 10_03_16 by space104 (Sabine Kaufmann)  
5.29 10_03_29 by space22 (Lukas Marti)
REFERENCES

color plate 11
11.1 p_1_0_35 by space050 (Bence Szerdahelyi) 11.2 p_1_0_34 by space038 (E. A. Kinzelbach)
11.3 p_1_0_43 by space043 (Sebastian Greim) 11.4 p_1_0_31 by space119 (Matthias Berke)
11.5 p_1_0_46 by space025 (Georg Huembelin)
11.6 p_2_35_28 by space072 (Daniela Tomaselli) 11.7 p_2_34_12 by space014 (Aimee Faeh)
11.8 p_2_35_20 by space043 (Sebastian Greim) 11.9 p_2_31_37 by space025 (Bence Szerdahelyi)
11.10 p_2_46_19 by space115 (Majo Todorovic)

color plate 12
12.1 p_3_28_9 by space011 (Eva Schaefer) 12.2 p_3_20_54 by space076 (Marcus Schmitz)
12.3 p_3_40_35 by space114 (Philipp Reichen) 12.4 p_3_24_23 by space078 (Henrik Hansen)
12.5 p_3_19_16 by space025 (Georg Huembelin) 12.6 p_4_10_4 by space040 (Tom Stemmer)
12.7 p_4_5_11 by space077 (Tanja Dilger) 12.8 p_4_44_37 by space020 (Markus Schietsch)
12.9 p_4_5_35 by space044 (Robert Munz)
12.10 p_4_16_24 by space037 (Jeannette Luehne) 12.11 p_4_16_17 by space025 (Bence Szerdahelyi)

color plate 13
13.1 p_5_11_20 by space051 (Oliver Schwartz) 13.2 p_5_11_21 by space078 (Henrik Hansen)
13.3 p_5_17_4 by space094 (B. Woelner-Hanssen) 13.4 p_5_11_49 by space016 (Jens Giller)
13.5 p_5_17_12 by space061 (Anna Locher) 13.6 p_6_20_12 by space087 (Marc Sigrist)
13.7 p_6_6_27 by space037 (Jeannette Luehne) 13.8 p_6_4_28 by space025 (Georg Huembelin)
13.9 p_6_20_3 by space094 (B. Woelner-Hanssen) 13.10 p_6_12_29 by space114 (Philipp Reichen)

color plate 14
14.1 p_7_27_38 by space020 (Markus Schietsch) 14.2 p_7_27_23 by space040 (Tom Stemmer)
14.3 p_7_23_16 by space061 (Anna Locher) 14.4 p_7_29_18 by space025 (Bence Szerdahelyi)
14.5 p_7_29_14 by space078 (Henrik Hansen) 14.6 p_8_14_5 by space038 (E. A. Kinzelbach)
14.7 p_8_6_4 by space051 (Oliver Schwartz) 14.8 p_8_4_1 by space115 (Majo Todorovic)
14.9 p_8_10_10 by space050 (Bence Szerdahelyi) 14.10 p_8_14_2 by space094 (B. Woelner-Hanssen)

color plate 32
32.1 82: motionlotion by space081 (Pirmin Amrein)
32.2 53: home12 by space012 (Tobias Geissbuehler ,noah‘)
32.3 130: Zwischenstation by nds9804 (Frank Mueller ,frankomania‘)
32.4 15: come in to relax by space091 (Alessandra Wuest)
32.5 314: bildbild by space082 (Stephan Britschgi ,brit‘)
32.6 321: Aussicht by space083 (Hanns-Jochen Weyland ,Ich bin da‘)
32.7 427: garden opening by space072 (Pascal Cavegn ,Neuromancer‘)
32.8 397: voyeur inconnu by space056 (Erhard An-He Kinzelbach ,:-)‘)
32.9 1085: im anflug by space129 (Sebastian Greim ,Alexboy‘)
U. HIRSCHBERG: MEMETIC ENGINEERING AND TRANSPARENCY

32.10  1205: zu Tom by space041 (Verena Henne ,gummiadler‘)
32.11  801: calbar3 by space026 (Marc Pointet ,bara‘)
32.12  361: subobscura by space073 (Reto Vinzenz ,vince‘)

