IN THE MAKING

An Investigation into Creation in Art, Design, Architecture and Technology

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IN THE MAKING – An Investigation into Creation in Art, Design, Architecture and Technology has been produced in the context of the doctoral program (PhD [Dr. phil.] in Art and Media Studies) at the Academy of Media Arts Cologne.

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Copy-Editing: Tom Ashforth
Cover photo: Zahra Mohammadganjee
Design: Zahra Mohammadganjee, Somayyeh Shahhoseiny
Printed by: Druckerei Köller + Nowak, Düsseldorf

Published by:
Verlag der Kunsthochschule für Medien Köln
Peter-Welter-Platz 2
50676 Köln, Germany
+49 (0)221 20189 213
verlag@khm.de
http://verlag.khm.de

A digital edition is available open access at https://e-publications.khm.de

ISBN 978-3-942154-62-8

Kunsthochschule für Medien Köln
Academy of Media Arts Cologne

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Introduction

Georg Trogemann
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This book is an interim report on a series of ongoing dissertation projects at the Academy of Media Arts Cologne. Its title fulfills a double function. Like any book title, *In the Making* primarily points to the content. The publication addresses various issues related to poiesis, i.e., the forms of knowledge that become active when we make, create, invent, or produce something. In this case, however, the title also says something about the actual state of the works presented. The contributions are reports from doctoral projects that are halfway through, i.e., still being (re-)searched, experimented, and reflected on. Their final statements and final form have yet to be developed. A particular difficulty arises from the situatedness of these particular research approaches. The doctoral candidates have an artistic-creative background (design, art, musicology, film), but their questions and topics reach deeply into other scientific disciplines. This specific starting point deserves a closer look.

If one wishes to characterize the approach of the works gathered here, two terms come to mind: *artistic research* and *transdisciplinarity.* Since the research presented has been developed out of the artistic practice or at least the artistic interests of the respective author and since the evolving questions are dealt with in the context of an art academy, it seems self-evident to assume that this is artistic research. However, this still means entering difficult territory, especially in Germany. Artistic research is a buzzword in an ongoing

debate that evokes both euphoric approval and vigorous disapproval. This begins with the difficulty around even defining it. Different actors in the field use the term with different meanings and intentions. In its recommendations for the postgraduate qualification phase at colleges of art and music, the German Council of Science (Wissenschaftsrat) points out that views on artistic research are varied. They range from the assertion that "any kind of artistic activity is per se a kind of research" (Wissenschaftsrat 2021, 51), to the statement that what one sees here is a great opportunity for "bringing artistic research into academia as a critical trojan horse in order to rethink and revise the standards and research culture of all academic disciplines" (Cramer and Nienke 2021). Simultaneously, however, there are a number of approaches that seriously seek to distinguish artistic research from scientific research on the basis of clear criteria.

In fact, procedures and discursive processes that strive for findings that are, for example, repeatable, verifiable, discussable, and thus analogous to the sciences, have always existed in art. Artistic research, as a self-initiated and self-organized practice acting reflexively with regard to both the medium used and the interrelationship between subject and medium, is nothing new in this sense. What is reasonably new is the institutionalization of the term and the emergence of internationally established programs with which academic degrees for artists are associated. Anyone in Germany who ventures to call their artistic practice artistic research today is still moving in difficult terrain with heated disputes that are primarily about the interpretive sovereignty of scientific standards. Thus, in the current debate, artistic, art theoretical, and philosophical issues have become closely entangled with educational policy goals and general demands for change in art, science, and society. In this context, however, it must also be noted that the situation in design or architecture is quite different from that in the fine arts, for example. In the above-mentioned recommendations, the German Council of Science proposes a compromise that forms the lowest common denominator for a very broad understanding of artistic research. According to this, artistic research is characterized by three features (cf. Wissenschaftsrat 2021, 55):

1. Approaches to artistic research are oriented towards answering a concrete, explicitly formulated question. The answer, however, does not necessarily have to be a verbalized or textual one but can take a general artistic form.
2. There is an aspiration to communicate the insights gained and to make them usable within the discourse of an artistic community.
3. Artistic research also seeks to have an effect on other social, political, or scientific discourses and, conversely, also refers to bodies of knowledge outside the arts.

Artistic research thus presupposes a question that has been precisely formulated linguistically, but remains completely free with regard to the strategies and media used in answering it. Artistic research also interferes with discourses outside the arts, but its goal is not primarily rational knowledge and insights, but experience and interpretation. At the same time, artistic research always remains self-referential, i.e., it strives for the further development of art or of artistic practices and forms of expression.

The center of each work collected in this book is also constituted by explicitly formulated questions that narrow down the subject matter. As is usual for research processes, the specific questions had not been precisely and ultimately determined when the doctoral candidates started to develop their theses. By working on the respective topics, application scenarios always shift, theoretical findings change perspectives, what was initially important recedes into the background, and what was initially secondary gains in importance, so that the central questions and methods develop their contours only gradually and with time. In contrast to the artistic research described above, not only the initial questions in this publication, but also the answers and the methods, are based on scientific criteria. Equal emphasis is given to coherent argumentation and to adherence to the linguistic and stylistic standards of scientific work. Thus, for example, the fair and appropriate handling of secondary sources and the ideas of other scholars obviously require citations that conform to academic rules. In this respect, the contributions

basically function as attempts and exercises by art and design students to practice scientific reasoning and writing, along with all the difficulties they face as inexperienced authors of scientific and academic texts. Nevertheless, the articles do not simply represent artistic research informed by the criteria and stylistic devices of science. The authors did not shy away from delving eagerly into the unknown and unforeseeable terrains that encompass their respective fields of interest and thus intentionally put up with "getting their hands dirty" as one paraphrased in his text (cf. the text by Christian Rust in this book). Since their occupations as artists, designers, coders, and programmers are rather practice-based, their theoretical reflections often turn out unique and at times unconventional in style and language: ignoring some rules of written language here and there, sometimes escaping the strict framework of grammar, and occasionally bending the norms of scholarly conduct, the different essays are written in the spirit of experimentation. They provide examples of research within the arts, conducted by artists who aim to break open and reconnect different disciplines, thus expanding not only their own artistic practice but also our cultural practices in general. While experiences made in practical action can be described and analyzed linguistically, the experience itself cannot be conveyed in text. Experience only reveals itself in practical action. Guy Bonsiepe summed up this insight for the field of design as follows: "You don't create a theory of design just by dwelling in the discursive space and reading texts…" (2021, 286; translated by the authors). In this sense, the approaches pursued in this book aim to change practices and perspectives as a way to open up new spaces of experience. Therefore, instead of speaking of artistic research—and in order to define the different contributions and their research objects and methods in greater detail—it appears more appropriate to speak of transdisciplinary research.

Jürgen Mittelstraß has developed and differentiated the concept of transdisciplinarity in various publications since 1987 (see e.g. "Methodische Transdisziplinarität"). He states:

> Innovative research, i.e., research defined by the search for the new, is decreasingly taking place in the cores and disciplines of subjects, i.e., where textbook knowledge also resides, but more at their margins, between different subjects and disciplines and their connections with each other. (2008, 4; translated by the authors)

While, according to Mittelstraß, interdisciplinarity means a concrete cooperation for a certain period of time and towards a certain goal, transdisciplinarity means that the cooperation leads to an ongoing scientific systematic order that changes the subject and disciplinary orientations themselves. It represents a form of research and work in science that becomes especially necessary when extra-scientific problems are to be solved. Mittelstraß mentions environment, energy, and health as examples of lifeworld problems (*lebensweltliche Probleme*) that do not owe their existence to scientific issues. The adequate description of a lifeworld problem in all its facets and consequences, such as the occurrence of the coronavirus, requires approaches that go beyond the perspective of a single discipline, such as medicine in the case of COVID-19. Transdisciplinarity is effective where disciplinary approaches fall short and no longer do justice to the problem. It also reminds us that subjects and disciplines do not have natural boundaries, but ones developed historically and more often based on institutional habits than scientific necessities. Subject and disciplinary constrictions are therefore removed in transdisciplinary research wherever they stand in the way of appropriate research action. This raises questions concerning the kind of problems that can only be answered unsatisfactorily in disciplinary terms, and where transdisciplinarity can lead to fresh and inspiring new ways of looking at things and actions.

As mentioned at the beginning, this is a publication about poiesis, which derives etymologically from the ancient Greek term ποιεῖν (to make). In Greek philosophy, *poiesis*, in contrast to *theory* and *praxis*, stands for purposeful action. Poietic knowledge is *techne*, i.e. action aimed at bringing forth something new, guided by proper planning. Poiesis, then, asks about the forms of thinking, planning, and acting that become active when humans make something. A work, a product, a

thing that was not there before and that, once brought into the world, exists for itself and comes into effect. The model used in Greek philosophy was that of handicraft. In the world of Socrates, the cobbler brings a material object, the shoe, from non-being into being by imprinting a different form on the material leather with his hands so that it can fulfill the intended purpose of protecting the feet. The fact that the cobbler can do this is his or her technique. A romantic image from today's point of view. The hand as a central human tool has lost its importance in the course of industrialization. Today, the conditions and techniques of manufacturing are characterized by the automatic processing of formalized knowledge and global flows of materials, goods, and information while the actual production is largely automated. In industrialized nations, materials have long since been processed by machines rather than human hands. Paradoxically, the ability of society as a whole to produce and operate complex technologies is constantly increasing while individuals are increasingly limited in their possibilities to produce something with their own hands, or even to secure their own survival. It seems as if actual making is delegated more and more to the machine or the networked technical milieu whereas all that remains for the human being is the *planning* of the making, i.e., the organization of the knowledge necessary for production processes. Manufacturing is increasingly limited to providing and disseminating the information necessary for the actual production, which is then carried out by machines. According to the Aristotelian theory of action, practice (politics, art, meditation) was reserved for the free citizens, while poetic action was assigned to craftsmen and slaves. Hence, in our consideration of poiesis, we are talking about an area of society that used to be entrusted to slaves and that is now largely automated and executed by machines. We suppose that, today, the forms of our poetic action are characterized by problems that cannot be solved in a disciplinary way, but only transdisciplinary. One example that helps to explain this situation in more detail is climate change.

Although policymakers had already declared climate change the greatest challenge facing global society in the twenty-first century in the early 2000s, little has happened since then. Climate change is attributed to

so-called greenhouse gasses (carbon dioxide [CO2], methane, nitrous oxide, fluorinated gasses, etc.) in the atmosphere. The reason for the increasing emission of these gasses is the technical activity of humans in the past 250 years. Enormous amounts of carbon dioxide and nitrogen oxides are produced by burning coal, gas, and petroleum during energy production. Deforestation for the use of raw materials and for the production of agricultural land means that the climate-regulating effect of forests is lost while nitrogenous fertilizers produce additional nitrogen oxide emissions. The enormous consumption of regenerative and non-regenerative resources is another problem. Meat production not only emits large amounts of climate-damaging methane but also consumes enormous amounts of water, land, energy, grain, and many other resources. Furthermore, the technologies of industrial societies depend on the permanent extraction and consumption of non-renewable fossil and mineral raw materials, which, after often only short periods of use, produce mountains of mainly long-lived and highly toxic waste. Over centuries, human interference with nature has added up and has now reached a scale where the consequences can no longer be ignored or denied as they once were. In December 2019, the European Parliament declared a climate emergency and called for immediate action to limit the effects of climate change. Through the so-called Green Deal, the EU aims to achieve climate neutrality by 2050 at the latest. Energy supply, agriculture, transport, and all industries must be fundamentally transformed to achieve this. Anyone following the discussion may be surprised—or rather shocked—to learn that the Green Deal is seen primarily as a financial problem. The economic system itself is not being questioned by politicians. They wish to solve the problem without noticeable impositions on citizens. Social—i.e. financial—compensation takes precedence over climate protection. What can we learn from this example? Above all, it shows that our disciplinary divisions are unable to deal properly with the complex problem, even though we are aware of the drastic consequences. From the point of view of politics, business, and large sections of society, climate change is merely an annoying side effect of an industrial production system that is otherwise considered very efficient and secures

our prosperity. The classic relationship between means and ends is disturbed by the unforeseen and the unintended, and this needs to be repaired. Ironically, the same constellation of technology and science that caused the problem, along with political measures, is now supposed to solve it. But a superficial correction will not do. A lack of knowledge is obviously not the problem, rather, we all act against our better judgment. We know very well that long-haul flights for short vacations, SUVs for city transportation, excessive meat consumption, and rampant plastic packaging are not only insane, but also do massive damage to the environment. Sober, scientific analysis of the situation is apparently not enough to change the actions of individuals. What is needed is a fundamental societal transformation that goes far beyond minor adjustments of our private consumption or the way politics addresses the problem as a triad of technology, science, and business. The thesis underlying the works collected here is that we need to bridge the gap between theory and action, and in this process develop other narratives about human entanglements with technology: narratives that allow for more empathy with the nature of poiesis. Climate change is currently the most visible proof that industrial societies have not yet intellectually mastered technology at all. As a global super-problem, it demonstrates the explosive nature of our technical actions. It is only recently that we have begun to think seriously about what it means to create our own living conditions by technical means and to settle down in this technically generated reality. We are also beginning to realize that poiesis precedes cognition. What we can know about the world changes to the extent that we technically produce our living environment. Not only has a serious consideration of the relationships between means and ends been greatly neglected, but the ends themselves have been superficial and often determined solely by economic reasoning. The poietic action that brings new things into the world must become aware of its power. It is not sufficient to always only deliver new ad hoc solutions to technical problems or develop further technologies solely based on markets. Rather, it is important to reflect more fundamentally on our technical thinking and actions, to question them and, first and foremost, to integrate them culturally. We have

to acknowledge that there are general limits to our planning, control, and predictive capabilities and that we need new approaches and new understandings of human poietic action. But are alternative approaches to technology, to design, and to development even possible any more? Can we imagine alternatives or are we already stuck in the technological and intellectual traps we have built for ourselves? What might new and different teaching methods in the fields of technology, design, or architecture look like? How could they provide a better understanding of the enormous significance and cultural consequences of our poetic actions?

These very fundamental questions about poiesis form the background of this publication and delineate the working contexts from which the respective contributions evolved. We are convinced that the social issues of technology, design, and architecture can no longer be solved in a disciplinary way. There is an asymmetry between the developments of societal problems and the disciplinary solutions proposed. The field of science and technology studies (STS), for example, is concerned with the nature and practice of science and technology and their impact on the environment as well. STS also assumes a strong interaction between technology and society and examines how society, politics, and culture influence scientific research and technological development and, conversely, how these influence political, social, and cultural thought and action. However, STS still constitutes an outside analysis of technological development. In contrast to such a perspective, we regard the separation of the humanities from the natural and technical sciences as one of the main causes of the problem. Consequently, the basic point is to abolish the separation of doing and thinking, of action and reflection. Of course, this only indicates the direction in which this publication points heuristically. A book like this cannot solve political issues or provide new and definite proposals for solving problems like the climate crisis. Rather, the idea and hope is to inspire readers to consider and practically experiment with approaches that enable us as technicians (poets, artists, designers, architects, etc.) to reflect on our own actions and see them in an overall cultural context.

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Creation as experiment

A pragmatic approach to being in the world

Christian Rust

Abstract
Building on the foundations of cybernetics and philosophical pragmatism, I argue for aesthetic experience and physical interactions in the (art)world without the necessity of viewing the world first and foremost with analytical eyes. I suggest the actual use of matter and tacit knowledge in the tradition of craftsmanship and a specific kind of artistic research as an addition to analytical approaches. This will be investigated through the guiding line of philosopher Andrew Pickering's interpretation of poiesis as a "doing without knowledge." I consider those thoughts relevant not only to art and media studies, but to any kind of interacting with the world, be it creating one's own experiences in everyday life or enabling such experiences for others through teaching.

Introduction

Both philosophical pragmatism and cybernetics are often based on a process ontology, meaning that the world is not at all static and predictable but constantly changing. Accepting this assumption, we need a concept that enables us to still interact in a meaningful way with our surroundings without the necessity to first analyze and theorize everything. Andrew Pickering's poietic "doing without knowledge" will provide the basis for such a concept in the following explorations. From pragmatism I am borrowing the concept that action comes before knowledge and every theoretical endeavor must be viewed with regard to its practical value. I will show that by interacting with the world, while engaging in such a doing and partially giving up control and considering certain agents as so-called black boxes, there is knowledge to be gained that cannot be obtained in any other way. The early teaching methods at the Bauhaus will constitute one example of how to enable others to gain this kind of knowledge through personal experiences. A certain kind of artistic research based on philosopher Henk Borgdorff's well-known classification will be offered as an alternative method for art and media studies rather than artistic practice. The examples of artists David Alfaro Siqueiros and Volkhard Stürzbecher will illuminate the differences between artistic and scientific practice and language. They clarify why artists do not gain as much from collaborations with the sciences as they might think or as the traditional and institutionalized version of artistic research proclaims. Finally, I will stress the necessity of gaining one's own personal experiences, experimenting, and getting one's hands dirty by introducing the artist Susi Sie as my main example. The arguments and results of this article are not only relevant for art and media studies, they can also be read as a general critique of the lack of exploration resulting in personal experiences in many parts of the humanities, teaching methods in schools and universities, and personal life.

Setting the playing field for performance

I often find myself caught up in my own head, overthinking, planning, analyzing, gathering all the information I can find on a cer-

tain topic. Way too often, however, I do not even start to actually *do* something with all this accumulated knowledge, although I put a lot of planning into it. I fall into a trap of "ifs" and "maybes" and tend not to put my ideas into practice. The reasons for this and my resulting frustration will not be the topic of this essay; a general lack of acting in different fields will be.

The rather analytical approach to being in the world outlined in the paragraph above is not limited to (my) personal life. It is also apparent in parts of art and media studies, teaching and modern communication. These days, there is a lack of doing, experiencing, and tinkering. Instead, people binge through endless offerings in the form of movies, series and YouTube, spending time on Instagram or TikTok, and watching concerts attended personally through the screens of smartphones. They are not able to build, create, or craft anymore. We are consuming culture through the perspective of others and experiencing the world through the eyes of influencers. In a way, we are distancing ourselves from real and own experiences.

I am very aware of the very thin (philosophical) ice I am treading on with such a perspective and the use of the term *real*. I am also very aware of examples such as the maker scene, which is pointing in the opposite direction. So, let us step back from the frozen lake and try to rest on some safer and less provocative ground.

In the light of the aforementioned process ontology, and even without, some questions just cannot be answered and not every outcome can be predicted. Circling a problem purely analytically does not necessarily get you closer to a solution. At least not through reading, analyzing, contemplating, and not getting into the subject itself. Imagine you want to throw a dice. Statistics tell you the chances of throwing a six or the chances of any other possible number. Unfortunately, that does not help at all in predicting the outcome of your single throw. You could build a highly sophisticated machine that, calculating and measuring all the necessary parameters, might throw exactly the number you want it to throw. But you alone would never be able to do the same. You probably do not have the means to build such a machine in the first place and therefore would still

have to try to analyze the situation down to its tiniest details in hope of gaining some insight. Maybe you do not even bother to throw it since you already know all the possible outcomes anyways. Maybe some highly valued theoretician, regarded as an expert in the field, wrote that throwing dice is just a waste of time and you chime in with his 400-page analysis. Or you could simply skip all those steps, just throw the dice and see what happens.

Andrew Pickering offers an alternative perspective to strictly analytical ways of solving problems in science and art through his interpretation of poiesis when he argues "that to get to grips with poiesis we need to think first not about knowledge, but about performance and agency, about doing things in the world" (2017, 1). He interprets poiesis as a "doing without knowledge" (2). This concept of poiesis might offer a way out of one's head, a different way of interacting with the world and first and foremost a doing rather than a cognitive analysis. This "doing without knowledge" will be the basis and guiding line for the following investigations. I shall therefore elaborate a little further on Pickering's perspective. Having a background in physics, Pickering often refers to scientific examples and positions art in relation or opposition to scientific doing. Coming from philosophical pragmatism and being heavily influenced by the UK branch of cybernetics, especially in the likes of Stafford Beer and Gordon Pask, he discards Cartesian dualism and representationalism and proposes "science as a mode of performative engagement with the world" (2011, 19), a "nomad science" (2009, 1), where one acts in an "ontological theater in which the artist himself has no definitive knowledge of how the work will behave and instead sets in motion processes of unpredictable emergence" (2016). In this cybernetic version of science, "the emphasis is on performative action with the object to be known […]. What Pask adds is that cyberneticians learn in general about their objects in just the same way: they interfere with them as much as possible in an exploratory fashion to see what they will do, with each observation provoking new, situated interferences" (2011, 344). This may sound counterintuitive from a traditional scientific perspective. At first glance, a mere physical

interaction with the world instead of using analysis, reflections, and representations, does not sound too promising as a path to knowledge. Pickering follows the cybernetic tradition when he writes that "performance is not necessarily about knowledge, and that when knowledge comes into the picture it is as part of performance" (2011, 381).

It seems as if there are two opposing approaches in Pickering's explanations above: a performative one he favors and a more traditional one in the vein of Western science and its quest for analytical knowledge. The former approach already suggests that I can find out something about the world simply by interacting with it and experiencing how it reacts to my doing. This connection between or distance from knowledge and *doing* requires some additional investigation.

Getting a grasp

The performative view is neither something Pickering invented nor is it new in the arts or sciences; it is also present in other fields. I recently watched an interview with the Aikido teacher Yoko Okamato as part of the documentary *Fokus Japan*. The interviewer, attending one of her training sessions, seemed puzzled about the fact that Okamato was not saying a word and still everybody seemed to know exactly what to do and when to do it. Asked about how she is able to teach without talking, Okamato answered that "nature and all the beautiful things surrounding us cannot be explained. They are simply beautiful. One has to see and feel them. One has to experience them" (Rohr 2018). With her training it is exactly the same. "There is nothing to explain. I throw them, and they have to feel it." Okamato's approach to training illustrates nicely what Pickering means by "performative engagement with the world."

In a way, it is like one of the first things children do to interact with their surroundings and build their understanding of the world, an approach adults often seem to have forgotten about. Interestingly, language offers many examples for this alternative way of gaining knowledge. The German term *begreifen*, for example, is synonymous with

understanding but also incorporates *greifen* which means "to grip/grasp." In English *getting a grip/getting a grasp (of something)*, i.e., understanding something or taking control, also incorporates *grip/grasp* as a physical activity. We build our understanding at least partially through physically interacting with the world and without the necessity of analytically wrapping our heads around the subject matter first. We literally get in touch with it. There is no planning needed, sheer interest and curiosity are enough. And, as the term *begreifen* further suggests through its meaning, interacting with the world simply through performance still can result in gaining knowledge. Performance and knowledge do not have to be in opposition. But what kind of knowledge can be gained through performance? When I press down a key on a piano, it will create a sound. This results in the knowledge *that* the piano creates sounds, but not necessarily the knowledge *how*. From then on, I will assume (i.e., I will *know*) that pressing down keys on a piano will result in the production of sound.

Such a doing in the world can also lead to another kind of knowledge that does not fit under the umbrella of inductive reasoning as in the piano example above: tacit or embodied knowledge. Chemist and philosopher Michael Polanyi uses the example of riding a bicycle and keeping balance in his book *Personal Knowledge*. You could certainly analyze all the necessary movements to achieve this (at first) seemingly impossible task. You could probably exactly explain why and when one will lose balance and what exactly has to be done to prevent this from happening. "But does this tell us exactly how to ride a bicycle? No. You obviously cannot adjust the curvature of your bicycle's path in proportion to the ratio of your unbalance over the square of your speed" (1962, 51). This analytical knowledge is irrelevant for actually riding a bike. It does not help. You cannot learn how to ride a bike by reading a book about bike riding. Even if you read all the books about bikes, about the necessary physics and human biology, you would most certainly still fail on your first ride. And if, after mastering bike riding, you were asked how you do it, you would probably fail again in explaining exactly what you are doing in order to not fall off the saddle. It

is a knowledge, or skill, that you do not have and seemingly do not need analytical access to. One could go even further and state that for the task at hand, the analytical knowledge about the necessities of actions gets in the way of solving that task.

There is yet another kind of knowledge related to performance, neither analytical nor skill based, that points in a similar direction and is specified in the following questions: How would one describe what sand feels like to a person who has never been exposed to sand? Or, what about the famous scene in the film *Good Will Hunting* where Sean asks Will about the smell of the Sistine Chapel? "If I asked you about art, you'd probably give me the skinny on every art book ever written. Michelangelo, you know a lot about him […]. But I bet you cannot tell me what it smells like in the Sistine Chapel. You never actually stood there and looked up at that beautiful ceiling" (Van Sant 1997). Will has read everything there is to read about Michelangelo and memorized it. He seemingly knows everything there is to know about him and his works. Still, something is missing. And this has nothing to do with the fact that maybe everything has not yet been written down. It has to do with the assumption that through experiencing something, being there, you gain a kind of knowledge that cannot be gained in any other way. Just as Will would have to visit the Sistine Chapel to really experience it, to smell it, and to feel it, you would also have to really encounter sand to gain this kind of knowledge. You have to feel the sand in your hand, trickling through your fingers, to actually experience sand and know what it feels like.