32.13  1212: interfacefondue by space051 (Ulrich Hofmann von Kap-Herr ,bart‘)
32.14  1264: cookies’ncream by space084 (Annette Spindler ,cosmic girl‘)
32.15  1154: translation by nds9802 (Daniel dalla Corte ,DAL‘)
32.16  964: uyo by space087 (Joerg Mueller ,york‘)

color plate 33

33.1  1343: silence by space042 (Isabel Gutzwiler ,t??l?)
33.2  1257: abDOMEn by space073 (Reto Vinzenz ,vince‘)
33.3  1373: trans2 by nds9809 (Monika-Ewa Wisniewska ,spaced‘)
33.4  1358: space cookies go by space084 (Annette Spindler ,cosmic girl‘)

33.5  725: Knockout by space094 (Gallus Gaechter ,nski‘)
33.6  729: benebelt by space094 (Gallus Gaechter ,nski‘)
33.7  1255: spiegel by space012 (Tobias Geissbuehler ,noah‘)
33.8  1229: ...more... by space031 (Georg Huembelin)

33.9-18 Tour ,Yeats‘ by nds9802 (Daniel dalla Corte ,DAL‘)
33.9  1294: water1 by space014 (Stefan Schwarz ,haus‘)
33.10  801: calbar3 by space026 (Marc Pointet ,bara‘)
33.11  1333: more water, dive by nds9802 (Daniel dalla Corte ,DAL‘)
33.12  366: night by space012 (Tobias Geissbuehler ,noah‘)
33.13  1094: Vernetzung by space027 (Robert Christian Munz ,asfd‘)
33.14  1200: air by space057 (Hartmut Friedel ,praenz‘)
33.15  1048: strich by space042 (Isabel Gutzwiler ,t??l?)
33.16  996: whirl by nds9805 (Hanna Rybarcyk ,Hanna‘)
33.17  494: gruener nebel by space120 (Nicole Mader ,elocin‘)
33.18  1299: the cave by space072 (Pascal Cavegn ,Neuromancer‘)
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Appendix

Using the Analysis Outworld tool

The Analysis Outworld tool can be found on the CD accompanying the thesis. It should run on any platform. It only requires a Flash Player (version 8 or higher) to be installed on the system. The larger datasets can take a while to load - depending on your computer Flash may open an alert, asking whether it should continue to run the script. Click Yes.

Authors

Authors sometimes include students as well as teachers. Authors can also be selected by clicking directly on a node or on one of the >IN or OUT> buttons. They can be looked at one by one, using the arrow buttons. To go directly to an author with a known number, select the current number and enter a different one.

Works

Works are shown as dots in the main display. They can be selected by directly clicking on them. Clicking once turns the thread on, clicking twice, also turns the branches on. Clicking a third time de-highlites all connections. Works can also be looked at one by one, using the arrow buttons. To go directly to a work with a known number, select the current number and enter a different one.

Patterns

Patterns are Threads with repeating authors. Clicking on the Patterns button, turns them all on together. They can be looked at one by one, using the arrow buttons. To go directly to a pattern with a known number, select the current number and enter a different one.

Threads

Threads are unique Sequences of connections. There are fewer threads than works. They can be looked at one by one, using the arrow buttons. To go directly to a thread with a known number, select the current number and enter a different one.

Reload

Loads / Reloads the dataset in the selection menu

Show all

Turns all connections on

Clear Lines

Turns all connections off

Toggle dots

Turns dots (works) off - sometimes this looks better, but the works can no longer be clicked on

>IN / OUT>

Turns Connection leading to or away from a work on or off. Using the Next >IN etc. buttons one can look at all authors one by one in this way.

Parent

Follows a thread to its origin. Only available when a work is selected. Using the 'Back > Child' button, one can return to the work where the function was first used.

Groups

Turns Connections of an entire group on: klicking once: >IN, second click: OUT> third click: >I/O> . Fourth click: all turned off again. Works the same for the gender buttons.
Probability Calculations

Probability $P_1$ that a student chooses $d$ designs by the same student out of a number of $s$ students in $ph$ phases. There are $s + 1$ students and $ph + 1$ phases in total.

$$P_1 = s \text{ binomial}(ph, d) \left( \frac{1}{s} \right)^d \left( \frac{s-1}{s} \right)^{(ph-a)}$$

Probability $P_2$ that a student chooses $d$ designs by the same student and $e$ designs from a second student from a number of $s$ students in $ph$ phases. There are $s + 1$ students and $ph + 1$ phases in total.