This understanding of knowledge as something that must be experienced to make it your own has also been used in teaching. *The New Vision* by artist and Bauhaus teacher László Moholy-Nagy is a text that documents the teaching of the pre-course at the Bauhaus and is just one prominent example of such a method. Moholy-Nagy's goal was to give a guideline, leading students to their own personal experiences (1947, 11). He wrote about very basic exercises in handling different materials, allowing those personal experiences and leading to a way of *begreifen*: "The student, in his initial exercises, studies materials principally by means of

his sense of touch" (23). Moholy-Nagy describes this kind of experience/knowledge explicitly as something that cannot be found in/through books. This sums up the examples of *Good Will Hunting* and Michel Polanyi nicely. You do not have to know what you are doing analytically and still are able to interact meaningfully with the world around you and even generate new knowledge by doing so—knowledge you cannot achieve in any other way. In short, you get to know the material world by interacting with it. However, I am not proposing to entirely eliminate the analytical method. I am merely arguing that it is not necessarily the best approach for every single situation, and it leaves out personal experiences and the knowledge they enable us to gain. Besides providing alternative or additional approaches to science and teaching, "doing without knowledge" also contains a description of some activities immanent in art as the following example illustrates.

In 1936, David Alfaro Siqueiros held a workshop about experimental painting techniques in New York, which was attended by Jackson Pollock. Siquerios found out that pouring layers of different colored paint on top of each other resulted in unexpected but fascinating patterns. This technique can be seen in some details of his painting *Collective Suicide*. In a letter to his girlfriend, he emphatically described his discovery as follows:

> It is about the use of accident in painting… a special method of absorption of two or more superimposed colors that infiltrate one another to produce the most magical fantasies and forms that the human mind can imagine…Something comparable only to the geological formation of the earth, to the polychrome veins and multi forms of the mountains… This organized thing that emerges from the mystery of who knows what laws, terrifying in their depth…Above all a tumultuous dynamism, of a tempest, of a natural and social revolution that at times causes terror. ([1936] 1996)

Only if we do not know the inner workings of the processes responsible for this generation of forms, if we are not able to predict the details of the outcome, can such happy accidents happen and surprise us. In a paper published in 2015 with the rather bulky

title "A Hydrodynamic Instability Is Used to Create Aesthetically Appealing Patterns in Painting," Sandra Zetina, Francisco A. Godínez, and Roberto Zenit analyzed Siqueiros method and came to the following conclusion:

> In summary, we have shown that the Rayleigh-Taylor instability is responsible for the generation of patchy and spotted patterns that appear in the paintings of Siqueiros where the accidental painting technique was used. We have shown, by conducting controlled experiments and by an instability analysis, that the density disparity between the different paint layers drives the instability and produces textures with aesthetic value. Understanding the flow physics can help conservationists and artists. (2015)

Although I will not go into detail comparing this to Siqueiros' words, one has to keep in mind that both texts, despite being presented in completely different languages, are describing the same process, obviously from very different perspectives. One focuses solely on doing and experiencing and the other argues analytically/scientifically. From an artistic perspective the latter is lacking a lot. From a fluid dynamic perspective, the first one is useless. I do not think that understanding fluid dynamics helps artists interested in using the kinds of patterns created by Rayleigh-Taylor instabilities and therefore object to the scientist's conclusions. Artists only need to know that a certain effect will be the result of a certain action. They do not need to know how this process can be explained in scientific terms. Or, as business academic Russel Belk wrote referring to Hans-Georg Gadamer's claim that there is truth/knowledge to be found in art equal to that of science: "The position taken by Gadamer is similar to the conclusion […] that science is able to convey knowledge about a phenomenon, but art […] is able to convey knowledge of an experience" (1986, 23).

Black boxes

Another important concept in Pickering's performative approach and in cybernetics is that of the black box. He describes a black box as "something that does something, that one does something

to, and that does something back—a partner in, as I would say, a dance of agency [...]. Knowledge of its workings, on the other hand, is not intrinsic to the conception of a Black Box—it is something that may (or may not) grow out of our performative experience of the box" (2011, 20). The basic assumption for the concept of a black box is that a complex system showing emergent behavior or chaotic dynamics cannot be fully understood in the sense of exactly predicting its outputs. Therefore, one should consider it as a black box and not even bother taking a look inside, and just engage with it performatively. As described above, knowledge may or may not come as a byproduct of interacting with the world. But it is always action before knowledge and not the other way around. Interacting with such a black box—and in the example of Siqueiros, the pouring of layers of different colored paint can be seen as such—results in a shift of agency. As soon as you are not the only acting force and there is a partner in this "dance of agency," a partner that you cannot or do not want to fully control, you give up at least part of your own agency, you give up control over the outcome and become one element in a feedback system. As Pickering puts it, this "reciprocal coupling of people and things happens in time, in a process that I called, for want of a better word 'mangling'" (2011, 19). Interacting with black boxes therefore results not only in uncontrollability, at least to some extent, but also in unpredictability.

One example of seemingly giving up control in an art context is provided by the experimental composer Brian Eno and his generative music. Eno sums up his work process as follows: "I set up situations that involve abandoning control and finding out what happens" (Jeffries 2010). Some may find it scary not being in control over the outcome of their actions, not knowing what exactly a certain process may result in or how it is doing what it is doing. For Pickering "an anthology of unknowability, as one might call it" and addressing "the problematic of getting along performatively with systems that can always surprise us" is the most interesting aspect (2011, 23). This element of surprise is often the reason for artists to use such techniques and processes in the first place. Letting the

system generate outputs the artist might not even have thought of or to easily create variety in a certain space of possibility laid out by the composer leads to a different kind of interaction with a system. Eno, as quoted above, was looking for exactly this kind of endless variety in his generative music. “My kind of composing is more like the work of a gardener. The gardener takes his seeds and scatters them, knowing what he is planting but not quite what will grow where and when - and he won’t necessarily be able to reproduce it again afterwards either” (Duerden 2011). Pickering also uses this evolutionary metaphor by stating that another non-modern aspect of cybernetic ontology was its “evolutionary, rather than causal and calculable, grasp of temporal process” (2011, 19). Stafford Beer wrote in *The Brain of the Firm*: “Instead of trying to specify it in full detail, you specify it only somewhat. You then ride on the dynamics of the system in the direction you want to go” (1995, 69). This became a very influential guideline for Eno (cf. liner notes of the album *Discreet Music*). In his generative works he steps back to some extent and lets a process take over. The giving up of agency to a process, a system, trying (and failing) to get the artist/composer out of the equation, has been a very prominent thought in the arts since the middle of the last century as well as in the new materialisms of recent times, although there have been many precursors to such ideas. Eno’s generators in the form of code-based machines work with probabilistic chance. He plays around with a certain set of rules and depending on the outputs the system presents he adjusts them. “Since I have always preferred making plans to executing them, I have gravitated towards situations and systems that, once set into operation, could create music with little or no intervention on my part. That is to say, I tend towards the roles of planner and programmer, and then become an audience to the results” (*Discreet Music* liner notes). The composer becomes the audience of his own creation.

It is important to note that Eno, in the end, takes back control so to say and adjusts the system to get outputs more to his liking. It is an interaction with the system. “The great benefit of computer sequencers is that they remove the issue of skill and replace

it with the issue of judgment," says Eno (Schütze 1995). With endless possibilities and endless possible variations, it is not about producing those patterns but deciding which ones to keep. I find this highly important, and it is one of several reasons why I am not including open-ended forms in my investigations. They always incorporate the risk of arbitrariness of the results. Generative techniques can produce generic results. Eno's generative systems are used to create the material building blocks out of which the work is realized under the judgment and "composition" of the artist. One might have expected that such generative systems are the creators of the work. Surprisingly, the way Eno works does not leave a huge role in creation for the system used because it can be completely bent and controlled down to the tiniest detail. In the end, it spits out results exactly to the composer's liking and if it does not, the system is adjusted. Eno does not let the system do its thing. He robs it of its characteristics and forces it to work as he intends it to. He keeps total control. After he is done with his work there is no surprise anymore and the dance of agency stops. This is exactly what Eno conceptually intends his music to be: unobtrusive, (just) ambience to the listeners' surroundings. One could therefore argue that it lacks the necessary opposition and material characteristics that make the dance of agency interesting. The material does not push back.

American writer William S. Burroughs further illuminates the interdependencies in a system balancing between total control or the total lack thereof by explaining, almost like a warning, that "All control systems try to make control as tight as possible, but at the same time, if they succeeded completely, there would be nothing left to control. […] When there is no more opposition, control becomes a meaningless proposition" (1993, 144). There will not be any agency in the completely controlled. Burroughs, also influenced by cybernetics, was talking about socio-political control, but his remarks also fit the notion of control in the arts. The concept of control, at least in the UK version of cybernetics, is more synonymous with agency than oppression. The *kybernetes* that steer the wheel of a ship on the ocean must listen to and work

with the given situation. He or she cannot bend the ocean to his or her own will, nor can he or she predict the weather for the next week. Just like dancing tango, it is a game of leading and following, communicating through performing. And as everyone knows, it takes two to tango. Through this dance of agency, through partly giving up control, the artist can gain a lot. Eno does not give up control, he uses generative systems (just) to create variety, a mere tool instead of a partner in crime.

Taking matter(s) into one's own hands

As seen in the examples of Siqueiros and to a certain extent Moholy-Nagy, black boxes do not have to be machines, code, or other technological systems. They can also be raw matter interacting with other raw matter or another human or non-human agent. Anthropologist Tim Ingold draws a fruitful comparison to the laboratory of an alchemist in quoting art historian James Elkins' proposition that alchemy "is the old science of struggling with materials, and not quite understanding what is happening" (2010, 9). In a very nuanced way, this picks up on, first, the performative interactions of Pickering, second, the feeling and handling of substances by Moholy-Nagy and, third, the concept of doing without knowledge in complex systems.

The perspective of performativity is at the basis of Pickering's ontological interpretations. This can be seen when he states that "in the west, we inherit from the scientific revolution and the enlightenment a vision of the world as fixed and knowable by the scientist, and controllable by the engineer or the artist" (2016). As an alternative he proposes a more Zen and Tao like view of an uncontrollable and unpredictable world in constant flow and becoming. The whole universe becomes a black box. This process ontology, as used in cybernetics, is also the basis for most advocates of philosophical pragmatism. The philosopher Nicolas Rescher, a major proponent of process philosophy states: "We live in a world where nothing stands still and where change is the very essence of reality" (1996, 25). In this context, I found the concept of "Li" in Chinese philosophy very fascinating as it seems to offer a different and additional perspective on matter, becoming, and the underlying processes. Li,

in the neo-Confucianism sense, can be located somewhere "between our notions of 'pattern' and 'principle'" (2007, 1). The veins in a leaf, the patterns of Jade, the stripes of a zebra, all those are Li "as manifestation of the gestalt, the inherent pattern of things" (1). Wade describes these visual patterns as "graphic expressions of a great range of archetypal modes of action, whose traces may be found throughout the natural world" (1). Action in this context can be compared to the performative approach Pickering elaborated on. It is nature itself performing and leaving traces of its actions. Those manifestations resemble "an order that arises directly out of the nature of the Universe" (2). Being universal processes, one can find "strikingly similar formations in widely different circumstances and in quite unrelated phenomena" (2). Even though the resulting configuration might seem static, the development to this configuration is the equilibrium of a process, a trace of Li. Li can be seen as traces of action, momentary glimpses of the universal processes underlying the endless becoming of a non-static universe, a "frozen moment, of a process caught at a particular instant of time, […] of the principle of energy engaging with that of form" (2).

In a similar tone, Manuel DeLanda in his essay "Uniformity and Variability" states: "the idea that many different material and energetic systems may have a common source of spontaneous order is now playing a key role in the development of a new philosophy of matter" (1995). This is not new to scientists and even beyond chemistry, biology, and physics, these insights might be regarded as common sense. Also, in philosophy this is a rather old idea as the concept of Li exemplifies. Leaving traces of action can not only be used to combine the approaches of Pickering and DeLanda but also be connected back to art. In an interview I conducted with Volkhard Stürzbecher, an artist known for his work with different fluids and their performative usage for stunning visuals, he explained his working processes and the way he started doing these kinds of performances. At some point, Stürzbecher became interested in the natural patterns he found all around him. Trying to achieve similar results, he started experimenting with different fluids to create pictures that painted themselves (Stürzbecher 2001). He was referring to the work of chemist

Friedlieb Ferdinand Runge and his text *Der Bildungstrieb der Stoffe* (1855) in which Runge documented the patterns that the interactions of different fluids leave, in his case as static results on paper. Since everything Stürzbecher did was on a rather small scale, he started to magnify what he was doing in glass dishes through the use of overhead projectors. His live performances resemble the very elaborate liquid light shows known from the 1970s, a time when such projections provided visual accompaniment to music events. At first working exclusively with visuals, Stürzbecher later added music as an additional narrative layer. The scientific community became interested in Stürzbecher's visual results and invited him to several scientific meetings where he then showed his work in the hope of the scientists providing him with more interesting fluids or processes he could use to generate new visuals. Although he learned about the names of processes he was already using and the physicists were intrigued by the visuals, it did not help him in his work to find new ways of generating such content. Similar to the example of Siqueiros and the way his art was analyzed, the scientists confronted with Stürzbecher's work viewed the processes with different eyes.

The starting point for Stürzbecher evolved from his findings in nature. He knew the processes he was looking at were universal and could be found on any scale. The processes he was seeing while adding a drop of liquid were the same that generated planets. As a consequence of this realization, he projected his visuals on a circular canvas in his performance *Living Planet*, as seen in Fig. 1, and later on a sphere.

When Stürzbecher moved to the USA he had to leave all his fluid materials behind due to flight regulations, which caused him to stop working in this manner. However, still interested in the same processes, he simply shifted perspective and scale. Nowadays he does landscape photography, capturing the same processes frozen in time, traces of Li. Interestingly, Siqueiros, as quoted above, also associated the patterns he created with forms and processes in nature and wondered about the forces that caused the effects. Those patterns are the result of actions or forces and the properties incorporated in the material acted upon. Artist and author Robert

Fig. 1: Still from *Living Planet* by Volkhardt Stürzbecher.

Morris, in his influential essay "Anti-Form," explicates that form is just a mere follow up of the material and its tendencies and properties. Writing about Jackson Pollock's work from the 1950s, he states that "the stick that drips paint is a tool that acknowledges the nature of the fluidity of paint. […] But unlike the brush, it is in far greater sympathy with matter because it acknowledges the inherent tendencies and properties of the matter" (1993, 43). In this way, the material is not just used to realize something, but the material properties themselves become a major part if not the main subject of the work. Furthermore, the way in which the material is handled regarding its properties and inert processes is important. Again, control becomes agency. But unlike the systems of Eno, in this case, you cannot change the inert properties of the material you are working with. In Eno's case one does not work with the

material and its characteristics at all. Eno completely controls the processes and shapes the characteristics and is working on material rather than with the material. To put it in the words of art historian Petra Lange-Berndt and her text "How to be Complicit with Materials": "I would therefore like to propose a methodology of material complicity […] to give agency to the material, to follow the material and to act with the material" (2015, 13). This proposition of Petra Lange-Berndt can also be seen as a fitting description and the basis of the work of Berlin based filmmaker Susi Sie.

Connecting the dots – Creating with Susi Sie

When asked what exactly she is doing, Susi Sie oftentimes lacks adequate words to describe it to others. Even if she takes several minutes to explain, it mostly leaves the asking person puzzled. She came up with the title "analog motion texture artist" with her husband Remo Gambacciani (2020). As a starting point to get an insight into her work I would recommend watching her showreel as an overview of different materials and *Soundscapes* as an example of one standalone short film. Susi Sie aestheticizes natural phenomena, our surroundings, and oftentimes the substances we interact with daily. She literally puts a macroscopic view on processes, reactions, and characteristics of matter within everybody's reach. Finding beauty or aesthetic experiences in everyday life seems to be a major driving force behind her films. Just like a portrait photographer, she stages her subjects and brings out the best in them. Susi Sie proves that even with very simple everyday ingredients there is a story to tell—at times a mysterious one—if one does not know what one is looking at. Her films are fascinating and raise questions. They offer true aesthetic experience to the viewer and even more so to the creator. The outcome and experience of such experiments has something magical about it. And just like every good magician she does not reveal her best tricks.

Susi Sie studied video art in Maastricht and worked in post-production for six years afterwards. At some point she realized she needed a change both professionally and personally. After buying

a camera and a macro lens with some borrowed money, she wanted to delve into filmmaking, capturing not just stills, but movement, and finding her own expressive outlet. She used what she had at hand in her small apartment, so the protagonists of her first films were just water and oil.

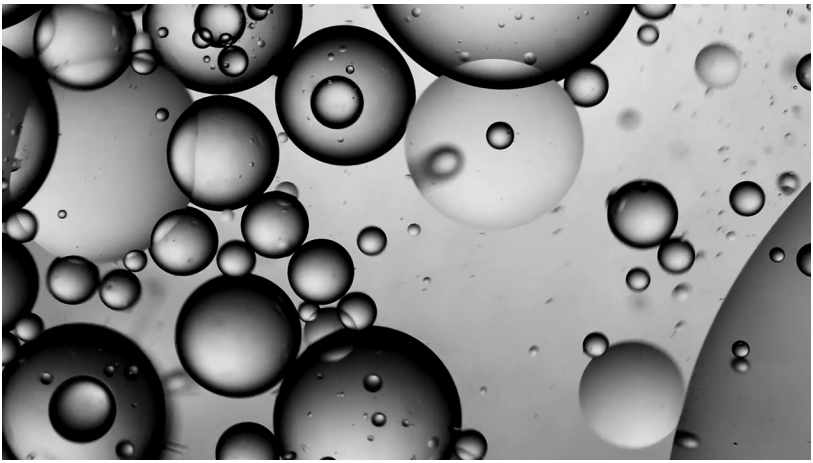

Fig. 2: Still from *Float* by Susi Sie.

What followed were experiments with all kinds of liquids and magnetic oil. When she stumbled upon the work of Hans Jenny, cymatics caught her interest and she added lycopodium to her toolkit. She worked with loudspeakers to set liquids, non-Newtonian fluids, and particles into motion and thus covered her apartment under layers of dust and worse pollutants. The drawings of Ernst Haeckel were another influence. The abundance of forms and patterns in animal and plant life he documented inspired her to start her own search for interesting patterns, structures, and textures in nature and her immediate surroundings. Working strictly with what she calls analog materials, she explains that for her it is "much more impressive when you see something that arises from itself, even if you could make the 100 percent exact same image using a computer. It's the difference between documentary and fiction"(n.d.). She adds that she "just wanted to get off the computer and do something with my hands" (n.d.). In a way, this could be read as reversed hyperreality. Instead of creating a fake reality that does not have a reference, Susi Sie shows

reality in a way that looks like something out of a computer or from another planet. In no way does it look like something you could film in a petri dish or find in your kitchen. As the recipient, you struggle with finding the reference because she decontextualizes the matter at hand and generates new perspectives while still maintaining and

Fig. 3: Still from *Six Seconds Series* 4/30 "Decay" by Susi Sie.

playing with all the characteristics of the substances used. For several years Susi Sie worked mainly with fluids and particles. And in a way fluidity has been the basis and major topic of all her films up to the beginning of 2020. She then realized she was missing out on three-dimensionality and in a way, everything started to look flat in her eyes. She therefore started her Six Seconds Series. It consists of material study miniatures, each of which is six seconds long and focuses on one single material (2020).

The *Six Seconds Series* is set up as a challenge to herself and a shortcut to her established work process. Completing a film sometimes takes her a year or more, but in this case she did not want to wait that long to get new results. Thus, she saved time that could be used to experiment with new materials. Since she has a long and ever-growing list of materials to explore and try out, the *Six Seconds Series* is also a way of covering as much ground as possible in the least possible amount of time: to just start and do and perform and try out instead of making endless

lists of possibilities. While not everything that sounded amazing on paper turned out to be interesting or even usable, other experiments turned out to be a lot more fascinating than expected. Which experiment would lead to which result could not have been found out by merely writing lists and imagining what it would be like to work with the material. It wasn't until the end that Susi Sie decided which material would be used for a complete film. During the series it became obvious to her and the viewers that, at least for a while, she preferred rather gooey and sometimes disturbing looking material which could have come right out of a horror movie reminiscent of some alien creature, and not the friendly E.T. type.

Fig. 4: Still from *Six Second Series* 7/30 "Spider" by Susi Sie.

The series not only documents material reactions but also Susi Sie's work process. It provides a look over her shoulder, right into her lab, not just watching the final film result, but also many tiny snippets that will lead to a longer film at some point. Many material interactions we witness would usually have ended up on the cutting room floor. This can be seen as artistic research in the wild, leaving the confined and secure spaces of a laboratory or workshop and experimenting out in the open for everyone to see. Not just making the process visible but making the process part of, or even the main subject, of the finished work.

Just as with her finished films, Susi Sie tries to make sure that, in everything she films for this series, the materials she works with are not revealed. She intentionally leaves her audience with questions. It is important for her to keep some secrets because it took her years to find this unique way of working, from which she also makes a living. Asked about her work process and if she had a certain result in mind, Susi Sie states that "this never actually works. Many things that happen are coincidences or accidents" (n.d.). Giving up control and documenting the reactions of the matter is a very important part of her work process. On the one hand she is "limited to the reactions of the substances" (n.d.). On the other—and that is the interesting part—she creates a little mini universe and explores its workings and boundaries through interaction in a very experimental and cybernetic fashion. Susi Sie is only interested in knowing that something is happening, not knowing how it is happening. She is completely indifferent about the scientific explanations of the processes used. Exploring what you mix with what in which proportions, temperature or even speed has many unknown parameters. In engaging with her black boxes and mastering how to play her instrument, in the form of water and oil for example, she is trying to focus on just one parameter at a time.

The unpredictability of her work, which she also has to communicate to potential clients, is essential to her style and immanent in the systems she works with. She does not force matter into form. She does not try and would not be able to control every last detail of how the processes might turn out. She lets matter do its thing, just following its traces. Through interacting with matter or setting it in motion, she allows it to create the material she later cuts her films from. In that way, her composition is more like a bricolage than design. She arranges forms with those objets trouvé that the system she has set up spits out. In a way, it is a generative system and a black box, but Susi Sie takes back control and tells a story of her own with the matter as protagonist. She adds her view, her perspective, her timeframe, color and light, her own wonder and fascination. She opens a window to a whole new tiny world, which

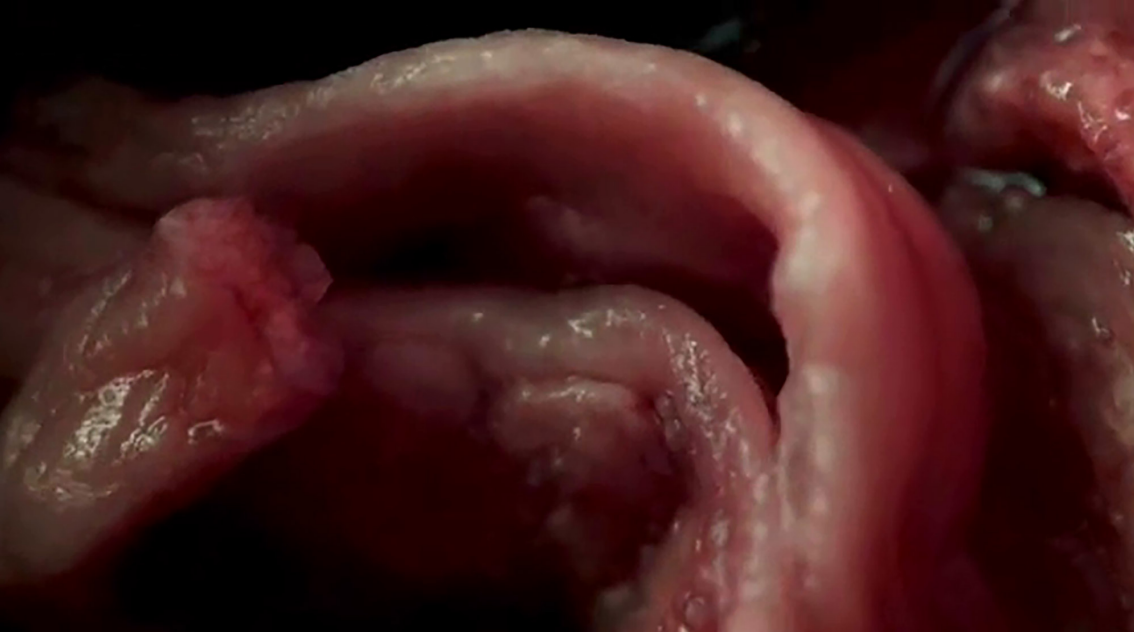

Fig. 5: Still from *Six Seconds Series* 13/30 "Tentacle" by Susi Sie.

lacks any scale reference so that the viewer cannot judge the size of what is seen. But this is not happening on some faraway planet for only a privileged few to ever lay eyes on, it is happening right under everyone's noses. At this point, one might object that there is no difference in this process to the way Eno is working. Eno, however, encodes his will into the generator. There is no "dance of agency" anymore, just "enslaved" material acting to his liking as the composer. Susi Sie, in contrast, allows the material to be itself, she uses the characteristics and plays *with* them. She never gains complete control and does not want to. It is always a dance between two equal partners and the material aspects are the protagonist in the final film. She works with what the material offers. Her taking back control is control over the final composition, not the material itself.

In addition to the visuals, sound design is equally important for Susi Sie. Over the years she has worked with several sound designers and musicians. When she is in the process of finishing a new film, she produces a raw cut with a reference sound reflecting the mood she would like to incorporate. She then sends this material to a sound designer she thinks might fit the project at hand and they are then free to do whatever they find appropriate. Interestingly, this is strikingly close to her approach regarding the handling of matter, as she again gives up agency and engages another

Fig. 6: Still from *Six Seconds Series* No 11/30 "Snake" by Susi Sie.

player in a "dance of agency" to use their strength, their style. Susi Sie does not influence the sound designer according to her will because she actually chose them specifically for the project. There is of course still a communication process to exchange thoughts. But, again, this happens in the style of a feedback system.

There is huge charm to her way of working and I would encourage everyone to start exploring this amazing universe in similar ways. You just have to take a closer look at the world around you. You can engage in the "dance of agency," you can start "doing without knowledge," you can get your hands dirty with matter instead of turning it over and over in your head, shovel by shovel. It is not necessary to know the scientific details of the processes or the atomic structures of the substances you use. Even the theoretical discourses to which this article refers and belongs are not relevant to the working artist, unless they decide otherwise. Every aspect I have elaborated on in the theoretical part of my investigations can be found in the work of Susi Sie. However, she did not have to read any of it before she started working like this nor will her works gain anything if she decided to read my essayistic mumblings.

Conclusion

To conclude my essay, I would like to propose a very specific form of artistic research and thus a change of perspective in art and media studies. The kind of artistic research in the wild that I delineated here is fruitful for many disciplines and a path back to explorations that are connected to and relevant for artistic practices. Henk Borgdorff, referring to Christopher Frayling, differentiates between "(a) research on the arts, (b) research for the arts and (c) research in the arts" (2007, 6). I doubt that the three perspectives can be strictly separated from one another, but for my investigation point (c) is the most interesting and at the same time the most controversial aspect. "It concerns research, that does not assume separation of subject and object, and does not observe a distance between the researcher and the practice of art. Instead, the artistic practice itself is an essential component of both the research process and the research results. This approach is based on the understanding that no fundamental separation exists between theory and practice in the arts" (6). Therefore, I would like to phrase my suggestion of artistic research as research *through* the arts, *through* artistic practice. Through talking to practitioners, drawing connections, tinkering, and trying out things in the physical domain, research in art and media studies would become a lot more relevant to art itself. Additionally, it would result in knowledge that, as shown above, cannot be obtained in any other way. The huge gap that exists between practice and research in parts of art and media studies needs to be bridged. The researcher also has to become a practitioner to fully understand the subject. Art and media studies, at least to a certain extent, seem to have forgotten about doing things, about creating and experiencing. Instead, they often focus solely on language and analytical approaches. The enterprise of institutionalizing artistic research in order to implement PhD programs for artists suffers from one major flaw in my opinion: It aims in the wrong direction. The resulting dissertations are mostly divided into a theoretical and a practical part, with the practical part being the interesting and innovative one and the theoretical part being a mere fulfillment

of the regulations to receive the academic degree. Regarding the artistic practice documented, there is hardly any necessity for the theoretical part. The artistic practice already existed before, while the fitting theoretical discourse, explanations, and quotes had to be found afterwards. This neither helps the arts nor the sciences. Compare this to the two descriptions of Siqueiros' accidental painting technique above.

Art does not need to be concerned with the details of analytically explaining phenomena as long as the explanation is irrelevant to the artistic practice. Yet, every artistic endeavor is artistic research and, as shown, produces knowledge of some kind. It may not be the knowledge that traditional science produces because there is a difference between being able to explain the fluid dynamic details of a drip painting and being able to use the method to create such a painting. Experimenting with a material or process, finding out how it reacts, how to work with it, maybe but not necessarily gaining some control over the outcome without ever being concerned about the why, is a form of research.

Therefore, it is not artistic practice that needs or majorly benefits from scientific methods or needs institutionalized artistic research programs, it is art and media studies that need and would benefit from artistic practice as an additional research method. This is the direction artistic research needs to go. Why should art and media studies have to be strictly textual and theoretical? Why can't it be experimental, exploratory, hands on? Why should it not engage in artistic research, as shown above? Documentary forms and ethnographic methods can additionally be used as tools in such a form of research. Research in art and media studies should, like poiesis, be about doing and making, about being in the world as an *acting* in the world and not only about theory. As we have seen with Susi Sie, an example I consider artistic research in its truest form, the artist's own perspective, documenting work processes in an artistic language, enables personal experiences and knowledge beyond books. Even if I wanted to wrap myself in theory, it should still be tested practically and not measured by counting quotations. I should verify the theory of bike riding by climbing onto the

saddle and treading on the pedals. If a theory cannot be tested or falsified in that manner, there is a problem with the theory anyways. Art and media studies should therefore find a way back to artistic practice and not indulge in endless theoretical discourses about other theoretical discourses. If the subject of art studies is not artistic practice and the products thereof and if the theory is not evaluated for its pragmatic relevance, then it will be irrelevant to artistic practice, the subject it was originally concerned with. It will only exist in its own little bubble. It will only be relevant inside the framework of its own theoretical discourses. The subject will not be art anymore, but art studies, sealed off from any actions or objects in the physical world. Artistic research, as presented here, can function as a model for alternative research in art and media studies, a form of research that bursts the theoretical and self-referential bubble.

To put it bluntly: It does not matter what you think you know or think you are capable of. The only thing that matters is what you do, your actions in the world. Start exploring and stop making excuses!

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Experiment and expectation

Exploring the social life of ink dots

Christian Rust

While researching artists that work in a similar way to Susi Sie, I came across the French group Chemical Bouillon, which is made up of Antoine Delach, Valere Amirault and Teurk.

> Chemical Bouillon is an artistic project studying the graphic aspect of chemical reactions. The goal is to find and isolate natural patterns by mixing every strange product we can lay our hands on. This results in a colorful mess that will sometimes turn into an amazing abstract video we're happy to share. (Chemical Bouillon "About")

For me, the visuals they are creating, compared to other artists working in this field, stand out for several reasons. First and foremost, I had not seen many of their processes and effects anywhere else before and had no idea about how to approach them at first. Secondly, I like the fact that their videos do not show a finished, high-gloss product, but are more like micro documentaries of the group experimenting with substances and talking in the background. This was the first of their videos that caught my attention:

Fig. 1:
Screenshot of thumbnail

The info underneath the video states that they were mixing ink, alcohol, and carbon. Clearly this is not a particularly detailed description of the substances and processes used. Since I had questions regarding this and other videos, I tried to contact them. My first attempt via their YouTube channel did not yield any results. After several weeks I wrote to their individual email addresses. Unfortunately, this was also to no avail. So, in the vein of "doing without knowledge," I started experimenting and tried to find out how to achieve a reaction such as the one shown in the video above. Although I did not put on a lab coat and safety goggles, my kitchen transformed into a mini laboratory for a while. This is the blurry still of what my ink implosion, or rather explosion, looked like in the end:

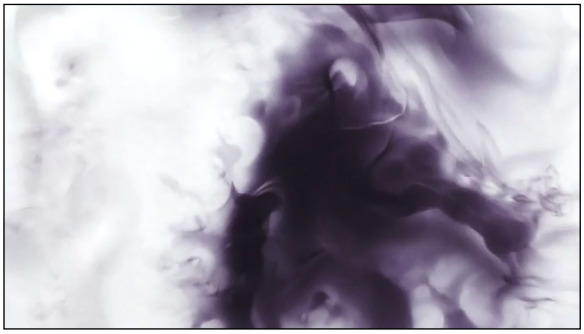

Fig. 2:
Still of unpublished video

I was quite pleased with the result, even though the reaction was more intense than I would have liked and disturbed the fluids heavily. Something else happened during my experiments that proved to be far more interesting. But let me go back to the beginning.

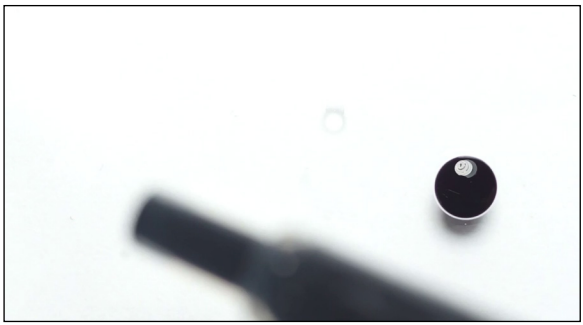

Fig. 3:
Still of GIF

In contrast to the video by Chemical Bouillon, my experiment did not produce many blobs of ink that "exploded" when coming into contact with a second substance. I started with this beautiful, suspended, single dot of ink; not very spectacular in its own right, even if I had known that it would explode in the end. But since I did not know what was to come, this ink, floating in a stable circular form, quite frankly left me slightly disappointed at first. It disappointed my initial expectation.

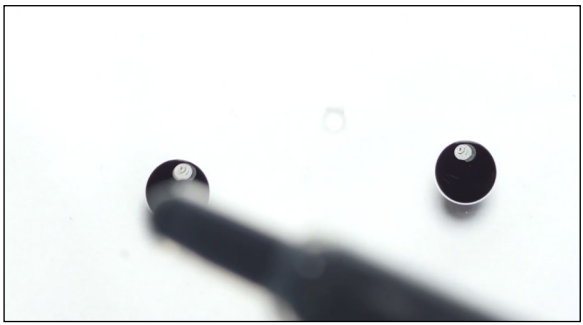

Fig. 4:
Still of GIF

As I added a second and third drop, the ink dots suddenly moved together and arranged themselves symmetrically.

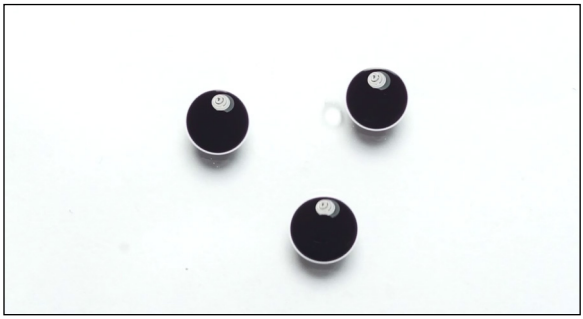

Fig. 5:
Still of GIF

This was something I had neither seen in the Chemical Bouillon video nor had expected. Although or because this had nothing to do with the planned experiment and initial expectation, the surprise due to this unexpected movement really caught my interest.

Fig. 6:
Still of GIF

When a fourth drop was added, it also began moving towards the constellation the others had formed and complemented the symmetry.

Fig. 7:
Still of GIF

This moment of surprise would probably not have been so captivating had I known the inner processes of the system in terms of fluid dynamics and surface tension. I would not have experienced the beauty of ink dots cuddling and defying my initial expectations. As illustrated in this short example, the gap between (the failed gathering of) analytical knowledge and simply trying things out opens up a fruitful field full of possible surprises, experiences, and discoveries. Experimentation does not need, nor should it be solely about, expected outcomes, but should also be about valuing the process. In the process, along the path of a planned experiment or through exploring undiscovered territory, unexpected things may happen. We should be open to shift our direction of travel towards a different destination, go with the flow of the materials used and maybe come across something magical.

Fig. 8:
Still of GIF

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The unforeseeable in the design process

Natalie Weinmann

Abstract
In current design processes, the unforeseeable is often regarded as a mistake. It is prevented, covered up or stylised as deliberate in retrospect. If at all, the unplanned is seen as an obstacle to overcome. With this essay, I would like to counter this tendency and address the productive moments of the unforeseeable. By exploring dimensions of a design process frequently ignored in relevant debates, I aim to make the unforeseeable, which is inherent in every design process, more tangible and illustrate its diverse manifestations. This essay explores the necessity of interruptions in chains of actions and illustrates how perception, interpretation, and a mostly unconscious handling of the unforeseeable often lead to a supposedly goal-oriented and plannable design approach. Using examples involving different forms of the unforeseeable, this essay illustrates the impact of a hands-on approach through the process of making, and the relevance of expectations, prior experience, knowledge and imagination of the designers. With this essay, I wish to raise awareness and appreciation for how those unplannable dimensions can strengthen designers and design projects and ask what must change to create space for this awareness in the future.

Introduction

In the course of a design process, there are both goal-oriented phases that can be planned and phases of incalculability. The latter produce results that often appear spontaneous and random. They elude a strictly predictable causal chain. No matter how well planned the design process, these dimensions seem to be inherent and show up in different forms. Described by designers as an unpredictable event, as an unexpected shape of an artifact produced, or possibly as a surprising new understanding of something that leads to new knowledge, they illustrate the diversity in which the unforeseeable can be experienced. The following text addresses dimensions of design processes that are not only evident in design itself, but also, for example, in related fields such as architecture or engineering. Actors from those fields might perceive the unforeseeable as liberating aimlessness and often as a threatening loss of control. Surprisingly, when seen retrospectively, it appears to most designers like a good idea, a surprising turn of events, and a happy coincidence, in other words serendipity. During the design process the unforeseeable might even be described as unnecessary, accidental, and unplannable. But as Huber and Stoellger beautifully pointed out, the unforeseeable is by no means simply random "but perspective, possibly effective and […] of its own aesthetic relevance, which eludes the alternative of necessary and arbitrary" (2008, 8; translated by the author). I would like to take this thought one step further. With all its contingent aspects, the unforeseeable is not only relevant but essential for the emergence of design outcomes such as innovative products, original objects of use, new knowledge, or aesthetic artifacts. However, design is an applied creative discipline and strongly influenced by the system approach of the 1950s and 1960s and the engineering processes of the 1980s and 1990s. It is therefore still trying to follow a uniform methodology and a plannable design process (Archer 2006, xiii). From this perspective, emergent and unplannable moments, unexpected behavior, or unintentionally produced artifacts and phases of unpredictability might still be perceived as disturbing and unwanted. For most designers, this paradox frequently leads to a discrepancy between the communicated

and the lived design process. Uncontrolled and unexpected events during the process are communicated to clients and in publications as structured and well-planned, which then somehow and surprisingly lead to new and innovative results.[1] On social media platforms and websites of well-known design studios, this clear tendency to structure, aestheticize, and communicate the design process itself can be widely observed.[2] Faulty or bumpy steps in development are sorted out afterwards, the pre-selection is elaborately presented in shiny making-of photos or exciting studio process videos and finally communicated to the outside world via various media (Frye 2017, 118, 119, 197, 224). Cottenceau and Heiz point out that in a design process we can observe "the advancing development of the artifact as a back and forth between conditional contingency and determining possibility" where "form and function, construction and materiality, facts and context again allow for new possibilities from specific points of view" (2008, 266; translated by the author). As a high degree of simultaneity and complexity is inherent in the process, a complete and fully understandable representation cannot be derived nor created. Nevertheless, as Cottenceau and Heiz criticize, designers do not resist the temptation to document and present this process in an allegedly appropriate form. Therefore, chosen tools such as words and images are given higher priority than the question of their representativeness. The presentation might not even correspond to reality. "Consequently, everything evolves around something specific, which must meet the expectations of demonstration and comprehensibility" (266; translated by the author). This ambivalence manifests and constantly affirms itself in the expectations and evaluation of the designer throughout the process. The unforeseeable does not fit into this flawless imagination and will be instantly interpreted negatively as a mistake or fault. The generative and transformative strength inherent in those unplannable aspects cannot be seen positively if they are instantly interpreted as

1- On the design process as a practical mediation between ideality and reality, see, for example, Bryan Lawson (2006).

2- Aestheticized images of the design process can be found on Instagram pages of, for example, those of Stefan Diez or Hella Jongerius.

an accident. Surprising moments occur and interrupt planned processes, leaving those involved irritated, perplexed, and often angry or disappointed. Apparently frustration, ambiguity, and irritation as a reaction to the unplanned and the subsequent ruptures in the process flow do not play a role in a well organized and professional design process. Yet, they cannot be denied. The unforeseeable is therefore mostly ignored in current design debates,[3] or seen as a mistake which is covered up or stylized as deliberate in retrospect. If at all, it is thematized as some kind of obstacle to be overcome. I wish to oppose this tendency and address the hidden productive moments of the unpredictable in the following chapters.

There are things we don't even know we don't know.

> There are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know. (Rumsfeld 2002)

US Secretary of State for Defense Donald Rumsfeld referred to the limitations of our knowledge in his statement on February 12, 2002. He stresses the unignorable uncertainty of the future. It comes with risks that we would rather avoid but cannot, as we simply do not know the future. There will always be things that we do not know anything about. We do not know that they exist or will come into existence in the future. Rumsfeld's categorization brings attention to the different types of the unknown. It is based on an analysis technique called Johari Window, created by psychologists Joseph Luft and Harrington Ingham (1961). This technique was developed for humans to gain a better understanding of themselves and an awareness of their relationships with others. It gives an idea of the different types of the unknown, which can also be considered when trying to categorize the unforeseeable. Of course, the unforeseeable and the unknown are not identical.

3- Relevant debates discussing different methodologies in design and design processes can be found by authors such as Wolfgang Jonas, Claudia Mareis, Wolfgang Schäffner, Nicola Doll, Horst Bredekamp, Christof Windgätter or Gesche Joost, to name just a few.

They are similar in a lot of ways but, whereas the unknown is strongly tied to knowledge, the unforeseeable is closely related to the process of foreseeing, i.e., expectations and imagination. Nevertheless, in the following chapters I will draw on the similarities, not the differences.

The unforeseeable in a design process is not easily defined. When trying to define what the unforeseeable is, the ephemerality of the moment in which the designer is confronted with it becomes evident. Due to the fleeting nature of this moment, the designer perceives, interprets, and reacts intuitively. There seems to be an implicit knowledge of the necessity of those unplanned moments, which makes the unpredictable blend fluidly into the process. It even appears to vanish for external viewers and sometimes even for the designer themselves. Retrospectively, the unforeseeable might be described in the form of a lot of things: a specific material behavior, a new tool, or the appearance of a surface. But to be defined as unforeseeable or unpredictable, there needs to be more than just a new object or its specific behavior. The thing observed is tied to the person, hence in this case the designer observing it. Also, the expectations regarding the process and the way it can be perceived is bound to a specific time and space during the design process.

To better understand the different types of the unforeseeable, I would like to apply the Johari Window analysis technique to the design process via four simple examples (cf. Fig. 1): There are (i) known knowns—things a designer knows they know—such as if they cut through one piece of wood it will make two pieces of wood, which they also know before cutting. Then there are (ii) known unknowns, things a designer knows they do not know, such as the timber structure hidden inside the wood. Even though they do not know exactly what the structure looks like, they might have previous experience and knowledge in cutting timber. Hence, they know prior to cutting that there is a spectrum of uncertainty involved, where only the pattern of the structure might surprise them but not the fact that the pattern exists. As a third option, (iii) unknown knowns, the designer also might

have previous knowledge about unexpected holes made by woodworms for example, which can be found inside a naturally grown piece of wood. This knowledge might be hidden or avoided by the designer unless it happens to appear. And lastly, (iv) during the course of cutting, the piece of timber might break into a completely unexpected shape, maybe even destroying the piece or the cutting tool, due to unpredictable irregularities in its structure. This could be called an unknown unknown. The designer is not able to predict this happening, nor know how the piece of timber or the machine might look after the cut.

These examples should be understood as a first attempt to categorize the different types of the unforeseeable. However, the design process can be far more complex than these simplified examples. Below I present two examples of very different design processes that illustrate different forms of the unforeseeable in more detail.

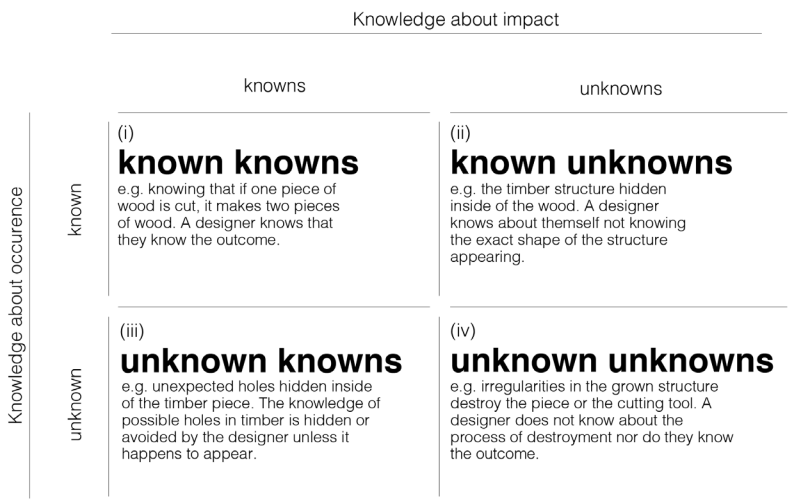


Fig 1: 2x2 matrix based on the Rumsfeld quote and the Johari Window technique by Luft and Ingham, 1955, transferred to the design process.

The MYTO chair example

When Konstantin Grcic designed the cantilever chair MYTO in collaboration with BASF and PLANK, the brief he set himself was to design a chair out of polybutylene terephthalate (PBT). Such an approach to a design brief can be described as a goal-oriented process. This will be explored in detail later on. The final outcome of the chair's design was set at the very beginning, during the briefing, and was not supposed to change during the process. Grcic chose injection molding for the fabrication method, during which liquified plastic or rubber material is forced into a prefabricated mold and subsequently solidifies into its specific shape. Injection molding is by no means an unusual production method and is quite common in mass production. But the specific BASF material PBT had never been used to make furniture before—it was mostly used in the automotive industry. Consequently, the material's behavior still needed to be explored, so the process turned in part into an experiment. In the magazine *MYTO a cantilever chair*, Anniina Koivu points out that during development, which she described as a "see-saw between computer animations and various full-scale models built in wire, foam and scrap from other furniture" (2007, 68), the unexpected had a great impact on the design process. Complications arose when the well-structured process was interrupted due to the unplanned material behavior in the perforation of the seat, as Koivu, quoting the designer, describes:

> At one point the experiments on various types of perforations came to an abrupt halt. We realized that the machine could not guarantee the ideal flow of the heated plastic throughout the chair and especially to the thinnest parts of the net, as it tends to cool down and harden before reaching the furthest point of the mould. (68)

The design and production team members were surprised by the unplanned behavior of the liquid material during the flow process. The material was not behaving as fluidly as they had expected it to. This interrupted the linear and goal-oriented experimentation process and defined the shape of the chair's

perforation, which was needed for both aesthetic and lightness purposes. Furthermore, the interruption asked for a negotiation in the design between precisely defined holes of specific sizes and technical requirements in the design for reinforcement and strength (cf. Fig. 2). In this example, the unforeseeable showed itself in the form of unexpected material behavior which surprised the designers and producers, prevented the planned approach from continuing, and established a new order. Referring to the categories above, the unforeseeable material behavior could be understood as known unknown, since the designer and the producers were aware of the fact that the material might not behave like other injection molding materials, but did not know how it would behave. During the process the emergence of unexpected material behavior was not seen as something necessary, but rather as an unwanted determination of the process flow with a strong impact on the ultimate design. Koivu points out: "Volume in combination with decorative perforation is central to the final shape of the object" (2007, 68). Accordingly, the eye-catching perforation, which only developed due to the unforeseeable interruption, became a distinctive visual recognition feature of the chair. Finding a balance, in a see-saw-like process, between unexpected interruption and dealing productively with the unforeseeable, contributed to making MYTO a unique piece of design furniture, including the story of its creation. Nevertheless, Grcic himself states that as a designer you "make a lot of preliminary tests, but there is always a risk" (Yudina 2007, 72). With the word *risk*, Grcic highlights another contingent aspect of the design process in the way that he imagines those moments as possible but not necessary. The designer would have loved and could have imagined continuing as planned had the process not been interrupted. At the same time, and retrospectively, the unforeseeable interruption was conditional for the emergence of the final design. Therefore, it was necessary.