$$P_2 = s (s - 1) \text{ binomial}(ph, d) \text{ binomial}(ph - 2, 2) \left( \frac{1}{s} \right)^d \left( \frac{1}{s} \right)^e \left( \frac{s-2}{s} \right)^{(ph-a-b)}$$

These formulas return the following values for the different phase(x) courses (compare table on page 114)

<table>
<thead>
<tr>
<th>Phase(x)</th>
<th>students (s)</th>
<th>phases (ph)</th>
<th>$P_1$ (d=2)</th>
<th>$P_2$ (d=2, e=2)</th>
<th>$P_1$ (d=3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase(x)3 ss99</td>
<td>59</td>
<td>7</td>
<td>29.69%</td>
<td>5.35%</td>
<td>0.94%</td>
</tr>
<tr>
<td>Phase(x)2 ws97</td>
<td>140</td>
<td>8</td>
<td>19.16%</td>
<td>2.01%</td>
<td>0.28%</td>
</tr>
<tr>
<td>Phase(x)1 ws96</td>
<td>114</td>
<td>9</td>
<td>32.68%</td>
<td>5.28%</td>
<td>0.61%</td>
</tr>
</tbody>
</table>

Authorship References

To put the real names of the student authors rather than their aliases in the text would have seemed inappropriate in the context of a scientific study. In order to nevertheless provide the possibility to identify any author’s work, this section lists the author names for all aliases used in the projects that can be found on the color plates or in the Analysis Outworld tool.

- **Phase(x) ws96**
  - space01 Loward, Christine
  - space02 Leemann, Florence
  - space03 El-ariss, Balsam
  - space04 Schmid, Patrick
  - space05 Voillat, Pascal
  - space06 Meyer, Anja Barbara
  - space07 Hollenbach, Aline Sidonie
  - space08 Frey, Mark
  - space09 Kajjima, Momoyo
  - space10 Beyer, Matthias
  - space11 Roeschert, Stefan
  - space12 Mueller, Patrick
  - space13 Rihs, Sandra Margarita
  - space14 Mueller, Beat
  - space15 Van Eldijk, Barry
  - space16 Teppert, Horst
  - space17 Jentsch, Stephan
  - space18 Muench, Andreas
  - space19 Krieger, Markus
  - space20 Haeberli, Hans Peter
  - space21 Neubauer, Julia
  - space22 Marti, Lukas
  - space23 Kuepfer, Sibylle
  - space24 Daellenbach, Claudine
  - space25 Lorenz, Peer
  - space26 Nigsch, Sandra
  - space27 Leder, Oliver
  - space28 Cetkovic, Aleksandar
  - space29 Aebnerhard, Beat
  - space30 Spekenbrink, Roelof
  - space31 Waechli, Philipp
  - space32 Hofer, Remy
  - space33 Brunner, Sandra
  - space34 Trebo, Nadja
  - space35 Voigt, Tabea
<table>
<thead>
<tr>
<th>Name</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taraz, Schirin</td>
<td>Schuetz, Roland</td>
</tr>
<tr>
<td>Schlatter, Jan</td>
<td>Wu, Wei</td>
</tr>
<tr>
<td>Lienhard, Reto</td>
<td>Ulliana, Martin Stefan</td>
</tr>
<tr>
<td>Noureldin, Mirjam</td>
<td>Schmid, Thomas</td>
</tr>
<tr>
<td>Bergier, Julian</td>
<td>Wiesner, Sacha</td>
</tr>
<tr>
<td>Rey, Reto</td>
<td>Rehm, Tobias</td>
</tr>
<tr>
<td>Schmeink, Karen</td>
<td>Moscatelli, Fleur</td>
</tr>
<tr>
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  - Schneider, Maike
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Curriculum Vitae

Personal
Name Urs Leonhard Hirschberg
1966 born in Zürich
German Nationality
1990 married with Christina Hirschberg-Dorn, Cellist
three children

Professional
01.04 - Dean Faculty of Architecture, TU Graz
01.04 - Director Institute of Architecture and Media, TU Graz
09.02 - Full Professor Graz University of Technology
01.00-12.02 Assistant Professor Harvard Graduate School of Design, Cambridge
08.00 Visiting Lecturer Bauhaus University, Weimar
02.99 Academic Fellow Hong Kong Polytechnic University
04.98-02.00 Lecturer for CAAD, ETH Zürich
05.96-12.99 Partner Seenetz GBR Internet Consulting und Design
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