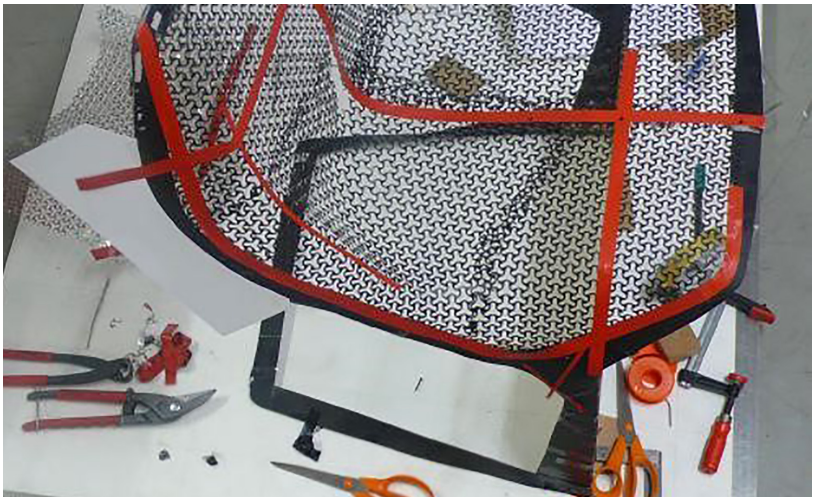


Fig 2: Working model of the cantilever chair MYTO by Konstantin Grcic.

The gel sphere example

In comparison to the goal-oriented process mentioned above, I would like to illustrate another example following an open-ended design process, where the outcome is not defined from the beginning. In the context of an experimental collaboration, I initiated a project called "Exploring Biochemistry from a Design Perspective" with biochemist Dr. Maximilian Urban. Inspired by different tools, ideas, and approaches from the fields of biochemistry and design, an aesthetic and intuitive collaboration began, which explored shared interests in an experimental process. We explored materials from the design workshop with laboratory utensils or examined different materials from the laboratory and combined different workshop tools and utensils from both work fields. Most importantly, we switched fluidly between different scales of working; between the macro, micro, and nano scale. After this discursive hands-on exchange of discipline specific tools, materials, methods, and topics, similar interests were found very quickly. It became obvious that even though the knowledge is completely different when working in different scales, e.g. biochemistry in nanoscale and design in macroscale, there is a resemblance between design and biochemistry and similar interests, ways of working, and approaches were

found. The productive process that followed involved studying material behavior during an experimental and open-ended process, combining materials, tools, and approaches from both fields intuitively. Material experimentation and observation was carried out, accompanied by discussions about relevant application or transfer possibilities. Inspired by the way scientists handle small amounts of liquid in biochemistry laboratories and using agar—a jelly-like substance obtained from red algae—as a carrier material, we studied the behavior of regular ink injected into agar gel spheres. The goal of this process was not to develop a design object with a function or specific use but, instead, to find a way for the fields of biochemistry and design to merge and stimulate each other via the process of making. The idea was to become curious, exchange, and start a productive design process with tools, materials, or technology from outside the design field, transferring it to a scale tangible for non-biochemists and observing the aesthetics that emerge during the process. The acts of observation, production, and documentation merged seamlessly into one another. Compared to more commonly used materials such as metal, wood, glass or plastic, agar is a very unusual material for designers to work with. The jelly-like substance behaved in a way a designer would most likely not have experienced or worked with before. Agar is too unstable to build products or objects. It is in a transition state, being neither liquid nor solid. Therefore, further design exploration was needed. Very quickly the material behavior became surprising to us. When black ink was injected via a syringe into the center of the sphere, a moment of resistance followed, during which the pressure increased due to the lack of space to expand. All of a sudden, the ink made its way through the sphere creating pathways resembling small fractures in glass or ice. The channels were not round and soft, as might be expected by a liquid running through a semi-liquid material, but instead radical and sharp (cf. Fig. 3a, 3b). With the unfulfilled expectation of fluid material behavior in a jelly-like substance, the causal chain of the process was interrupted. The attention shifted from curious intuitive experimentation to specific setups initiating and trying to control this behavior. Not being able to

determine or influence the flow of the ink completely, the vein-like ruptures of the sphere continued to surprise us. Knowledge about probable possibilities to influence the outcome was only gathered slowly. The flow of the ink could be guided by pre-set preparations of the sphere but never fully controlled (cf. Fig. 4, 5).

In this second example, similar to the previous one, unexpected material behavior was described as unforeseeable, but this time it can be categorized as an unknown unknown. Neither I, as a designer, nor my colleague, the biochemist, had conducted such experiments before with any of the materials we used. We therefore had no previous knowledge or previously gained experience. We did not know and we could not have imagined the unexpected behavior of the material before the experiment. We had, of course, an intuition[4] when choosing the specific materials and how to combine the tools we used with them, but we could not have actually known before the experiment. In contrast to the subsequent steps, the discovery of the manipulation of possibilities concerning the expansion of the ink can be categorized as a known unknown. During the repetition of the experiment, knowledge was gained but never enabled a full understanding of the process. We were continuously being surprised, but soon able to imagine some sort of outcome—including the uncertainty involved in the process.[5] In contrast to the first example, in which Grcic used the terms "risk" and saw the material behavior as a problem that needed to be solved, the exploration and the experiments carried out by Maximilian Urban and myself were not associated with taking a risk at all. Instead, it was perceived with joy and curiosity as serendipity. Accordingly, the question can be raised: how can two rather similar procedures that involved injecting liquids and the unexpected material behavior that followed be experienced in such contrasting ways? This leads us to the contingent aspects of the unforeseeable.

4- When using the term *intuition* I refer to Herbert Simon's understanding: as subconscious pattern recognition, which was pointed out by Roger Frantz in "Herbert Simon. Artificial intelligence as a framework for understanding intuition" (2003, 2).

5- The transformation of an unknown unknown into a known unknown and maybe later on into a known known points out the impact repetition and gaining knowledge has on the unforeseeable.


Fig 3a, 3b: Gel Sphere experiments with agar-based gel sphere and injected black ink.

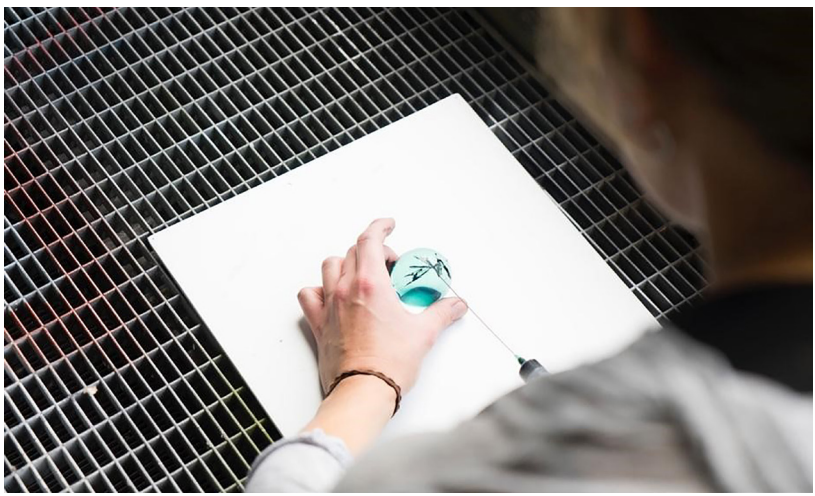


Fig 4: Preparations of the gel sphere during injection with a syringe.

Fig 5: Injection tests with spirulina colored liquid agar and glass filled with stiffened agar.

Contingent aspects of the unforeseeable

The unforeseeable in the illustrated examples above concerns more than just the transformation of a material or an object. It is also tied to the imagination, expectation, observation, perception, and interpretation of a human—the designer—and includes the aspects of temporality and spatiality. The designer enters the design process with an idea they imagined as an outcome. The designer builds up expectations, fully aware or unaware, with or without preset goals or plans.[6] Previous experience and gathered knowledge will influence whether or not the designer can perceive the unforeseeable in this time and space at all, or if they might even miss or ignore it. Time and space have an effect on how they will observe and interpret the unforeseeable, which emotions will arise in relation to this interpretation, be it joy, anger, sadness, or maybe frustration. As a consequence, the designer reacts in a specific way which ultimately has a strong impact on the outcome. Therefore, it is not, as one might think at first, the thing itself that would be described as unforeseeable, but it is a combination of different aspects. This correlation of factors coming together in one moment can be understood as an event, i.e., as something that happens unexpectedly and with significant importance. Henri Bergson, for example, sees the event as having the potential to break with existing orders and establish new ones (1912, 278).

Looking back at the previous examples, we find this potential particularly in the example of the chair. Here, the planned design process was halted due to unexpected material behavior. The unforeseeable was tied to the event that broke the existing order and established a new one, namely finding a balance between aesthetic purposes and technical flow requirements. This event was not imaginable before it occurred and it is "perceived", as Hörmann and Merziger beautifully illustrate, "as extraordinary; it is said to have great transformative potential. Events change the course of things" (2012, 1; translated by the author). P.M.S. Hacker highlights that

6- On the question of representativeness, correspondence of expectations, and comprehensibility, see also Cottenceau and Heiz (2008, 266).

events do “happen or occur” (1982, 479), they “occur at (more or less specific) times” and this can be observed, “by reference of changes […] undergone by material objects” (480). For design processes, this becomes extremely relevant since they mostly work with or on materials, tools or objects, constantly producing design objects in the act of making, understanding, or communicating.

Depending on how we approach and relate to the world around us, we see and interpret this unplanned transformation as a risk or a surprising happening. At this point, the contingent aspects of the unforeseeable arise. An event may or may not be recognised, be interpreted and reacted to in one way or another. The event might be seen as possible but not necessary and simultaneously irreplaceable in retrospect. The unforeseeable includes many contingent aspects, some of which were already pointed out. Generally speaking “contingency is mainly discussed within the framework of the modal terms of possibility and necessity, although different types of terminological models have emerged in history” (Mersch 2008, 24; translated by the author). As Huber and Stoellger state, contingency can be found as “dynamic of its own in production and reception as well as in the materiality of the medium, partly in the form of intentionally set undetermined spaces” (2008, 13; translated by the author). The authors claim that it is necessary to develop a sense for contingencies, to categorize them not in the binary as either necessary or random. Instead, they plead for a finer sense of discernment to be able to deal with contingencies productively (14). The question of why and how the unforeseeable emerges is therefore strongly dependent on individual interpretation and influenced by many factors such as existing knowledge, skills, previous experience, and expectations concerning the design process itself. Transformative properties can also change retrospectively. During the process, objects and time change and uncountable variations of formation and new relationships between things are created (Werner 2008, 116–17). In this way, narratives and visual information in which supposedly truth-creating discourses are integrated are conditioned by other narratives and information (126).

When comparing these two examples, the MYTO chair and the gel sphere,

the following contingent aspects were found in both: An interruption of a process flow which changes the continuation of the process can be seen as both an accident or as serendipity. The transformative force of the unforeseeable can be seen as necessary or unnecessary and the unforeseeable, seen as an event, can be described by the designer as coincidental and avoidable or essential for the design process that followed. We need to explore what relevance the awareness of these hidden dimensions has for the appearance, the perception, and the handling of the unforeseeable and if different design approaches demand different questions to be asked during the process. If so, does this, in turn enable a different engagement with, and handling of, the unforeseeable?

(Lucky) accidents in open-ended and goal-oriented design processes

The design discipline and its field of working has changed massively due to social, technical, economic, and cultural transformations since its birth in the nineteenth century (Haarmann 2020, 215–17). Accordingly, its terminology has been addressed intensively in theoretical debates by authors such as Vilém Flusser (1997, 9) and Claudia Mareis (2011, 24–27). In his text "A Cautious Prometheus?" Bruno Latour argues that design developed from a discipline of object-shaping into a world-shaping force. He explains: "It has grown in extension—design is applicable to ever larger assemblages of production. The range of things that can be designed is far wider now than a limited list of ordinary or even luxury goods" (2008, 2). In this sense, design cannot be solely reduced to the shaping of an object. And even if the outcome is an object which attracts mostly because of its shape, for example a product, the design process itself is an act of making, trying out, developing, and exploring.[7] It can be seen as a "change in the ways we deal with objects and action more generally"(2). During this mode of production, the designer, consciously or not, is constantly handling

7- This procedure of making and interacting can be described as a poietic act during which something new is produced (Trogemann 2020; Picht). This can be, for example, a product, an object of use, a work, a thing or knowledge.

the unforeseeable, but depending on their knowledge, skills, and expectations, perceives, interprets, and reacts to the unforeseeable differently. Looking back at the two examples mentioned, I would like to emphasize the important role the mode of approaching plays in individual interpretation and handling of the unforeseeable. The first example, the MYTO chair, was based on a goal-oriented design process, the latter, the gel sphere experiment, was based on an open-ended design process. Both approaches represent fundamentally different ways designers encounter the world around them during a design process. In the following, I will briefly introduce two approaches in design processes: (i) the goal-oriented and (ii) the open-ended process. Of course, there are processes which might switch from being goal-oriented to being open-ended and vice versa, but for the purpose of understanding, I would like to make a very strict differentiation by way of example:

(i) In goal-oriented processes, the goal is defined at the beginning. The designer's imagination of a possible final outcome leads to specific expectations of the design process. The designer makes plans, follows them during the process, carefully checks if they are still meeting expectations before moving on to the next step. By avoiding or eliminating possible disruptive factors in the form of breaks and surprises, the designer tries hard to not interrupt the development flow. Comparable with the planning process of an engineer, they define the problem step by step, analyze the condition, identify and prevent possible emerging issues. The designer conceives, evaluates, and selects comprehensible suggestions for solutions so that they can ultimately be developed and executed and/or produced. A constant process development flow in the direction of the initially set goal, the imagined outcome, is central to this approach. Deviations are accepted only in exceptional cases. The initial plan must always stay in focus for the designer involved. Questions asked during this process are for example: What is needed to reach the imagined goal? What can be expected during the process? What happened in the process and does this

resemble the previously imagined outcome? What needs to be done for the product to be as close to what was imagined as possible?

(ii) In an open-ended design process, on the other hand, the goal is not defined from the beginning and therefore the designer does not enter the process with a specific image of a final outcome. Instead, they have some expectations concerning the design process itself. Due to a lack of experience or knowledge, the designer enters the process without a specific expectation. Individual goals emerge in the course of an intuitive, often unregulated process. However, the open-ended design process is by no means without rules or structure. Rather, it is guided by an individual set of rules developed and structured by the designer, using their imagination and expectations, which may constantly change in the course of the process.[8] Questions asked during this process could be for example: Which materials or tools are needed to start a process in a new way? What does the setup look like when using those materials or tools? What happened in the process and how does this surprise the designer? How can the unforeseeable be examined further instead of being eliminated or avoided? What is needed or what needs to be changed in the setup to create something similar to what has been observed? Where might this lead?

The unforeseeable in the first approach is seen as an unwanted problem, an unlucky event and, if at all, a challenge that has to be mastered and controlled using existing skills. In the latter approach, however, the unforeseeable is seen as an exciting happening, as a lucky event, and something that should be followed up with great curiosity. In a goal-oriented process, structure, the use of methods and previously gained knowledge to stay focused and not get lost is essential to productivity. In an open-ended way of working, curiosity towards the

8- The open-ended processes illustrated in this text are of course not without a goal, since the goal could be to explore a material or technology or follow one's own curiosity, for example. But to clarify it as a practice beyond purpose and rational goals, it will be called open-ended in this essay.

unknown is just as important as having confidence in the dynamic flow or bumpiness of the process to enable productivity. Independent of the mode of process, the designer must deal with the unforeseeable. Whilst being appreciated in an open-ended process, the designer in a goal-oriented process may be strictly focused on problem-solving, which in turn can prevent a recognition of the potential in the unforeseeable. If they are no longer able to regain control, the designer may also find themselves feeling frustration or even panic. Hence, in both approaches, a consciousness of these dimensions of the design process is useful for the productive handling of the unforeseeable. The question of how designers can develop a sensibility not only towards unplanned moments but also towards their perception, behavior, and the way of acting during a design process, therefore, needs to be explored in more detail. The open-ended design approach gives the unforeseeable significantly more space and attention than the goal-oriented approach. The following paragraphs will take a closer look at this mode of working, while trying to explore how designers develop an awareness of the unforeseeable.

Space of opportunity provided by the Dare'n'Do Seminar

To understand the potentials and conflicts of the unforeseeable and to allow designers to learn and experience the open-ended process, I established the Dare'n'Do project in 2017 (Weinmann 2017). Founded as a seminar at the Stuttgart State Academy of Art and Design, architecture and design students met experts from other disciplines and came in contact with complex, previously unknown topics, mainly from the field of scientific research. Detached from firmly defined design tasks, the students learned how to develop a productive way of dealing with new, unplanned impulses in an open-ended and mostly experimental process. Goals, tools, and outcomes were developed during the seminar. For example new ways of interacting with technology, speculative product designs, objects communicating scientific content, aesthetic artifacts, and the creation of new knowledge and mental connections were individually negotiated and defined during the process.

In the context of the first Dare'n'Do seminar, regular collective reflection sessions highlighted that some students were not at all aware of the influence the unforeseeable has on the design process, independent of the mode of working. They quickly realized how little space and attention is devoted to these fleeting moments. The interpretation of the unforeseeable varied greatly and was perceived by students as either very positive or very unsettling, depending on the context, the form, and the moment in which the unforeseeable appeared to them. In his text "1.2 Archäologie des Designs," Oliver Ruf examines design based on its "susceptibility to interference" and its "dimension of irritation" (2020, 69; translated by the author). He argues that "design events are not seen as links in a causal chain" (70; translated by the author). Thus, they catch designers unprepared, emerging suddenly and seemingly random in their own uniqueness. To follow this investigation, the Dare'n'Do seminar developed into a series with constantly changing formats and topics. These seminars not only allowed students to engage with the unpredictable and grow an awareness of design events, but also included the unpredictable as part of the teaching concept. Unique formats initiated external impulses as ad hoc encounters and offered space and time for an open-ended process beyond purpose-driven, rational goals. Furthermore, sessions involving collective theoretical reflections were introduced. In these sessions, students discussed the ways the unforeseeable emerged in their projects, how they handled it, and what effect this way of handling had on them and still has on design in general. During several sessions, it was observed that students who had already gained previous experience in the open-ended design process, for example in the foundation course at the ABK Stuttgart, INKUBATOR, had fewer problems with this type of creative process and also with the productive handling of unplanned moments. On the other hand, students who had completed their basic education at other universities—applied science universities or in foreign countries—and whose experience was exclusively in goal-oriented processes, clearly had more problems with this approach. To contrast the potential and challenges of the open-ended process, examples from the

Dare'n'Do seminar Gestaltung trifft Biochemie (Design meets Biochemistry) will be illustrated in the next section (Weinmann 2017). The focus will be on two very different perceptions of interpreting and handling the unexpected from students participating in the seminar. For a better comparison, both examples refer to students with no prior experience in this kind of approach.

Potential of the open-ended design process

The Dare'n'Do seminar Gestaltung trifft Biochemie was developed after the collaboration project that resulted in the gel sphere experiments. Having seen the qualities of a joint exploration of biochemistry and design, this link seemed to hold great potential for exploration by architecture and design students. Like every Dare'n'Do seminar, we started with an ad hoc encounter as a non-design impulse. The students met researchers working in nano and micro fields at the Max Planck Institute for Intelligent Systems (MPI) in Stuttgart (cf. Fig. 6). Guided tours through the laboratories, lectures, and discussions provided the students with new impulses. In two three-day workshops at the Stuttgart State Academy of Art and Design, with tutoring offered from both fields—biochemistry and design—the students explored a chosen impulse in an open-ended and productive approach. One exchange student investigated the field of nano-molecular research, focussing on DNA origami. Inspired by this biochemist approach of creating inseparable yet flexible and mobile linkages, she started combining different mathematical knot theories and created structure models as haptic experimental prototypes (cf. Fig. 7, 8). These prototypes were made of paper, a material commonly used in design disciplines for model making. The student started the experimental process with the expectation that mimicking theories physically would lead to a better understanding. This proved to be the case when constructing flat-dimensional models on the table. Inspiration came from simplified illustrations in biochemistry papers as well as knot theories from the sailing industry. During the act of making and experimenting, the material was switched from paper to strings and cords and finally rubber bands, circumventing the problem of the paper strip's two

dimensionality.[9] Rubber bands had the advantage of being commercially available anywhere and offering a variety of colors. Assigning colors to construction categories helped the student to clarify the increasingly complex knot system and define rules and structure within this open-ended process (cf. Fig. 9, 10, 11). Inspired by the Borromean rings connection,[10] which is also used in a less complex way in biochemistry, a flexible but inseparable connection of rings developed. The outcome was a flexible but inseparable structure in which it was possible for the rings to change position (cf. Fig. 12, 13, 14). Through a continuous process of intuitive making and the implementation of new complex knot theories in the existing physical models, the student not only gained new knowledge about knot theories but additionally acquired new skills and new ideas, helping her to continuously act in a productive process. During the course, the student moved from two- to three-dimensional space, assuming this complexity could be investigated in several dimensions like a spider web. She expected the built system would help her to reduce the complexity and understand more clearly. She then systematically enhanced a self-determined color categorisation strategy and introduced a transparent box as a working tool. With this step, an increasingly complex network construction evolved. At this moment, the student was not able to imagine the outcome because it exceeded her cognitive abilities, both due to her lack of experience and the complexity of the system. The unforeseeable, as a moment with transformative potential to the design process but also in the form of the physical object, occurred when levels were cross-linked in the model. Suddenly, not only the individual pair of rubber bands changed position as before, but the entire three-dimensional shape of the system behaved in a completely unexpected way. A mental transfer into an architecturally innovative framework construction

9- If a paper strip is connected at the ends to form a loop, there is always the problem of the paper's flatness, which not only creates restrictions in the movement, but also limits the possibility of expanding in a third direction.

10- Borromean rings usually consist of three rings, which are unknotted in pairs but cannot be separated from each other. Due to the accurate connection, in the example of 3 rings, it is possible to change the position of two rings without having to separate the system, as illustrated in *The Borromean Rings* (Cromwell et al. 53).

suddenly became not only possible, but obvious. The artifact developed was also very surprising for the biochemist Maximilian Urban, since such complex functional prototypes can not yet be produced on the nanoscale. He, too, had not expected this behavior and was fascinated by the information this model provided in terms of complex movement behavior studies. During this process, an artifact was created that not only served as a constructive prototype for architectural hypotheses and further research, but was also new in itself, extraordinary, and highly exciting. It aroused curiosity and stimulated further exploration. The inspiration provided by an ad hoc encounter with biochemists, the curiosity aroused as well as the creative process gave the student space and time to intuitively test and produce new things without fear of judgment or failure. This led to a continuous flow of exploration and reflection, constantly producing complex models, developing new ideas and handling unexpected moments. Despite her inexperience, uncertainty, and lack of clarity about the direction of the process she did not feel uncomfortable. Being given space and time, as well as the unusual format, enabled her to reflect on her approach and experience the potential of an open-ended design process.

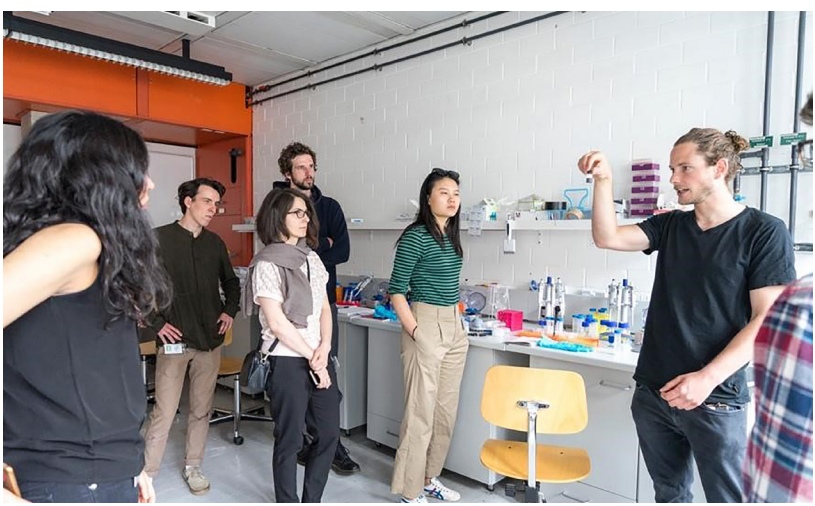


Fig 6: Biochemist Dr. Maximilian Urban illustrates laboratory work with DNA for students of ABK Stuttgart.

Fig 7,8: Prototypes made of paper, approaching knot theory.

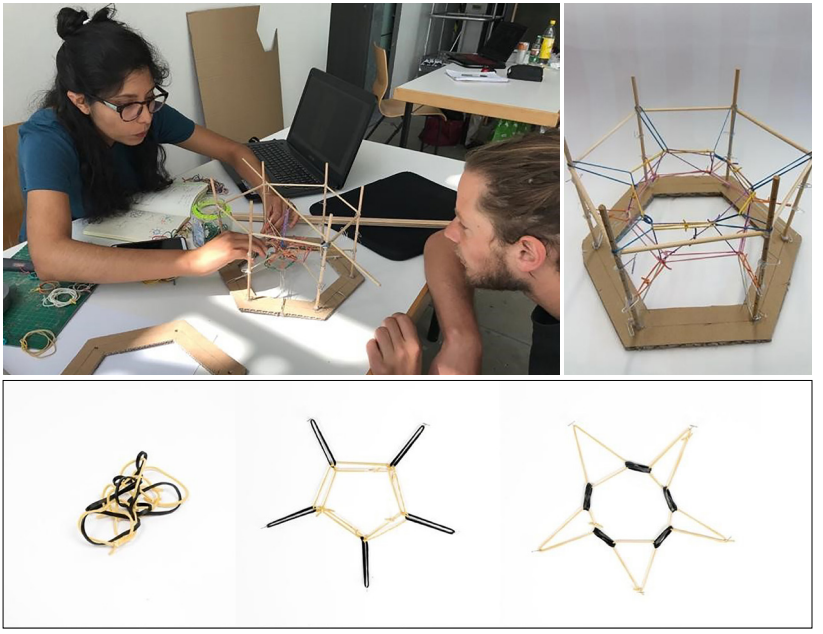
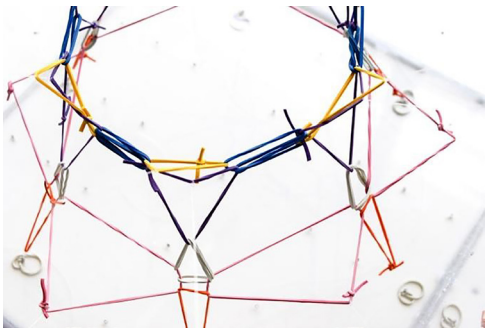
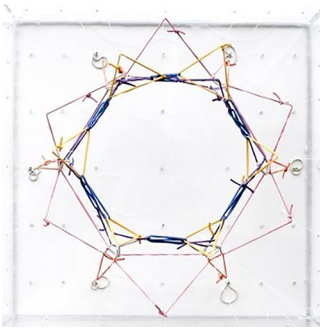


Fig 9,10,11: Working on prototypes made of rubber bands.





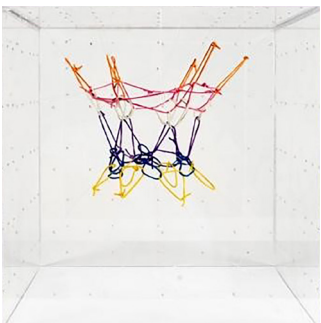


Fig. 12,13,14: Final outcome: a flexible but inseparable structural model in which it is possible for the rings to change positions. Materials used: rubber, nylon thread, and acrylic cube.

Challenges of the open-ended design process

Another student participating in the same seminar experienced something quite different. Just as enthusiastically, this student followed an impulse from the ad hoc encounter, in her case flexibility in controlling UV light on the nanoscale. Comparable to the previous example, she too transferred this topic into a dimension that was tangible and interactable for her. A setup including dynamic and flexible light refraction using a simple laser beam and transparent gel spheres was developed. From this point on, the process could have been driven by her curiosity, her interest, and her perception. The potential inherent in those very first approaches appeared completely obvious to the external observer. However, surprisingly, the student faced great difficulty entering the productive process from this point on. Missing a preset goal and the fear of not having a clear understanding of where the process might lead kept her from becoming productive. Even after several intensive and motivating exchanges with the tutors from

both the design and biochemistry fields, she only succeeded in a rudimentary and short-term productive creative process, sticking strictly to the suggestions given by the tutors. In reflective discussions, it became clear that she struggled with the lack of planning certainty and any externally set evaluation logic in this kind of design process. Furthermore, the qualities of unplanned events that appeared in this process were either not seen, ignored, or recognised and evaluated as mistakes and failures. Hence, as soon as she realized the unforeseeable and understood her expectations were not met, she felt the urge to eliminate it. The recurrent negative interpretation of the non-fulfilment of her expectations in the shape of new and unknown things as, for example, meaningless, useless, or disturbing, combined with her insecurity in this mode of working, created a sense of frustration and inability to act.

According to Reinhart Koselleck there is a strong link between experiences gained in the past and expectations of the future. He explains: "Hope and fear, desire and will, concern, but also rational analysis, receptive contemplation or curiosity enter into expectation by constituting it" (2020, 355; translated by the author). This implies that prior experiences have a strong influence on our expectations and the way we deal with situations in which those expectations are not fulfilled. Thus, the student from the second example constituted expectations based on her experiences from the past. She expected something specific to happen, which did not happen in the end. Finally hope turned into fear and desire into concern. This correlation between experiences in the past and expectations of the future is also explored by Bruno Gransche ,who argues that past and future always intertwine and the unexpected is mostly understood as a risk that needs to be prevented. He points out that "disappointments of expectations resulting in damage can be understood as accidents" (2015, 211; translated by the author). In his view, this way of interpreting unfulfilled expectations cannot be interpreted as an event with potential and value. Since the unforeseeable cannot be foreseen and therefore not expected, the designer who equates the unpredictable with risk will not be able to see the potentials therein. Luhmann even claims: "And if the absence of expected benefits also

counts as damage, all the more the entire future qua future falls under the dichotomy of risk and danger" (2003, 36; translated by the author). This explains why the student mentioned above was incapable of acting. Due to the absence of expected benefits, she was full of fear, seeing only risk and danger in the future and thus in the continuation of the process. Without a fundamental trust and openness when approaching the unknown during an open-ended process, it is very difficult or nearly impossible to break out of this cycle. Therefore, previous experiences correlate to expectations, the world behaves differently than expected, disappointment follows and leads to negative experience. Those experiences in turn influence future expectations and interpretations.

These two student examples suggest the opportunity and potential in dealing with the unforeseeable in an open-ended design process but also point to several possible conflicts and problems. The first example illustrated how an open and curious adaptation to the approach enabled new ways of exploring the unknown. The making of things gave access to and enabled the designer to create something new. The second example, in contrast, showed how past experiences influence expectations of the future and the way of acting if those expectations are unfulfilled. It illustrates how this correlation can lead to a limited perception, seeing only risks and danger instead of chances. Not having a specific goal in mind and letting go of control was experienced as joy by the first student, for the second student it led to fear due to the lack of control and ultimately ended in stagnation.

Planning the unplannable: a paradox

The wish for control and plannability during a design process is not uncommon. Since the unforeseeable, as pointed out in the beginning, is inherent in every design process, the wish to understand and (re-)produce such events might lead to the paradox of trying to plan the unplannable. But how come some designers find it so difficult to let go of control and embrace the unexpected instead of wishing for a plan and to foresee? One indication could be that goal-oriented design processes have been paradigmatic in the design field since the introduction of serial

industrial production.[11] The planning paradigm of the 1950s and 1960s attempted to structure the incalculability of the design process, so that it was easy to understand, particularly for non-designers, and thus made it more plannable, predictable, goal-oriented and therefore also teachable.[12] In particular, the interdisciplinary movement for the systematization of design, known as the Design Methods Movement, not only caused a formerly unknown methodological curiosity about design but also reduced the design activity to pure planning (Frye 2017, 81–82). Design processes were to be made rationally comprehensible and discursively communicable (Mareis 2013, 4). This led, as Mareis discussed, to numerous debates in the 1960s (2011, 35). Subsequently, various design methods were developed and have been established in the design discipline over the last decades. In some cases, these methods, Design Thinking for example, increasingly served as an interface function between different professions and support for understanding and communication between different expert rationalities (Lindberg et al. 2009, 47). Design Thinking was established as a strategy-making model for politics and management (Owen 2007) and turned into a learnable additional qualification for non-designers within an education (Stanford d.School n.d.). This eventually led to its popularity growing more outside the design field than inside. Generally speaking, methods are great tools for designers to reach specific goals when using them. In addition, they enable an increase of awareness and understanding of the necessity of the design discipline for non-designers. But at the same time, the limitations of seeing design as a discipline mainly based on methods, which is commonly taught at different design schools, communicates an incorrect picture of the design process as being totally structured, predictable, and applicable and therefore controllable. As a

11- On the development of the concept of design cf. Mareis (2014) and Bürdek (2005 and 2012). On the distinction between design and science see Simon (1996).

12- Frye and Mareis both explored the planning paradigm in the Design Methods Movement in more depth (Frye 2017, 14, 83–86; Mareis, 2011). For more information on a unified methodology see also Krippendorff (2006), Simon (1996), and Bürdek (2005 and 2012).

consequence, the unknown and unplannable dimensions inherent in every design process are completely ignored. The general longing for security, structure, and order is firmly anchored in our society. It is explored by John Dewey in *Experience and Nature* where he argues: "The need for security compels men to fasten upon the regular in order to minimize and to control the precarious and fluctuating" (1929, iv). He emphasizes that "uncertainty and indeterminateness […] create the need for and the sense of order and security" (396). Whilst stressing its sociocultural influences, Dewey gives an understanding of how this effect of rationalization and wish for control of our environment is strongly rooted in our society and therefore not exclusively linked to the context of the design process. To clarify, a goal-oriented process, structure, and the use of methods must not be understood as unnecessary or fundamentally wrong. The relevance of controlling, planning, and focusing in design becomes obvious the moment concrete tasks need to be fulfilled and solutions need to be found for specific problems. At the same time, it turns out to be less reasonable when the urge for controlling and planning prevents the designer from seeing further potential in the unforeseeable and understanding the unknown as a source of creativity. As mentioned at the beginning, this leads not only to frustration and fear but often to a strong discrepancy between the communicated processes of planning and analysis and the reality of an actual design process, which might be rather spontaneous and improvised. Not only does this dichotomy have a strong impact on the role of design in our society, it also affects the designer's self-confidence and thus their behavior in job assignments, collaborations in interdisciplinary teams, and their general ability to act when facing the unforeseeable.

Another reason to examine the long-standing question of the necessity of planning and controlling design processes is caused by the overcoming of the disciplinary borders currently visible. As pointed out by Anke Haarmann, today's designers do not only design patterns, shapes, and products anymore but also data flows, corporate structures, human interrelationships, communication

platforms, social processes, and political controversies. They explore the designed world with the means of their speculative expertise and intelligence (2020, 217). The joining of different variables and disciplines is nothing fundamentally new to the design process. But a work field that rapidly expands into completely new areas can be expected and already observed today. Interdisciplinary teams work collaboratively on projects for public exhibitions (Stuhl et al. 2017), in research clusters (*Exzellenzcluster Bild Wissen Gestaltung; Matters of Activity*), for university-based institutes (*MIT Media Lab*) or with scientists in the field of astronomy (NASA/JPL et al.). These new kinds of collaboration, where experts from different fields work intensively together and not only next to each other, are found more frequently and yet seem unusual. They change the way we define disciplines in general and how we can encourage a new interdisciplinary way of working and thinking. Until now, interdisciplinarity has been mostly seen as a temporary form of collaboration, aiming to provide the most appropriate problem-solving potential through the cooperation of suitable experts from different disciplinary backgrounds (Jaeger and Scheringer 1998; Balsiger 2005). The evolution of the term *transdisciplinarity*, for example, established another form of research and science. Compared to *interdisciplinarity*, not only does it go beyond a collaboration for a limited period of time, but it can enable an ongoing, self-changing systematic order of science (Mittelstraß 1998, 1). This has enabled a new way of thinking and engaging without disciplinary restrictions, continuously developing and shifting the borders of the disciplines, until they are no longer relevant or visible to those participating.

Designers today are increasingly involved in technological development processes, for example of DNA reading devices (Oxford Nanopore Technologies), in constructional works with living silkworms (Mediated Matter research group), in the development of advanced, interactive planetary-scale analytical systems (NASA/JPL, Caltech, and Art Center College of Design, n.d.) or in the exploration of memories inherent in our visual memory (*Max-Planck-Institut Für Empirische Ästhetik*), to name just a few. These new fields of practice

are no more or less relevant to our society or our everyday life than the design processes of serially produced products. However, new fields of practice also create new spaces and opportunities for designers to apply their knowledge and skills in unknown contexts. Since these novel fields of research and action often operate in uncharted territory and deal with a high degree of uncertainty, designers offer great potential due to their ability to creatively and productively handle the unknown. This requires an understanding of all aspects of a design process, specifically those that do not exclude the unforeseeable. However, the risk we are facing here is that this understanding and categorisation might lead to a functionalization of the unforeseeable and therefore again a strict methodical approach. This research must not be misunderstood as a call for new methods with future predictable results to follow. Instead, it asks for a general understanding and appreciation of the unforeseeable in its diverse shapes. Consequently, it will lead to a new way of collaborating beyond disciplines necessary for the future. One approach to introduce this general understanding and appreciation of the unplannable in the design process can be seen in the discussion on improvisation. In this context, the ephemerality of unplanned moments as well as the emergence of new things due to improvised actions becomes clear and is worth considering in more detail.[13] Nevertheless, performativity and intuition as well as spontaneity in the process are needed when handling the unforeseeable productively.[14]

Impulses

The ability to improvise spontaneously and combine existing knowledge, skills or means in the form of materials, techniques, tools, and artifacts with a variety of new impulses from outside the design field plays an important role in any design process.

13-Several authors explore the creative potential of improvisation with curiosity and without the necessity to formulate a methodology. Cf. Frye (2017); Jencks and Silver; Landgraf; Feige (2020).

14- Consequently, this might lead to an exchange of the eureka moment with an acceptance of the unforeseeable in the design process. This involves a negotiation process on a formal, technical, and social level, which includes plannable and unplannable aspects alike.

Since designers find themselves increasingly confronted with fast-developing technology, new contexts, and new work fields, they will also be confronted with unknown professional cultures more frequently. This involves engaging with, learning about, and often improvising with foreign work languages, work environments, perspectives, materials, and tools. Cross-disciplinary thinking and direct interpersonal encounters, therefore, catalyze the production of and the confrontation with the unknown during a design process. In *Relational Aesthetics*, Nicolas Bourriaud explored the fact that during such encounters knowledge, tools, methods, topics, and interests collide, atmospheres are intensified, new things emerge through dialogical exchange, and the experiences made leave a lasting impression on all sides, which in turn initiates individual processes (2002). Haarmann states: "Design processes are activities that take place between the designers, the users, and the things of design, in the course of which all those involved change and participate" (2020, 224; translated by the author). If we understand the unknown as a source of creativity, then human encounters can also be seen as factors with great transformative potential, alongside unknown materials or tools. The Dare'n'Do seminars enabled designers and experts from non-design fields to meet in dialogical and interdisciplinary formats. One example is the Dare'n'Do - Identität – Wohnzimmergespräch (Identity – living room conversations; Weinmann, 2018) in which the participants explored in conversation the question of how the term identity manifests itself in different contexts. An intensive exchange of definitions and perspectives took place in an open atmosphere (cf. Fig. 15, 16). Five guests from the fields of anthropology, empirical integration and migration research, blogging journalism, dance and performance as well as gender studies, were invited to discuss with architecture and design students. In the course of this event, a variety of methods were used to structure this very open dialogue format. For instance, real-time note taking enabled all participants to take part in the discussion and simultaneously take notes on what they considered as important or relevant. The written notes

and quick sketches were made on a large piece of paper covering a big dinner table, without being filtered by importance, the perspective or the discipline (cf. Fig. 17). This tool enabled the participants to keep track of thoughts and mental connections and helped the students to analyze and reconstruct these partly impulsive, unstructured but very valuable thoughts after the event. In this constant flow of unstructured dialogue, the notes were traces of this previous event, which produced so many unexpected ideas, questions, and suggestions and connected seemingly unrelated fields. In this ad hoc encounter, the students were not only confronted with an unknown format, experiencing the potential of interpersonal encounters and productive exchange of thoughts, perspectives, and approaches, but they also learned the potential of open-ended formats combined with open methods used intuitively and experimentally without strict structural constraints. Serving as an impulse for the open-ended creative process in the following three-day workshop, further methods such as "Reflection-in-Action" (Schön 1987, 76–267) or "Think Aloud" (Someren, Barnard, and Sandberg 1994) were introduced. The idea was to explore the potential of unexpected thoughts and ideas that appeared when the notes from the event were sorted through and to instantly speak out loud, write or draw any idea or connection that came to mind (cf. Fig. 18). Similar to the other Dare'n'Do formats mentioned previously, the development of the project needed to be negotiated for each individual's processes. A decision had to be made as to when to open and therefore give opportunity or when to close and therefore reduce opportunity for new things to evolve, focusing on the development of things that already exist. Such decisions influence what we expect of the process and how we deal with the unforeseeable.

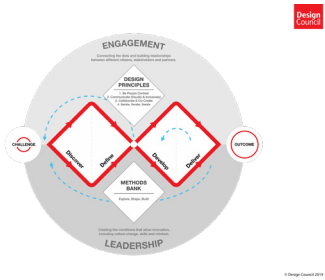

Fig. 15,16: Living room conversations "Identity." Guests and participants introducing themselves and asking questions in an open and relaxed atmosphere (left). Discussing and sharing perspectives on the term *identity* at the table whilst taking notes on the paper table cloth (right).


Fig. 17 (left) : Objects and notes on the paper table cloth.

Fig. 18 (right) : Dare'n'Do seminar students reflecting on ideas generated during the previous event and thinking out loud.

Fig. 19: Idea cards written by the students next to the table cloth with objects and notes from the event.

At this point, the question arises whether and when focus should be open or closed during a design process. The Double-Diamond design process model by the British Design Council (Ball 2019) or the Double Funnel Model by Paul Laseau (2001, 115) are two examples suggesting possible opening and closing structures (cf. Fig. 19, 20). The goal-oriented creative process has to be fixed or closed and therefore well structured, always comparing the results of steps with the expectations and, if necessary, changing the system in some way or another, leading towards the goal set. This is illustrated by a multitude of goal-oriented design methods thematised broadly in the field of design theory. Despite partial openings in the course of these processes, they usually resemble a narrowing funnel. In contrast, the result in an open-ended process cannot be determined from the outset. Neither the course of the process nor the ending can be predicted. Although this may seem illogical at first, an open design process also consists of focusing phases. But not according to a predetermined structure. It could much better be described as a fluid oscillation between focus and openness. To encounter and handle the unforeseeable productively, a good balance between exploration and focus is obligatory. Both openness towards unknown impulses, towards interruption and possibly a complete change of the process flow as well as the possibility to structure a procedure and at times focus on a fixed direction are essential. Switching between phases of exploration and focus becomes particularly relevant when experimental practices must be introduced into a design process.



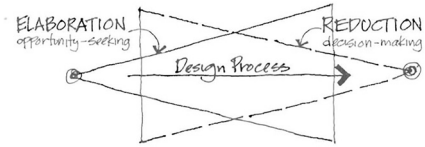


Fig. 20 (left): Double-Diamond design process model by the British Design Council
Fig. 21 (right): Double Funnel Model according to Paul Laseau

Experimentation, making, and poiesis

In the 1960s, experimental art practices were already inspired by fields and methods from non-design disciplines such as theory, ethnology, and sociology (Bippus 2019, 39). Thereafter, the process of experimentation was also introduced to the field of design. By definition, an experiment can be seen as "a scientific test that is done to study what happens and to gain new knowledge" or as "a new activity, idea or method that you try out to see what happens or what effect it has" (Oxford University Press, n.d.). The first definition might suggest introducing scientific approaches to gain objectivity while the second associates with the venture and the uncertain attempt of practice. In both cases, the act of experimentation can open the process since new and unexpected possibilities arise, or close it since alternatives are eliminated and one specific option is chosen to focus on. Generally, experimentation can be done in both open and closed design phases. In a lot of design processes however, experimentation is foremost understood as a way to generate knowledge.[15] This was also the case in the example of the MYTO chair. In contrast, the purpose of experimentation in the gel sphere example was not primarily about gaining knowledge, but about trying out, making, and seeing what happens during the process of making. The latter resembles the way Tim Ingold describes the process of thinking through making and learning by doing in his book *Making: Anthropology, Archaeology, Art and Architecture*. He points out that "the only way one can really know things […] is through the process of self-discovery" (2013, 1). He states further that "in the course of direct, practical and sensuous engagement with our surroundings," we can develop "skills of perception and capacities of judgment"(5). This process of producing and engaging with, but also understanding and changing, the world around us can be described as poiesis.[16]

15- Further discussions on the process of experimentation in design can be found by Marguin et al. (2019), see also Rheinberger (2012), Schmidgen (2017) and Dalsgaard (2016).
16- My understanding of the term poiesis is based on Georg Trogemann's description in *Reenacting Poiesis – More Anarchy in Technology*!: "We use poiesis (from ancient Greek ποιέω, English 'to make') to describe all operations and processes that bring something into being. This 'making,' which does not only include human action and therefore does not have to be goal oriented, is self-contained" (2020, 134).

Throughout such processes, something new can emerge as an idea, object of use, product or knowledge. The role of design is precisely to make and produce things that have not yet existed. A productive creative design process is therefore by no means an unintentional interaction with given structures, tools or materials. Rather, it is a purposeful way to engage with the world and produce new things. It must be kept in mind that this engagement is never independent of our expectations and imagination, which we constantly compare to the behavior of the world. But the question that must be discussed concerns the potential we see in these differences, the space we enable the unknown to take up and the way we handle it. Are we able to take the unforeseeable in with openness and curiosity and accept the limits of our capacity for imagination? Despite or maybe even just because of knowing those differences in expectations, imaginations, and the actual behavior of the world, designers are able to make decisions without knowing, to handle the unknown productively, and to produce new unforeseeable things that did not exist before.

Conclusion

We need to further question whether it is possible to derive a general conception of the design process including the emerging, perceiving, and productive handling of the unforeseeable or whether the design process can, in principle, never be understood as the implementation of a plan (Kim 2020, 245). This intention or research question must not be confused with the elaboration of a purely methodological objective, since the unplannable entails the paradox of never being plannable by definition. Nevertheless, to understand and appreciate the relevance of the unforeseeable in the design process and to make it fruitful, current methods and relevant methodologies in the design field still need to be further investigated. For example, further research needs to find out which and understand how methodologies already enable openness and encourage designers to make decisions based on limited knowledge and experience and for an unknown future. Also, most design theories focus on the role of

experimentation as a way of generating knowledge without addressing the role of poiesis in this productive process, something that could be explored further.

Another aspect that must be investigated is the transformative potential of the unforeseeable as an event and of the designer themselves, including their way of thinking, as this potential is not limited to the impact on design outcomes nor the design process as such. The designer involved is also changed. As P.M.S. Hacker points out:

> The general and obvious interrelationship between and mutual dependence of objects and events is no more than the unity of the spatio-temporal framework of our experience and its objects, of the world we encounter and of our thought about it. (1982, 480)

Consequently, the unforeseeable in a design process has to be seen as an event in an empathic sense, in terms of the possibility of transformation, not only including the things we interact with but also our relation to ourselves and the world (Rölli 2004). The transformative, innovative, and aesthetic potentials of those dimensions of a design process that are frequently ignored will be elaborated in further research. The objective is to raise awareness and to develop understanding and appreciation of these contingent aspects, both within and outside the design discipline. And finally, we need to question if this awareness might enable designers to act productively while being confronted with unknown technology, material, or work cultures in such a manner that they can authentically and confidently experience, appreciate, and communicate the unforeseeable as an integral part of the design process.

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List of Figures

Bubble experiment

Natalie Weinmann

I would like to take you on a thought experiment. Please try not to look at the images on the following page before reading this text.

Step 1: Imagine a bubble. A round sphere floating through the air.
Step 2: Now imagine a second bubble meeting and touching this first bubble. What does this pair look like?
Step 3: Next, imagine a third bubble joining them, touching both bubbles simultaneously. What happens now? How do they touch? What does this new triangular shape look like?

If we were asked to quickly illustrate this on a piece of paper, the outcome might look like the drawing in figure 1. In reality, it should look more like figure 2.[1] This may or may not come as a surprise depending on whether we have spent time in the past observing bubbles closely. Reducing complexity helps us to deal with everyday problems. But it also leads to us no longer being able to see the complexity of reality. Even though we know it is there, we try to ignore it. When two bubbles meet, they merge in such a way that the two surfaces between them adopt a shape and create one single surface. Since the bubble film has a surface tension,

1- Based on rules defined by physicist Joseph A. F. Plateau, soap films always seek "the most mechanically stable arrangement" and "the criterion for mechanical stability is that the junctions should always be threefold, with 120° angles" (Ball 2009, 64).

this minimizes the surface area, so that a straight wall is created between the bubbles if they are equal in size or bending into the bigger bubble if their size is unequal.[2]

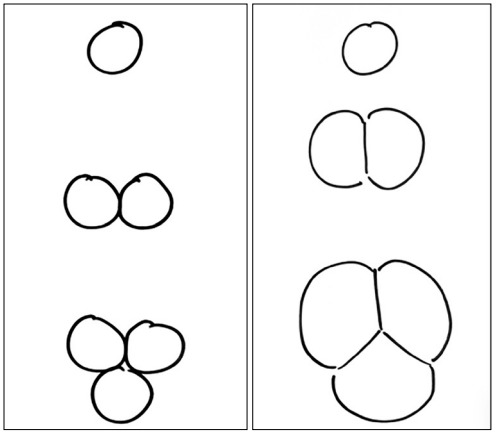

Fig. 1,2:
Drawings of bubble attachments.

Now continue the thought experiment as follows:
Step 4: Go through Step 1 to 3 again and specifically imagine the surfaces of the bubbles when they meet, keeping the process of merging in mind. Try to imagine the straight, thin soap film between two bubble cells. Which walls are straight and which are bent in your bubble compound?
Step 5: Now imagine more bubbles joining, slowly, one by one, on the sides, from the top, on connections of bubbles that are already attached and so on. How do they behave when another bubble joins? How does the soap film change its shape? Do corners appear? How many corners does your first bubble develop in the process of attachment?
Step 6: Finally imagine the bubble in the center bursting. How do the others behave now? Do they rearrange? Is there a movement? In which direction? Do they change their shape and adapt to the new situation?
It is very difficult to imagine such complex behavior in a system of bubbles. We may be able to follow this thought experiment to somewhere in the middle of Step 5, but, at some point there are too many factors we need to consider, resulting in us being unable

2- The capillarity phenomena on surfaces is explored intensively by Robert Finn (1999).

to imagine the visual outcome. Even if we know a lot about the mechanical arrangement behavior of soap films, we will always arrive at a point where we reach the limits of our imagination. For me, this lack of capacity creates a strong fascination. Our expectations of the behavior of the things we interact with is based on our experiences of the past and quite often does not match the real behavior of things. This is why, as a designer, I love to experiment with materials that designers do not usually work with. Because they behave very peculiarly and cannot be shaped in the way wood, metal or clay can, the forms they create can hardly be standardized, sometimes they can not even be reproduced at all, and are most often unpredictable.

In the following experiment, I create a setting in which I set constraints but also give the material the freedom to behave in its own way. I observe this behavior very closely, constantly building up new expectations based on my observations, comparing them to the real behavior of the material, and capturing unexpected moments as still photography or film. For me the camera has two purposes here. Firstly, as a tool to observe and focus on the object or part of an object I am interacting with. Secondly, I use it to filter and frame my discoveries for others to understand and see. Finding the correct time and aperture and producing the needed depth of field, together with the lighting, not only creates atmosphere, it also leads the viewer of the photograph right to the spot I want them to look at.

With the camera as a guidance tool, I would like to take you on a visual journey to the unexpected material behavior of the bubble.[3] In the chosen examples, there are factors I can control such as the sizes of the surfaces the bubbles attach to (some I can only partly define), the sizes of the bubbles, and the surrounding backgrounds and lights. But there are factors I can neither define nor control such as the self-assembling behavior of the soap film, the moment when the bubbles merge, and their lifespan until they burst.

3- For the purpose of better understanding, the bubble is described as one material in this experiment even though it consists of several ingredients. Most commonly water is mixed with washing-up liquid. Glycerin is sometimes added for stability.

Arrangements

In figures 3 to 6 the merging of bubbles and the straight lines of soap film separating the bubble cells can be seen step by step. Figure 7 shows unexpected arrangements due to different bubble sizes and figure 8 shows unexpected triangular cell shapes. The moment the constellation changes, for example when a new bubble attaches or when an existing bubble bursts, the whole system reacts and moves. Bubbles rearrange, form new connecting soap films or partly separate again if a distance has to be bridged for a more stable arrangement.

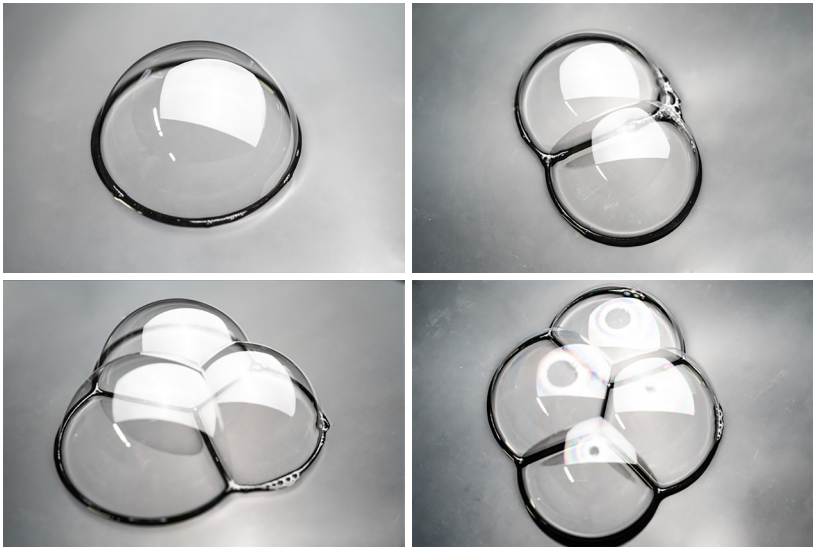

Fig. 3-6: Photographic series of bubble experiments showing different bubble constellations from one to four bubbles.

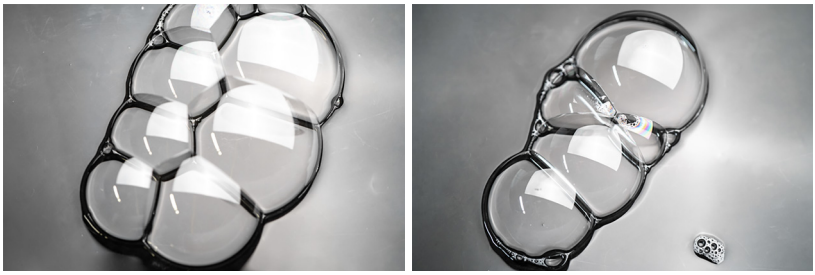

Fig. 7,8: Photographic series of bubble experiments showing different bubble constellations with different sizes and shapes.

The touch

We may assume that touching a bubble with another object will always burst it. This is only partly true, as I discovered during my experiments. The glass straw I used had very rounded edges, which did not break the surface. Instead, it connected with the soap film and caused the bubble to dynamically change shape, constantly adapting to the movements of the straw. When I moved the straw to the left and right but stayed close to the bubble it followed and deformed. This was also the case when I pushed the straw into the bubble (cf. Fig. 9–11). Taking this investigation further, I tried the same with constellations of bubbles, as can be seen in figure 12.

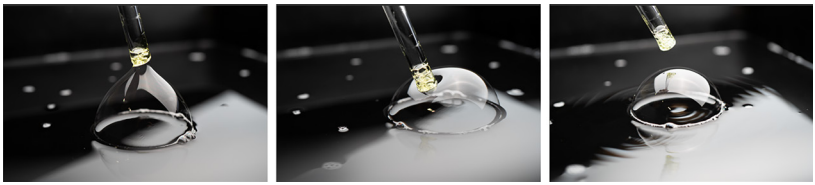

Fig. 9-11: Photographic series of a glass straw touching and shaping a single bubble.

Fig. 12: Photograph of a glass straw touching and shaping a bubble constellation.

One full space

In this series of experiments, I filled a space with bubbles of different sizes. The reaction of the whole system of bubbles when one burst was unforeseeable. There were usually two outcomes: either all the other bubbles burst in reaction to the first bursting or they rearranged in such a way that the space seemed to stay as full as before. It appeared as if the goal of the bubbles was to keep this space full for as long as possible (cf. Fig. 13–16).

Fig. 13–16: Photographic series of a bubble constellation rearranging in a black bowl.

Visible and invisible

This video was created by architecture and design students during one of my Dare'n'Do Seminars. In collaboration with Dr. Maximilian Urban, we created a workshop inspired by the field of biochemistry in which students could explore material behavior in an experimental way (Weinmann 2017). The video was recorded in a space lit only by black light, which makes the bubbles themselves invisible. Only the unforeseeable behavior of the fluorescent paint inside the bubble is observable (cf. Fig. 17 and video at www.darendo.com/relevanz-nanolab/).

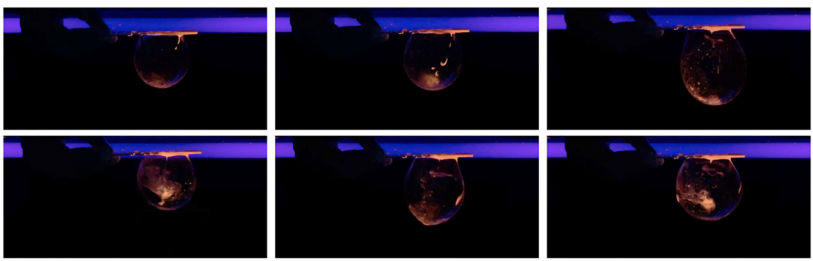

Fig. 17: Still images from a video created by architecture and design students, showing fluorescent paint moving inside a bubble.

Only lines

Like the previous experiment, this one was also conducted in a black light setting. Thousands of invisible bubbles were created in a transparent container, fluorescent paint was injected from the top and slowly made its way along the connection lines of the bubble cells. The soap surfaces, in contrast, did not allow the paint to attach (cf. Fig. 18).

Fig. 18: Photograph showing bubbles inside a transparent container with fluorescent paint illuminating connection lines.

Golden bubbles

This experiment was surprising as the video in combination with the setting created some unexpected outcomes. It would seem as though figure 19 presents an image of liquid gold or a similar metal. In fact, it is only regular soap water in a transparent container standing on top of a daylight projector. The daylight projector created unexpected colors that were only visible with the camera filming directly from above. The camera was not only a guidance or documentary tool but also became part of the experiment. Another surprising aspect was the appearance of unexpected thin lines

seemingly crossing through closed bubbles. This is another illusion caused by the daylight projector. Bubbles on top of each other are merged in the eye of the viewer and can no longer be recognised as several layers on top of each other, but appear as one.

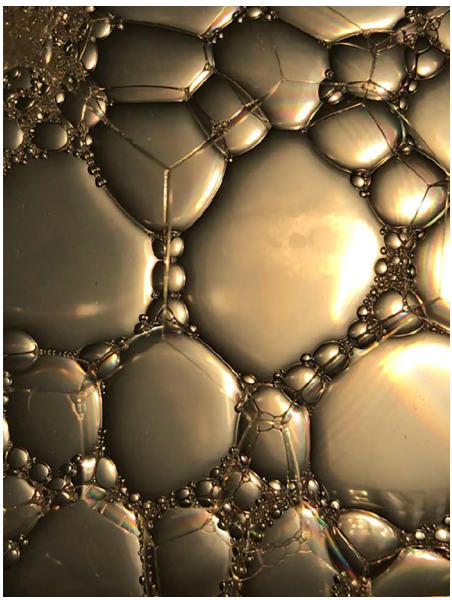

Fig. 19: Still images from a video showing golden bubble structures.

As simple as these little experiments may seem, they point out the rich potential of working with materials in a hands-on, open-minded and curious way. They also illustrate the difficulties we have imagining complexity and the limits of predicting the behavior of a complex system. Some interesting research has been done on the behavior of soap bubbles. Architect and structural engineer Frei Otto, for example, experimented with nets, wire models, and soap and used this as a technique for finding new forms with membrane surfaces (2015; 2017). Physicist Cyril Isenberg was also known for studying the analog computing possibilities of soap bubbles (1976). Nowadays, designers and architects mostly design in CAD (computer-aided design) programs that visualize the behaviors of membrane surfaces on buildings and use programming tools that solve complex mathematical and static problems. Soap bubbles are only to be found in bathtubs, at children's birthday

parties and in science centers these days.[4] When designers limit themselves to using CAD programs and programming tools, they also limit themselves to the boundaries of the structure given by these tools. Surprises and unexpected potentials are mostly excluded and the unforeseeable only shows up in the form of problems and mistakes.

I often hear the following sentence when working with design students: "I didn't do this, because I know what the outcome would be." But, remembering the thought experiment we began with, we reach limits when imagining shapes and material behavior if we do not interact with the material itself. Therefore, if we believe we can imagine the design outcome without interacting with the physical world, we are limiting ourselves to imagining a version of an outcome in a reduced complexity of whatever we are dealing with: a shape, a behavior, a reflection, a merging process. Not only does this lead to frustration and fear due to the unforeseeable showing up in the design process, it also reduces the perceived potential of the material and ways of imagining, seeing, and creating new incredible things in the future (cf. Fig. 20).

Fig. 20: Photograph showing complex bubble structure inside a transparent container.

4- Science centers mostly focus on explaining the color phenomena on the surface of soap bubbles, which arise from the interference of light reflecting off the soap film surface. The color we are able to observe is defined by the thickness of the film (Huibers and Shah 1997).

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List of Figures

Design and the role of tools

Steffen Mitschelen

Abstract
The disciplines of design have always been characterized by the tools available to them. In contemporary design, such tools are largely provided in the form of computer interfaces, designed to help users perform their everyday design tasks more quickly and efficiently. They ensure the feasibility and usability of design results by introducing standardized formats.
While the advantages of such tools have made them an indispensable part of today's design practices, they simultaneously impose limitations on the design process: When using such tools, designers go from authors to operators. The tools handle design problems from fixed perspectives and define the degrees of freedom within which design work can take place.
In this essay, I reflect on how design tools affect design work and argue for a more deliberate approach to the creation and use of such tools and the models they provide.

Introduction

> *I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail. (Maslow 2002, 15)*

Abraham Maslow's law of the instrument describes how the tools available for certain tasks have a direct effect on the way these tasks are tackled. In this essay I argue that this also holds true for the tools used in design. Design tools provide designers with the means to carry out design work. Such tools are intended to give users an advantage in the design process. In this context, advantage refers to a qualitative superiority compared to designers who work without such tools. A ruler, for example, allows for the drawing of straighter lines. A grid allows for a more elegant arrangement of elements on a page. And the view of a three-dimensional object on a computer screen allows for a more holistic understanding of that object's spatial relations. As such, design tools always emphasize the qualities they are supporting. A draftsman who draws with a ruler will tend to construct shapes with straighter lines than one without a ruler. The use of a grid will render anything that does not fit into it as bad taste. The holistic observation of a three-dimensional object on a screen places greater value on its overall structure than a sequential work on its individual parts. This fixation on certain aspects strongly influences the way tool-equipped designers think about forms while designing. Design tools are therefore actively involved in the specification of apparently desirable properties of things in the making. This makes the importance of a reflected handling of design tools obvious: understanding their nature consciously is the only way to ensure a conscious approach to the qualities they evoke in the results of their use.

However, a look at the current design mainstream shows that many contemporary design disciplines are heavily characterized by only a few state-of-the-art tools. Here, the application of design software has become an essential part of both the training of young designers at design schools as well as job descriptions in the industry, where a confident handling of certain tools is a frequent

requirement. As a consequence, designers often qualify themselves for their jobs precisely through the skillful use of specific design tools. In many cases, this goes so far that the brand names of a certain design software can be synonymously understood as the design work that is carried out in these disciplines. The ability to "photoshop" something, for example, becomes a necessary skill to survive in such a corporate environment. Designers in these fields therefore can hardly escape the use of standardized tools and, in the absence of alternatives, are often no longer able to question the implicit properties they convey.

The qualities reinforced by these tools increasingly constitute the image of what entire design disciplines aspire to do. Net artist and interface design professor Olia Lialina fittingly shares her experiences of working with design students who tend to rely on the tools they are familiar with, regardless of the context of the design tasks at hand. "99% of them are under the delusion that the design of everything in the world is made in Photoshop or other Adobe products," she criticizes, elaborating further, "in case the design is to be perceived on a computer, these Adobe files will be thrown into a room full of programmers who are longing to make it all interactive according to noble ideas embedded in the graphics" (Lialina 2010). It would be possible to draw up a long list. If the design showed a wooden table, it could be handed over to a carpenter. If it depicted a building, it could be handed over to a construction company, and so on. Of course, such tools and their associated production chains have already proven to be useful in their respective fields. If they hadn't, they would never have had a chance to become so popular. They secure the plannability and feasibility of design work as well as the manufacturability of the resulting forms through the introduction of standardized formats and procedures. They allow designers to work on things whose material characteristics would otherwise elude their way of working.

As powerful and useful as they are, it is nevertheless of tremendous importance to point out that thinking, in terms of the formats that design tools convey, can never be free and is always limited by the original thoughts of the tool's authors. Alternatives that

cannot be thought from the tool's perspective, and are potentially better, are thus excluded from the outset. As spaces for trivialized design thinking, design tools do not allow for higher-level changes in the abstraction of the design problems at hand.

This is important for the discipline of interface design, the perspective that I am primarily interested in, for two reasons: on one hand, interface designers, themselves part of the design mainstream, work with established design tools on a day-to-day basis. It is therefore of great interest for the discipline itself to develop a more conscious relationship with its own tools. On the other, the discipline of interface design is concerned with interaction. It questions and makes claims about how people should encounter the world and interact with it by means of predefined models. From this perspective, the following questions can be raised: How can the inherent effects of design tools be made more transparent to users? What exactly are those effects? How can the phenomena described above be made beneficial in the design of new design tools? In order to address such questions, it is first and foremost necessary to understand how design actually works. What are designers doing? How can design tools support them in the first place?

This essay attempts to offer a starting point for answering some of these more fundamental questions. In the first part I will introduce helpful concepts from the fields of design, architecture, anthropology, philosophy, and psychology. In the second part I will present some practical examples to make these claims and phenomena more tangible. To conclude the essay, I will briefly outline how I personally plan to proceed with the topic at hand. For this purpose, I will introduce a short project sketch.

Design

In the following I will roughly outline the activity of design as a complementary coupling of inner thinking and external action, aimed at solving certain design problems, leading to some desired results in the world. I argue that it is precisely the way in which this coupling between thinking and acting is handled that determines how design problems can be addressed and what qualities can be aspired to during a process of design.

Artifacts, context, and form

In contrast to all other living things brought forth by nature, we as human beings no longer adapt to our habitat through a purely biological development of our bodies, but primarily through technological means we exert on our environments. As Colomina and Wigley point out, "the whole of our evolution has been oriented towards placing outside ourselves what in the rest of the animal world is achieved by species adaptation" (2016, 52). Thus, instead of having to subordinate ourselves under a larger biological order, the technological means we have invented allow us to adjust the forms of the things around us to our needs. The philosopher Georg Picht identifies this particularity of humanity as the origin of design, namely "that original capacity which enables man to produce and plan, to build himself houses, to found cities, to form states, and to produce that artificial world which makes life possible for him in the face of a hostile nature" (1959, 431; translated by the author). In short, design is the foundation of all the artificial things, the artifacts, which we create to deal with the diverse challenges we face in the world every day.

Sociologist Herbert A. Simon's definition comes in handy in helping us understand how artifacts work. He characterizes an artifact as a gate, an "'interface' in today's terms between an 'inner' environment, the substance and organization of the artifact itself, and an 'outer' environment, the surroundings in which it operates" (Simon 1996, 6). According to the architect Christopher Alexander, these two spheres of the artifact can be understood as its context and form. Alexander defines the form as "a part of the world

over which we have control, and which we decided to shape while leaving the rest of the world as it is. The context is the part of the world which puts demand on this form; anything in the world that makes demand on the form is context" (1964, 18). The act of design, therefore, is synonymous with the search for a suitable form for an artifact that solves a design problem, i.e., that enables it to have a desired effect on a given context.

Since artifacts are based on human action, they are always contingent, just one realization of countless possible variations of form that were conceivable at the time of their design. As a simple example of this variability, let us consider the different types of electric power plant. Although all power plants are intended to solve the same design problem—to supply their context with electricity—quite different processes take place in their internal structures. A coal-fired power plant is based on a fundamentally different form than, say, a nuclear power plant. Their inner processes are completely different. At the same time, all possible variants are characterized by different side effects, i.e., undesired or unforeseen effects that artifacts have on their context. In the example of the power plant, this would include effects that occur during the extraction of the required materials or the production of waste and pollutants that are accepted as necessary evils as long as the artifact fulfills its duty. The question of the best form for an artifact is up to design, because, as Picht explains, things "must 'sit' properly in the context of the world into which they are to be placed" (1959, 433; translated by the author). However, such a question cannot usually be answered objectively since it depends essentially on the criteria considered important by the designers in charge. This is why the perspective from which a designer approaches a design problem is of utmost importance to anything that may follow on from it.

Design thinking and representational actions

Psychologist Pierre Sachse's concept of the design process offers a clear picture of how the criteria taken into consideration shape emerging forms. Sachse describes design activity as a complement of inner

design thinking *(Entwurfsdenken)* and external representational action (*Darstellungshandlungen*) processes. Design thinking in this regard means a gapless thinking ahead, that sets the goals of design and thus controls its boundaries. For Sachse, "'gapless' means that thinking ahead must already include everything that concerns the artifact to be produced, i.e., function, effect structure, production and appealing form" (2001, 5; translated by the author). In design thinking, all knowable attributes a desired form should meet are collected. The complementary representational actions include all such gestures that can be used to apply the contents of this thinking to the material world. "In the external representational action," Sachse explains, "the inner processes of the planner are complemented by a kind of 'auxiliary language,' which can, at the same time, be carried out in different symbol systems with varying abstraction" (39; translated by the author). Representational actions may include work on the actual materials of the final artifacts as usually happens, for example in traditional crafts, but also the creation of sketches or other makeshift forms typical of contemporary design disciplines. Sachse emphasizes that representational actions are never just neutral activities, merely following some purely internal commands. "It is crucial," he argues, "that the externalization is not simply equivalent to a fixation of internally fabricated solutions/ideas, but that these are shaped, if not generated and developed, in the mental-motor process" (33; translated by the author).

Thus, during design processes, forms always emerge from iterative feedback loops between thinking and acting. Ideas that arise during design thinking are transferred into material forms by means of representational actions. The virtues and shortcomings of these concepts are thereby made tangible through practical implementation. Aspects of the form that are not quite right or that had not been considered before, are detected by putting them into perspective. This process leads to gaining knowledge about the design problems at hand and initiates a next round of design thinking and representational actions and so forth until the designer is satisfied with the outcome. "The process of alternating

internalization and externalization seems to be at least the 'gear' if not the 'engine' of the design process. The 'inner' and 'outer' processes thereby constitute an unalterable, necessary unity" (Sachse 2001, 72; translated by the author).

Tools

Tools occupy a very special position among artifacts. They serve as extensions of our bodies, thus granting us new abilities. Tools give emphasis to our gestures. A hammer, for example, allows us to focus the strength of our arms to one single point in a way we would not be able to without a hammer. Likewise, a pair of tweezers grants us a sensitivity that we could never master with our bare hands.

In the field of design, tools can be characterized as intermediate artifacts. As such, they are not created as ends in themselves but as means to make the creation of further artifacts feasible. To illustrate this, let us consider the hammer again. Humans did not initially create hammers because they needed them per se—they created them to split stones or to drive nails during a superordinate manufacturing process. In the same way, a drawing board is not created for its own sake but to support the conception of new forms during representational actions. In summary, design tools are sub-forms helping to satisfy sub-contexts that arise during the creation of a primary form to satisfy a primary context.

Once created, all tools can be re-used in further projects where they help to speed up the process of making, as the sub-problems they solve do not need to be rethought from scratch each time. Thereby, it is important to remember that tools are by no means neutral. Since they are, as I have shown, materially fixed solutions to precisely defined sub-problems, they always carry the intention of their creators. When using a tool, users not only agree that the answer the tool suggests is the right one but moreover that their creators have asked the right questions. Tools put their users into a state of mind from which they approach problems from a given perspective. As already stated in the opening quote of this essay, the moment one picks up a hammer, one accepts the current situation

as one in which hammering in nails solves a certain class of problems. In a similar way, a designer working with a drawing board could easily be misled into believing that all possible forms can be represented graphically. It thus becomes difficult to consider the actual problem from a more abstract perspective. In a world where standardized tools are pervasive, it can be difficult to think outside of the toolbox. Only the critical questioning of what the available tools suggest we do can eventually give birth to new approaches. Cognitive scientist Don Norman illustrates the moment in which a designer takes such a shift of abstraction as follows:

> Once you realize that they don't really want the drill, you realize that perhaps they don't really want the hole, either: they want to install their bookshelves. Why not develop methods that don't require holes? Or perhaps books that don't require bookshelves. (Yes, I know: electronic books, e-books). (Norman 2013, 44)

Models, interaction, and correspondence

In view of design as a feedback loop, the importance of appropriate means for representational actions becomes very clear. The design process can only provide designers with knowledge about such properties that have been made tangible by the chosen tools and materials.

Since models are always abbreviations of reality, design tools are always abbreviations of the design contexts which they represent. This means that they are always limited to a selection of attributes that can be mapped and edited. To give a simple example: design work in a black-and-white drawing space may allow for conclusions about some geometric relationships, but not, of course, about the color scheme of an artifact under construction.

According to anthropologist Tim Ingold, such model-based activities can be described as interaction. He draws attention to the fact that the very concept of interaction suggests that only a superficial understanding between all the interacting parties can take place. He explains: "The implication of the prefix inter-, in 'interaction,' is that the interacting parties are closed to one another, as if they

could only be connected through some kind of bridging operation" (2013, 107). While a model mediates between the context and form, it always also stands between the two. The considerable advantages of direct feedback processes are lost in favor of those of design as interaction, as reflected in the growth of technological possibilities. Limited by the attributes the model provides, designers can only develop an equally limited understanding of the design context while designing. Hence, Ingold characterizes interaction as "inherently detemporalising, cutting across the paths of movement and becoming rather than joining along with them" (107).

As an alternative to interaction, Ingold introduces the concept of correspondence. Based on a continuous and intimate exchange of information between several partners, correspondence emphasizes the benefits of being and acting in the world. He explains: "To correspond with the world, in short, is not to describe it or to represent it, but to answer to it" (2013, 108). Ingold illustrates the differences between the two concepts by contrasting anthropological and ethnographical research methods. Based on interaction, "ethnography is a study of and learning about" (3). The filling out of multiple-choice questionnaires comes to mind. The results can hardly be surprising, since all possible outcomes have already been laid out in advance. All that may come out as a result here are variants of something already fixed. By contrast, based on correspondence, "anthropology is studying with and learning from" (3). A researcher who participates in the life of a culture with an open mind will most likely come up with surprising results.

Obviously, timing is important for both approaches. It is about using them consciously and being aware of their limitations. Interactive procedures are supposed to lead to quantifiable results easily and quickly due to their standardized applicability. Correspondence based procedures, on the other hand, may reveal potentially new qualitative insights through individual, long-term procedures. In design, all activities that are not carried out through abstract models but in the actual design context itself can be described as correspondence. Designers performing representational actions

not ex situ through a model but in situ in the actual design context potentially reveal entirely new criteria to work with.

Quality

The two different concepts, interaction and correspondence, are accompanied by distinctly different notions of quality. Interactive design processes must aim at the best possible satisfaction of some attributes that have to be defined explicitly right from the start. A high quality in the results of such an approach is therefore given if a form meets these attributes as closely as possible. This enables the design of highly complex technical devices whose functionalities are essentially based on formalization, as in machines and computers. At the same time, however, the idea of giving equal weight to all the attributes of a context becomes unattainable. Since it is clear that the chosen model can never cover all aspects of a design context equally, the results of interaction are always only relatively good by default. From an interactive perspective, "the gap between satisfactory and best [...] is of no great importance, hence the unrealism of the assumption that the actors optimize does not matter" (Simon 1996, 29).

In view of architecture, one could, for instance, consider the example of the prefabricated house, which by neglecting its exterior, can no longer respond directly to its surroundings (cf. Fig. 1). Alexander expands on this and explains:

> Instead of orienting the house carefully for sun and wind, the builder conceives its organization without concern for orientation, and light, heat, and ventilation are taken care of by fans, lamps, and other kinds of peripheral devices. (1964, 29)

In stark contrast, the qualities of correspondence cannot be evaluated out of context. The intended quality here consists precisely in the most optimal harmony between context and form. According to Alexander, such a concept of quality can be understood as the wholeness of a system. He explains: "A view of the building as a whole means that we see it as a part of an extended and undivided continuum. It is not an isolated fragment in itself, but

part of the world which includes the gardens, walls, trees, streets beyond its boundaries, and other buildings beyond those" (Alexander 2002, 80). To highlight the added value of such a quality, Alexander shows the configuration of a hut system of the Mousgoum, a culture without written design theory that constitutes an illuminating contrast to the example of the prefabricated house (cf. Fig. 2). Using relatively simple means, this evolved structure meets both the inherent demands of the group as well as all external environmental challenges by gradual adaptation. Alexander summarizes its structure as follows:

> Each hut nestles beautifully in the dips and hollows of the terrain. It must, because its fabric is as weak structurally as the earth it sits on, and any foreignness or discontinuity caused by careless siting would not have survived the stresses of erosion. [...] The grouping of the huts reflects the social order of their inhabitants. Each man's hut is surrounded by the huts of his wives and his subservients, as social customs require—and in such a way, moreover, that these subsidiary huts also form a wall round the chief's hut and thereby protect it and themselves from wild beasts and invaders. (1964, 31)

The design mainstream of today, as well as its tools, is distinctively defined by interactive design procedures. Its associated machine-like quality is now so pervasive that it defines our idea of how the things around us come into the world and what good design is all about. Simon fittingly reports on the disbelief of his architecture students when confronted with the fact that medieval cities grew correspondingly—without the involvement of a superior planner and in response to myriads of individual human decisions over time, fulfilling countless needs of their individual users:

> The idea that a city could acquire its patterns as naturally as a snowflake was foreign to them. They reacted to it as many Christian fundamentalists responded to Darwin: no design without a Designer. (1996, 34)

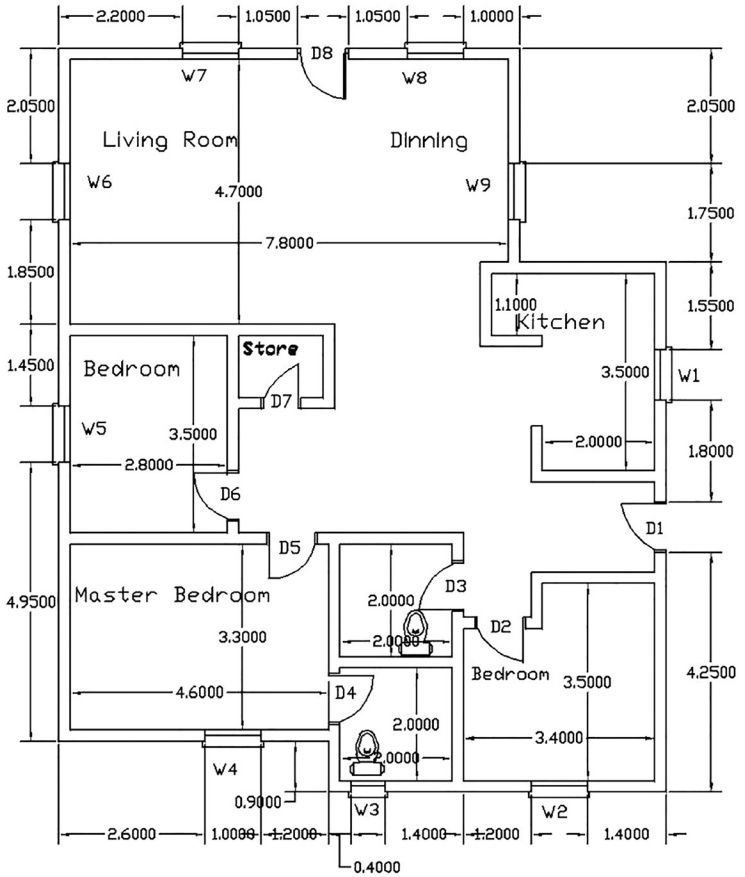

Fig. 1: Typical blueprint of a prefabricated house. Generalizable and abstractable user needs are served.

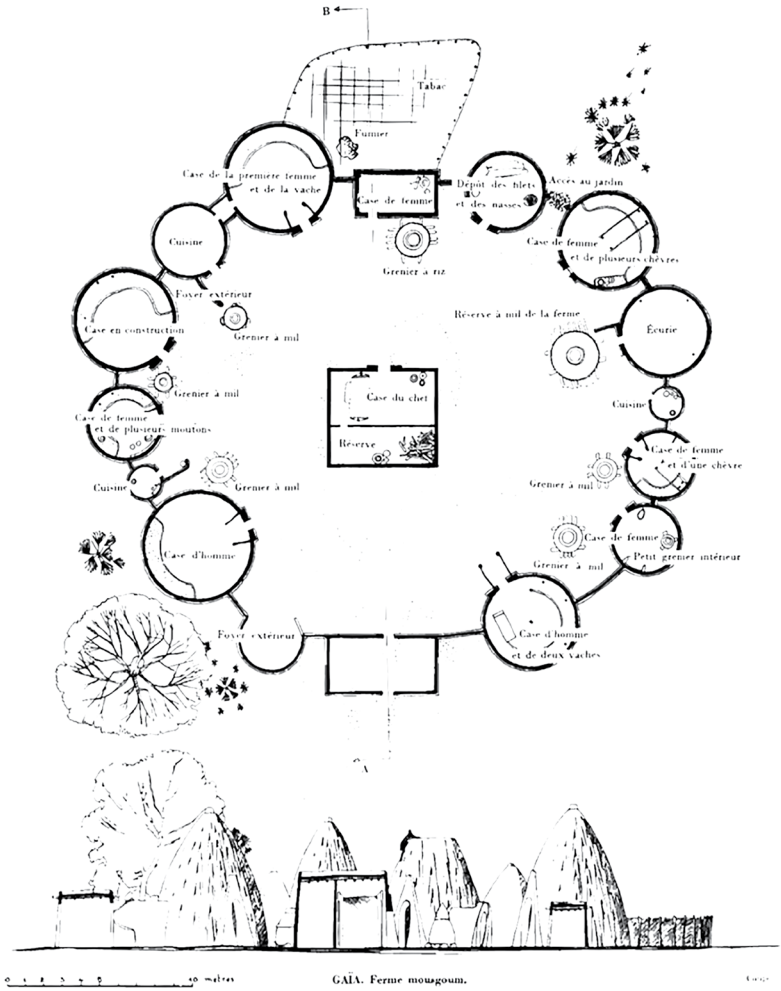

Fig. 2: Drawing of a hut system of the Mousgoum. Multiple demands from the context contribute to the shape of a holistic system.

Case study

In the following, I will briefly present four examples that show the described relations in concrete cases. They demonstrate how the contextualization of design thinking and representational actions are directly reflected in different design processes and in their associated products. In 2.1 and 2.2, I show two examples from the design of physical artifacts that carry very different notions of quality. In 2.3 and 2.4, I will then show two experimental settings from the history of digital design tools that likewise evoke very different qualities in the forms that can be created under their application. They give a sense of how the phenomena described are implemented in the form of tools.

The Wheelwright's Shop

The Wheelwright's Shop is an autobiographical report by George Sturt, the owner of a wheelwright workshop in Farnham, Surrey, England. Sturt took over the two-hundred-year- old family business in 1884 and ran it until 1891, when it went bust in the face of the new demands of industrialization. "To say that the business I started into in 1884 was old-fashioned is to understate the case," Sturt writes in the introduction, "it was a 'folk' industry carried on in a 'folk' method" (1958, 17). The report describes in great detail the processes that were used in the production of traditional wooden carriages (cf. Fig. 3). The most astonishing thing is the ubiquitous use of non-formalized knowledge, characteristic of all the working steps described. The choosing and felling of the right trees, the versatile processing of the wood, the necessary blacksmithing: there were no explicitly formulated guidelines for any of these tasks. Instead, workers had to rely on individual experience and intuition acquired directly in the context. Sturt points to the lore, an extensive network of knowledge that developed over time between all those involved in the manufacturing process, allowing them to act under such conditions. He explains:

> The lore was a tangled network of country prejudices, whose reasons were known in some respect here, in others there, and so on. In farm-yard, in tap-room, at market, the details

> were discussed over and over again; they were gathered together for remembrance in village workshop; carters, smiths, farmers, wheel-makers, in thousands handed on each his own little bit of understanding, passing it to his son or to the wheelwright of the day, linking up the centuries. (1958, 74)

Sturt exemplifies the character of that kind of knowledge by reflecting on his own expertise: "My own case was typical," he explains. "I knew that the hind-wheels had to be five feet two inches high and the fore-wheels four feet two; that the 'sides' must be cut from the best four-inch heart of oak, and so on. This sort of thing I knew, and in vast detail in course of time; but seldom I knew why" (1958, 74). Sturt's tale of the dish (cf. Fig. 4), a complicated bend in the form of carriage wheels, makes the self-management of forms in the design context particularly clear. Although he points out that the dish was an elementary part of the artifact's form, stating that he "had seen wheels fall to pieces for want of it" (20), Sturt cannot find an intellectual explanation for it: "What was the use of 'dish'? [...] That question, I am ashamed to say, puzzled me for years, long after I had seen that this odd shape lent itself to many advantages and that a wheel lacking it could not be trusted to travel a mile safely. 'Dish' was plainly necessary, but why?" (92). Even after consulting all the workers in his shop, he does not find any formalizable answers to this question. "It was a detail most carefully attended to by the men in my shop; but [...] none of them, any more than myself, could have explained why it had to be so" (20).

Only years later did Sturt himself conclude that the shape of the dish must be due to the fact that the wheels had to simultaneously balance several complicated acting forces, such as those of the rugged roads of the time, the movement of the horses pulling the wagons, and the fluctuating quality of the materials available. Therefore, the features of the wagon must have been created in a way in which, over time, all elements were gradually brought into a state of equilibrium, "like an organism, reflecting in every curve and dimension some special need of its own country-side, or perhaps, some special difficulty attending wheelwrights with the local timber" (1958, 67). This process is radically based on correspondence. Design thinking and rep-

resentational actions are congruent here. Thinking is, in this sense, equal to experience. The technical conditions of the time would not have allowed for any other procedure. “It was the answer,” Sturt concludes, “country folks had to make everywhere to a law as inevitable as gravitation” (94). While such processes may be characteristic of traditional craftsmanship, they are by no means old-fashioned. On the contrary, they can be described as ultra-modern, always precisely suited to the context at hand. They never fall out of time. An amusing incident Sturt describes highlights this quality. Confronted with a non-contemporary problem, he was once forced to fall back on a more interactive procedure:

> So it happened that when an ancient dung-cart arrived, needing a wooden axle for its still serviceable wheels, nobody was quite sure how to mark out the axle on the bone-hard bit of beech that was found for it. It was then that my rather useless schooling came in handy for once. With a little geometry I was able to pencil out on the beech the outline of an axle to serve (in its clumsiest dimensions) the better-known purposes of iron. Yet I have no doubt that the elderly wheelwright’s tradition would have been better, if only he could have remembered it. (1958, 20)

What could be read as an admission of failure, is actually a clear awareness of the strengths and weaknesses of the different approaches. Such a mindset is necessary to avoid tool dependency.

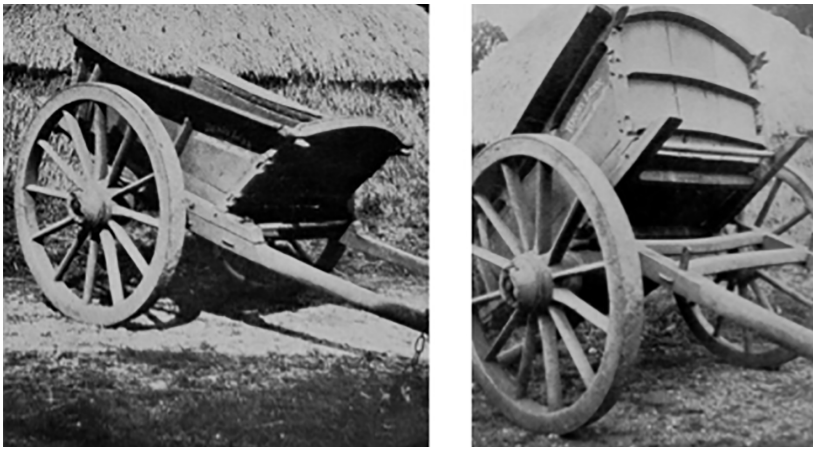

Fig. 3: Organic quality in a wagon, made around 1870.

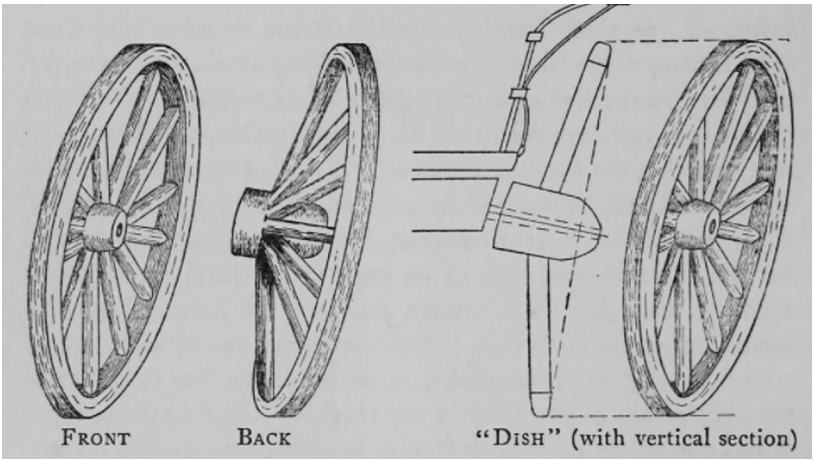

Fig. 4: A drawing, showing the dish in the wagon's wheel.

The Practical Draughtsman's Book of Industrial Design

The Practical Draughtsman's Book of Industrial Design, by the French engineer Jacques-Eugène Armengaud, is a textbook on drawing for industrial designers. It was first published in English in 1851 against the backdrop of industrialization. In this context and in an early sense, the term industrial design refers to all such design activities whose representational actions were no longer taking place on some final materials but were relegated to the drawing board. This was necessary because more and more materials that were difficult to process, such as steel, were being used while at the same time the complexity of the artifacts was increasing rapidly as, for example, in the design of complex machinery. "We have outlived the times of random construction, and the mere heaping together of natural substances," Armengaud argues and demands that "we must now design carefully and delineate accurately before we proceed to execute" (1851, v). In the book's preface, Armengaud illustrates the typical course of such a new design process and the role of drawing in it. He elaborates:

> A chance sketch—a rude combination of carelessly considered pencilings—the jotted memoranda of a contemplative brain, prying into the corners of contrivance—often form the nucleus of a splendid invention. An idea thus preserved

> at the moment of its birth, may become of incalculable value, when rescued from the desultory train of fancy, and treated as the sober offspring of reason. In nice gradations, it receives the refining touches of leisure—becoming, first, a finished sketch—then a drawing by the practiced hand—so that many minds may find easy access to it, for their joint counselling to improvement—until it finally emerges from the workshop, as a practical triumph of mechanical invention—an illustrious example of a happy combination opportunely noticed. (1851, iii)

To assist the draftsman in such a process, the book presents a variety of techniques, materials, and tools and explains how and when to use them. The knowledge it provides ranges from very general principles such as the drawing of basic geometric shapes to very specific ones such as the correct construction of toothed gears. Of particular interest to this essay, however, are not the individual techniques shown in the publication but its underlying concept to establish a universal language for representational actions. As Armengaud already points out in the book's subtitle where he claims to offer "a complete course of mechanical, engineering, and architectural drawing," the techniques provided are intended to be used to tackle design problems across a variety of different domains and contexts. The exemplary drawings in the appendix demonstrate this range of variety very vividly (cf. Fig. 5-6). They range from simple architectural forms such as columns and staircases, to quite complex mechanical structures such as a steam powered locomotive or an internal combustion engine. The drawing operators used thereby serve as the smallest common denominator, making all the forms comparable. They determine some characteristics to be intercontextually desirable and all the emerging forms developed under their application share some of them. The process is fundamentally based on interaction. The drawing equipment becomes a model of reality and the execution of drawing operators the main source of feedback that the designer receives while working on forms. Considerations are thereby reduced to everything that can be represented on a drawing board.

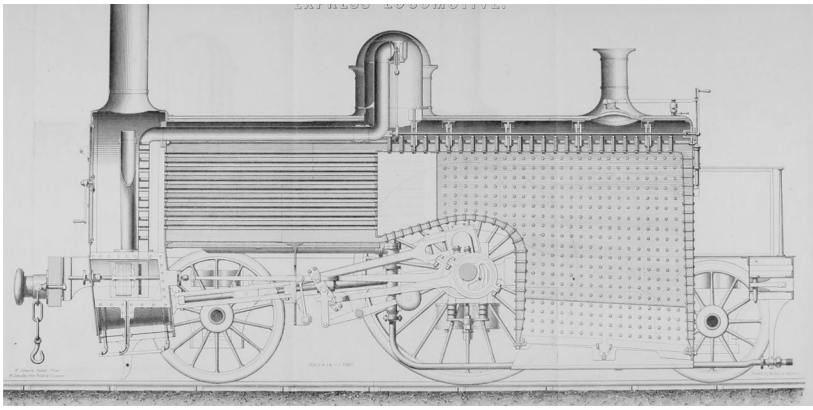

Fig. 5: A mechanical drawing of a locomotive from Armengaud's examples.

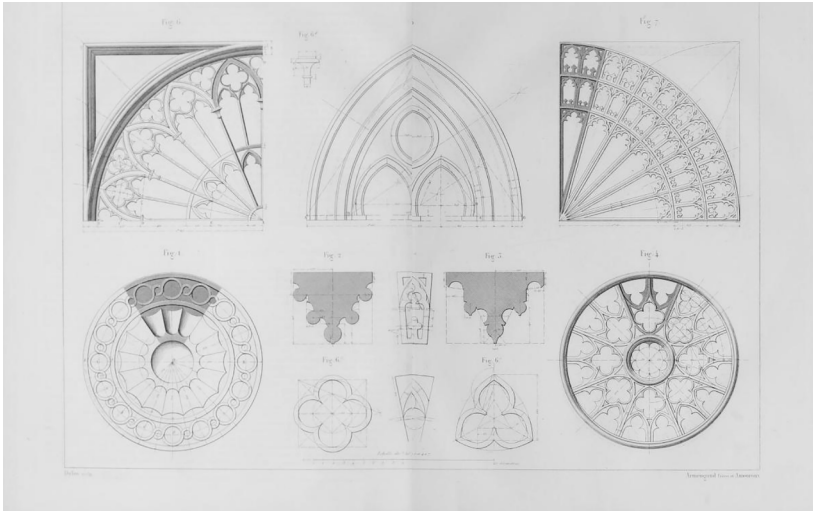

Fig. 6: Architectural elements designed using the same techniques.

Sketchpad

Ivan Sutherland's drawing program Sketchpad, developed in 1962 as part of his dissertation, can be seen not only as the forerunner of all the modern computer aided design tools we have today, but moreover as one of the very first graphical user interfaces ever created. It was programmed on the T-X2, an experimental computer system housed at the MIT Lincoln Laboratory, which was designed to be equipped with a variety of different peripheral

devices for the exploration of experimental human-computer interaction scenarios.

Sketchpad combines the graphical output of an oscilloscope with the positional input of a light pen, which serves as a pointing device. This combination allows for direct drawing on the computer image. The system gives its users the ability to manipulate a virtual drawing board in real time, giving them direct feedback on the results of their actions. "The Sketchpad system makes it possible for a man and a computer to converse rapidly through the medium of line drawings," Sutherland summarizes (1963, 17). Until now, "we have been writing letters to rather than conferring with our computers," he states, explaining the difficulties with the nature of purely written instructions in the form of code: "For many types of communication, such as describing the shape of a mechanical part or the connections of an electrical circuit, typed statements can prove cumbersome" (17).

For the drawing itself, Sketchpad offers a number of functions such as the construction of lines and arcs or copying in already finished drawings. Most interesting for this essay, however, is the concept of constraints implemented in the system. Sutherland defines those constraints as a "specific storage representation of a relationship between variables which limits the freedom of the variables, i.e., reduces the number of degrees of freedom of the system" (1963, 141). Constraints are axioms that can be applied to the drawing space. That means that due to the programmability of the computer, desirable attributes can be incorporated directly into the design tool. Such constraints could be, for example, that drawn quadrilaterals are automatically corrected to rectangles or that drawn objects automatically snap to their designated position in a grid. In their totality, the options and constraints provided by the system constitute the designer's space of possibilities. Designers using such a tool may first and foremost produce forms which are characterized by these attributes without even having to know them. With regard to interactive design processes, such a system can be understood as the implementation of a catalog of requirements into the working space itself. And, in fact, Sutherland himself

considered Sketchpad the technical implementation of such an interactive design process:

> Construction of a drawing with Sketchpad is itself a model of the design-process. The locations of the points and lines of the drawing model the variables of a design, and the geometric constraints applied to the points and lines of the drawing model the design constraints which limit the values of design variables. The ability of Sketchpad to satisfy the geometric constraints applied to the parts of a drawing models the ability of a good designer to satisfy all the design conditions imposed by the limitations of his materials, cost, etc. In fact, since designers in many fields produce nothing themselves but a drawing of a part, design conditions may well be thought of as applying to the drawing of a part rather than to the part itself. When such design conditions are added to Sketchpad's vocabulary of constraints, the computer will be able to assist a user not only in arriving at a nice-looking drawing, but also in arriving at a sound design. (1963, 28).

The implications of these constraints can be observed in the experiments demonstrated by Sutherland. On one hand, they allow the design of highly complex structures as shown by the load simulations of a bridge, whose shape automatically approximates certain defined properties while it gets drawn (cf. Fig. 7). On the other, they may limit human abilities if used inappropriately (cf. Fig. 8). An easy example for such limitations is the representation of Sketchpad's input interpretation (cf. Fig. 9). It shows that the user's gestures are trivialized to the extent that the program's model can make sense of them.

Sketchpad demonstrates a peculiarity of all user interfaces very well: Paradoxically, the computer is made more accessible to its user by hiding it. Users can easily interact with it precisely because its true materiality is veiled. Working with a user interface, thus, is always interaction, always just the manipulation of a model. And this model cannot be questioned as long as the interaction is maintained.

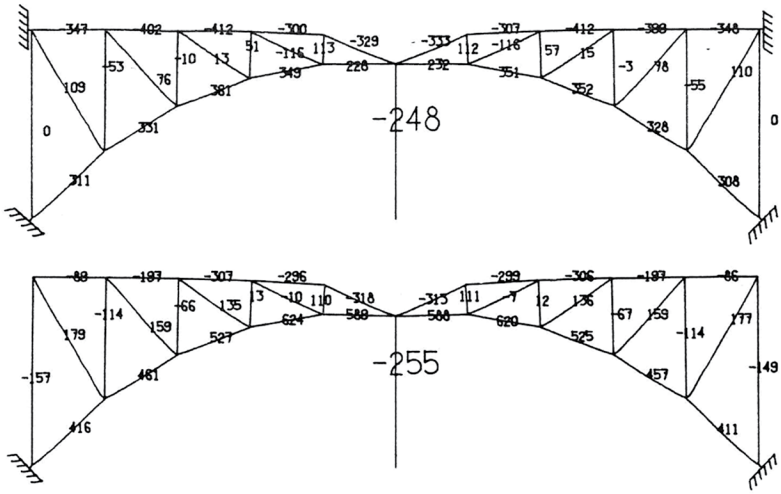

Fig. 7: Design of a bridge in Sketchpad. Elaborated constraints allow the modification of a form for an expected improved static performance.

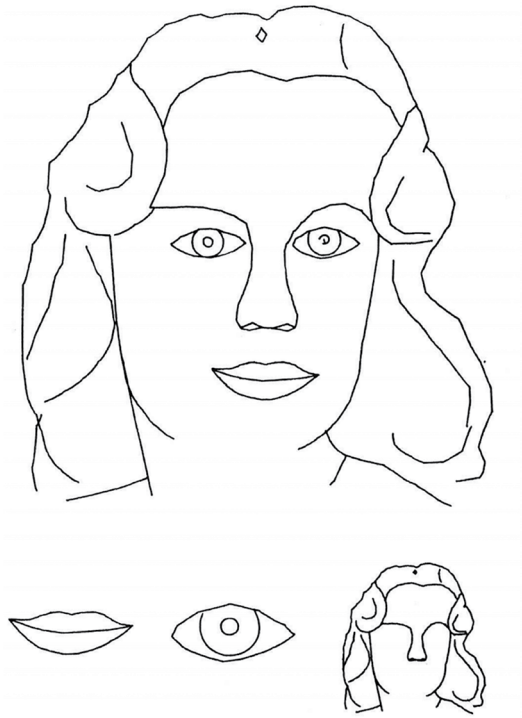

Fig. 8: A traced photo in Sketchpad. The effects of the technical limitations of the design tool on its results becomes obvious.

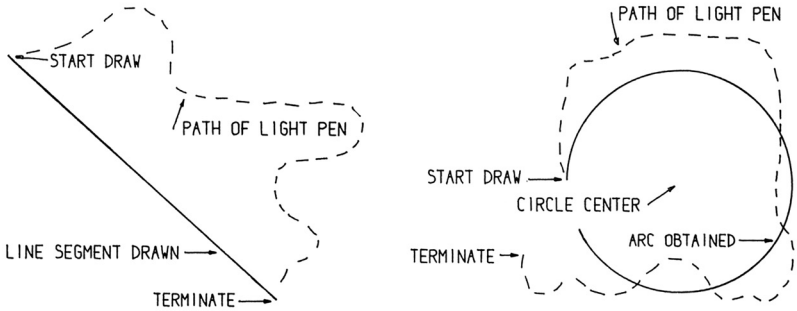

Fig. 9: User actions are trivialized due to Sketchpad's input constraints.

Gatemaker

Gatemaker is an experimental computer program which was created by Christopher Alexander and computer scientist Greg Bryant in 1997. It was developed as the outcome of a research project funded by Sun Microsystems. The IT company was interested in seeing Alexander's own ideas for translating his work into the world of computer science, a field where a traditional interest in his concepts existed for a long time, although on a more abstract level. Simultaneously, Alexander was interested in harnessing the power of the computer for his own architectural goals, namely, to support the quality he was seeking in his work. Bryant summarizes the scope of the project that resulted from this cooperation as follows: "We aimed to create a very different breed of CAD tool: one that helps people design with feeling" (1997). The outcome is an interesting example of an alternative approach to design tools aiming at a correspondence driven design process (cf. Fig. 10).

Far from being a universal tool, Gatemaker, as its name suggests, is designed to support a very limited architectural design problem: The designing of gates. The user starts by loading a photograph of the place for which a gate is to be designed into the program. Everything that follows is carried out by simply painting directly onto that picture with the computer mouse. Bryant explains the importance of working on the picture as follows: "We wanted the user to judge the harmony of their emerging gate within an actual

setting. The photo is crucial because design with feeling feeds upon the complexity of reality. Computing technology, and blueprints, fight against our understanding of the site. Someone new to this cognitive problem will need the photo as a reminder" (2014).
Most interesting for this essay is the way Gatemaker guides its users through the design process. Based on an abstract sequence of steps developed and tested by Alexander, it provides its users with instructions about what should be considered at each point of the process. "A sequence," Bryant briefly summarizes, "is much like a genetic code, and drives increasingly complex structure, a 'complexity' that is still as simple as possible, coherent, and profound" (2014). In that sense, it resembles the way Alexander discusses the emerging forms on a building site with his clients. For this purpose, the tool shows what might be done at the current work step in the form of a guiding principle, a statement that can be followed. However, at the same time, none of the instructions are mandatory. When the user feels they are done with the current step, they can proceed to the next step at any time. Bryant explains: "We wanted people to be fully conscious of each proposed step, then let the work proceed. Otherwise, the sequence can't help them to experience smooth unfolding. Of course, they also need to feel that the advice is optional" (2014).
What distinguishes Gatemaker from other CAD tools is the fact that at no point does the computer take control to correct anything. Since the measure of what is considered good is based on human feeling, it could not do so anyway. That also means that a result made with Gatemaker cannot be more than a first sketch of a gate. "If a good design resulted," Bryant explains, "the actual construction, on site, needs to recapitulate the process, using the drawn design as a guide" (2014).
An anecdote Bryant shares about presenting Gatemaker to the IT crowd at SUN gives a sense of how difficult it really is to introduce new concepts of design into a world founded on already established principles. The appearance of Gatemaker was intentionally designed to evoke a playful mood in its users and to free them from the bias of what good design is allowed to do or what it must

not do (cf. Fig. 11). Bryant elaborates: “Using feeling as a measure, we did our best to make the program comfortable, playful, approachable, fun, child-like, joyful, and relaxed. Most importantly, it feels positive, not neutral” (2014). However, even on that level, the tool was criticized by the experts as too “‘amateurish,’ ‘unfinished,’ ‘not 3d enough,’ ‘not slick,’ etc. They didn’t understand that those properties were intended—even after we told them” (2014). At this point they had not even begun to talk about the actual content of the tool let alone its underlying concepts. The user interface was the first thing the experts saw and it simply did not carry the attributes they would have expected it to have. Looking back on this experience, Bryant aptly points out that, from today’s perspective anyway, all “the ‘professional’ applications of 1997—‘hot,’ ‘fashionable,’ ‘expensive,’ and ‘leading-edge’—look terriblydated”(2014).

Fig. 10: The Gatemaker interface. The image of the place is at the very heart of the tool.

Fig. 11: The initial title screen of Gatemaker. The playful style hints at an unusual user experience.

Conclusion

> *Basically, all models are wrong, but some are useful.*
> *(Draper and Box 1987, 424).*

Throughout this essay I have argued that the way in which design thinking is contextualized by its accompanying representational actions has some fundamental implications for design work. The concepts used not only determine what kind of forms can possibly emerge from individual design processes—on a higher level they also determine the very way in which design problems can be grasped or tackled at all. In corresponding approaches, such concepts evolve over time, during the design processes, and are thus perfectly fitted to their respective contexts. In interactive approaches, explicitly formulated rules are established in advance. It is in the ubiquitous risk of using unsuitable models for given design tasks that comes with interaction where I have identified the limitations and dangers of such approaches.
However, from today's perspective, it is very clear that the established

and pervasive concept of interaction is here to stay. Moreover, human-computer interfaces are fundamentally based on it. So, from the point of view of interface design and for the creation of new digital design tools, it would make little sense to ask how it can be avoided or overcome. A meaningful goal cannot be the condemnation of the whole practice of interaction but must anticipate a more prudent way of dealing with its peculiarities. A first step in improving design tools could be the creation of more transparency in their modes of action and their associated effects. To move on from here, and to support a more conscious approach for both the creation and the handling of design tools, I propose the creation of a pattern language for the design and reflective handling of digital design tools.

As digital design tools are found in many areas and genres of design, their comprehensive classification would be a research project of its own. Therefore, for the processing of my questions, I will focus on a specific group of digital design tools: prototyping tools, the type that are themselves used in the design of computer interfaces. Prototyping tools are a natural fit for my investigation as they are interfaces for the creation of interfaces. They are predestined to be examined from the perspective of the designer as well as from the perspective of the user. My declared goal for the course of my dissertation project is to create a format to collect information about how different aspects of representational actions are affecting design thinking while using such prototyping tools. For this purpose, and in addition to the further investigation of design processes and tools, I plan to adopt an experimental approach.

Based on my research, a series of little design tools is to be developed. The idea is to create a toolbox that showcases the individual identified patterns of representational actions as clearly as possible. Thereby, I intend to make their effects tangible while enabling users to try them out individually. These experimental tools will then be used in a series of design tasks. They will serve as the basis for a reflection on my own design thinking and how it differs under different conditions of representational actions.

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Figure 8: Girl Traced from Photograph. In: Sutherland, Ivan Edward. 1963. "Sketchpad: A man-machine graphical communication system." PhD diss., MIT. Accessed August 28, 2021. www.cl.cam.ac.uk/techreports/UCAM-CL-TR-574.pdf. p. 111.
Figure 9: "Line And Circle Drawing". In: Sutherland, Ivan Edward. 1963. "Sketchpad: A man-machine graphical communication system." PhD diss., MIT. Accessed August 28, 2021. www.cl.cam.ac.uk/techreports/UCAM-CL-TR-574.pdf. p. 22.
Figure 10: Peter Gabriel's Gate. In: Bryant, Greg. "Gatemaker: Christopher Alexander's dialogue with the computer industry." Rain Magazine. Accessed August 30, 2021. www.rainmagazine.com/archive/2014/gatemaker.
Figure 11: The initial screen. In: Bryant, Greg. "Gatemaker: Christopher Alexander's dialogue with the computer industry." Rain Magazine. Accessed August 30, 2021. www.rainmagazine.com/archive/2014/gatemaker.

Bitmap

Steffen Mitschelen

In the following I present the experimental tool Bitmap, which I developed in the course of my research work. It aims to offer an interactive approach to the reflection of the technical properties of digital design tools and how they intervene in processes of design thinking and representational actions.

Digital formats are characterized by the precise formal limitations of what they may contain. A digital image file, for example, limited by its pixel count and color depth, can only hold a finite set of different images. It is formal conventions such as these that allow computers to display a variety of different content types in the first place. Files of standardized formats can be viewed and edited on most computers precisely because they are instances of something that these machines already know. This has some fundamental implications for doing design work with digital tools. Working with traditional (i.e., non-digital) design tools involves the addition, subtraction, or deformation of actual materials; for example, in the application of paint to a canvas or in the chipping of stone from a sculpture. Digital files, on the other hand, are modified by applying predefined sets of attributes to a predefined set of elements, as in the assignment of a color value to an array of pixels. For this purpose, and to spare users juggling with numbers, the interfaces of digital design tools provide users with actions that can be used to explore such digital formats.

Design thinking and representational actions, then, inevitably unfold between fixed variants and given operators. The sheer numbers of possibilities that such spaces bring with them makes it easy for users to forget that they are just making preconceived choices.

In order to draw attention to the fact that there is always only a search for predefined variants, Bitmap frames digital design tools as navigational devices for the exploration of spaces of possibility. Thus, Bitmap puts the focus not only on what can be reached but simultaneously on the limits of such tools.

The Bitmap interface is made up of two parts, reflecting the ambiguity of its name (cf. Fig. 1). The upper part provides the user with a very simple and confined drawing area, made up of a square of 3 by 3 pixels. Each pixel can take on the value "black" or "white," forming a very simple bitmap format. The drawing area is accompanied by a handful of different operators, represented by a set of icons: The pen and the eraser can be selected and directly used on each of the nine pixels to turn them either black or white. The actions *reverse* and *repeat* can be used to iterate back and forth through the steps that have already been taken. *Rotate* (left and right), *mirror* (horizontal and vertical) and *invert* are global actions that affect the entire drawing area at once.

Underneath the editor is a map. It shows all 2^(3 x 3)= 512 possible states that the format can take, side by side. This is also the reason the drawing area was kept so minimal. With 2^(4 x 4) there would have been 65,536 possibilities, which could not reasonably be looked at side by side. The map automatically keeps track of the path the user takes through the space while they interact with the editor. A visualization of the current session is created, keeping track of the order in which different states are reached and which operators were used at each step. The map also provides some additional details about the process: A legend to indicate the operators used, the numbering of steps, the percentage of the space visited, and an overview of the states not yet visited can each be turned on or off individually.

The combination of the two parts—the drawing area and the map—allows for a conscious reflection on how the application of different

operators changes the experience of the space (cf. Fig. 2–5). In this way, it becomes clear that different operators are not merely neutral actions. They provide access to different knowledge, thus suggesting different ways to traverse the space. For example, while the pen alone may allow the user to reach all the possible options, it is now easy to see that its application suggests a specific direction, moving further and further to the bottom right of the space, thus valuing some options above others. Adding more operators, for example the eraser, changes these relationships significantly. Changes of direction are being encouraged. Similarly, mirroring, rotating, or inverting the drawing area not only allows for a quicker movement of long distances through the space, they also promote the understanding that many of the elements in space share an isomorphic relation with each other. The operators become the sensorium by which the possibility space can be explored. My hope is that the conscious use of such an exposed and simplified possibility space may also promote an awareness of the more hidden and complex possibility spaces of our everyday tools. Bitmap was developed using HTML5; the map is drawn using p5.js. It can be found and used online at: https://mitschelen.de/bitmap/editor.

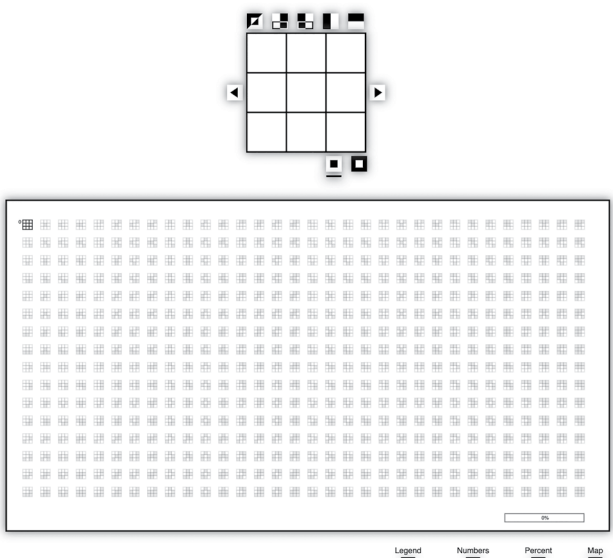
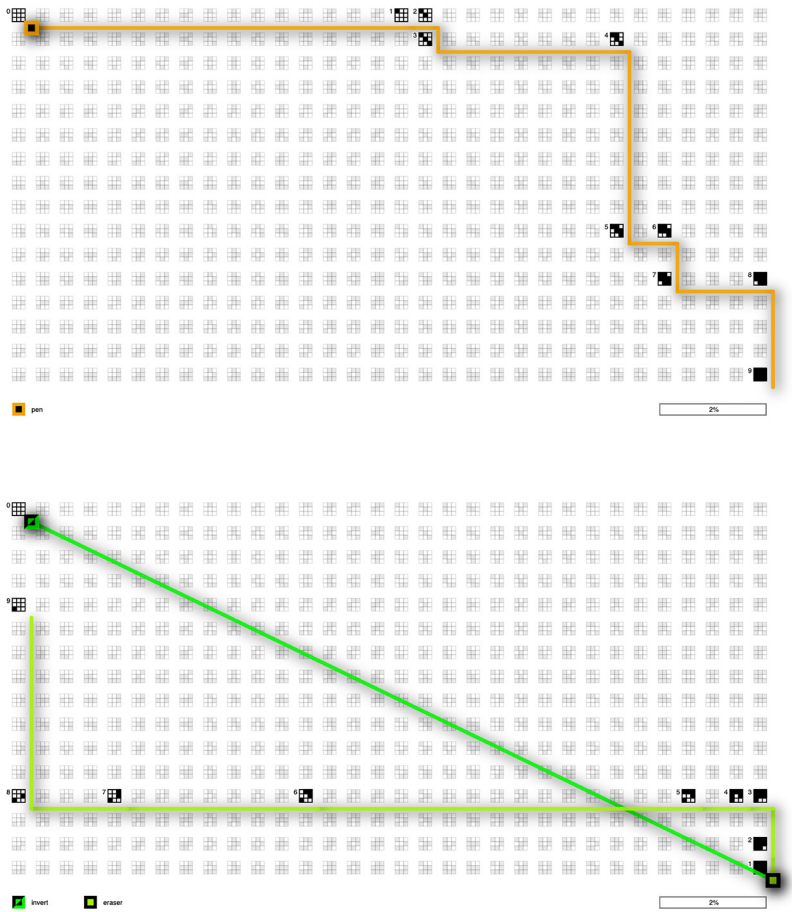
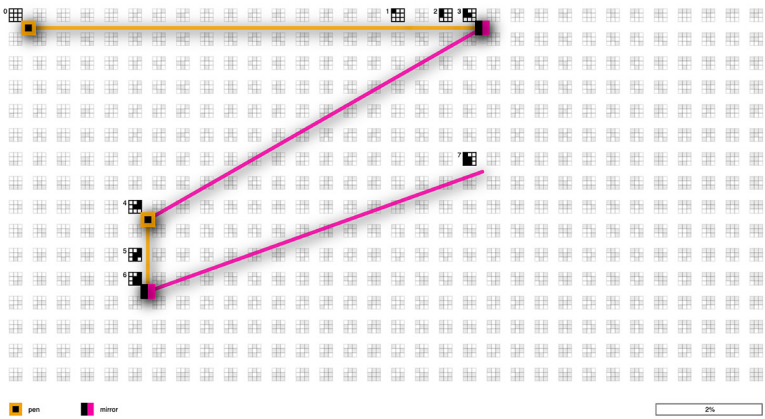


Fig. 1: The Bitmap user interface. The drawing space at the top is accompanied by a map at the bottom.

Fig. 2-5: A selection of different paths through the space using different combinations of operators. The suggestive nature of the operators becomes apparent.

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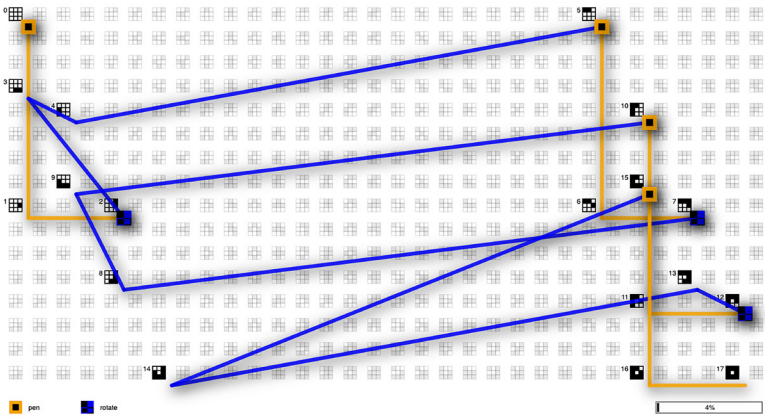
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Active experience, not knowing and unlearning

An investigation of alternatives for methods in design

Zahra Mohammadganjee

Abstract
This article discusses systematic design methods, reflecting on whether they have worked in practice, and whether alternatives can be considered. For this purpose, the history of methodology in design and various opinions in this regard are reviewed. The article tries to show that the design process cannot be confined to an operating system that is predefined and sequenced, as many designers have shown. Furthermore, it describes three alternative approaches that are not necessarily far apart and can even be complementary. They articulate the precedence of intuition, not knowing, and active experience. The article focuses on the ideas of John Chris Jones, Bruce Archer, and Andrew Pickering.

Introduction

A wide range of academics as well as experts, engineers, designers, urban planners, architects, industry managers, psychologists, and artists were involved in defining a methodological approach to design in the middle of the twentieth century. Their goal was to realize a universal and systematic method and rationalize the design process in order to facilitate an organization of problems, the development of solutions, and fostering of creative ideas. From their point of view, traditional design practice, which was mainly referred to as "design by drawing" or "design by intuition," was "too simple for the growing complexity of the man-made world" (Jones 1992, 27). Undoubtedly, technological developments and the progress of cybernetic theories, computer techniques, and management theory were good stimuli for designers advocating systematic methods (Cross 1984, 58). They had concluded that a consensus should be formed between the various disciplines concerned through creativity and problem-solving to withdraw the boundaries and barriers of cooperation between different specialties for better co-thinking. A summary of their approach can be found in an article published in *Design Magazine* by J. K. Page entitled "For Those Interested in Creative Processes." Page explains the purpose of the movement and states that designers in these meetings were concerned with "subjects such as creativity, computer-aided design, and design automation, systematic design methods, system engineering, and individual case histories" (1966, 30). They wanted "to see how various design methods can be applied, for example, to architecture, engineering, and industrial design" (30).

Erasing the line between art and science and shaping the unknown future was prevalent in this era. Page optimistically predicted that "if all these plans succeed, the society may help to break down barriers between different interests and, by giving people an insight into how others go about their creative work, help to destroy the division which exists between the arts and sciences" (1966, 30). Advancements in system theory and operations research coached designers to define methods for design-

ing existing and emerging realities. The methods worked like tools in the hands of designers, and preparing students and a generation of designers to use them was easy. Studying the Design Research Society's publications is an excellent way to accurately understand the dimensions of their approach to methods in design. An editorial in *Design Magazine* 202 states:

> By giving the designer a logical tool with which to make him a more effective part of the production team, systematic design methods also create an interdisciplinary link. They make for common ground between the different specialists, help the designer to reconcile conflicting requirements, give these requirements their correct priorities, and ensure that no factors have been overlooked (1965, 26).

In this view, a systematic approach enables designers to solve their problems either by referring to factual data or by following intuitive solutions. The tendency to rationalize design methods was a way to become equipped to deal with the complexities and uncertainties of upcoming problems. In contrast, the intuitive approach to design seemed ambiguous and indefinable, making the path of creativity unpredictable, uneducable, and dependent on individual designers. In this context, the process of ideation and, more accurately, the critical moment of creativity was not fitted into any defined method.

In this article, I will try to look at the design world from the perspective of this split and seek to answer the questions that arise from this. Which approach gives the designer more possibilities for creative design? Which one makes a creative leap possible? Which way offers more reliable solutions? Is it possible to prioritize the two approaches? Is there any alternative to the systematic method in design? What role do intuition, poiesis, and experience play in ideation, creativity, and problem-solving within the design process? Finding the answers to all these questions would require extensive research and I can only review a limited number of arguments by designers and thinkers representing the two perspectives in my brief article. A study of design history shows that this gap was caused by the organizers of the first

Conference on Design Methods. They also wrote the first critiques of systematic methods in design. A wide range of experts in various fields concerned with creativity, problem-solving, and design are involved in this path. The diversity of participants was mainly due to the fact that the boundaries between different fields of design had started to fade in the last decades of the twentieth century: "The boundaries of what was once recognized as discrete design disciplines such as product, graphic, textile, and fashion design have been and continue to dissolve" (Rodgers 2016, 19). Rodgers and Bremner specify:

> Many modern-day design pursuits have a core of designerly activity backed by other subject specialist areas such as fine art, engineering, anthropology, computer science, and business. The edges between product design and service design, for example, continue to be increasingly fuzzy. [...] the work of design companies and designers such as Hella Jongerius, Ronan and Erwan Bouroullec, Marti Guixe and IDEO now all regularly transcend historical disciplinary frameworks such as interior design, fine art, product design, and graphic design. (Rodgers and Bremner 2019, 174)

Simultaneously, the type of complexity that designers face has also changed. Indeed, mass production is no longer a design concern. "From the era of mass production, we move to the era of mass customization (even if the first survives today; the second has become the reference)" (Van der Linden, Lacerda, and Aguiar 2011). Methods do not remain untouched by changes in the design world. They are usually equipped to deal with complexities and changes and cannot be questioned from the ground up. In this article I try to address issues such as why particular methods take shape, the history of their formation, and what criticisms they have been subject to. I specifically address the perspectives of thinkers such as Chris Jones, Bruce Archer, and Andrew Pickering, whose approaches differ from systematic methods in design. They can be considered alternatives or complementary approaches.

The essence of methods

How are methods formed?

The 1960s were a crucial period in the history of design. Understanding design's scope, dimensions, possibilities, and effects on human life helped shape a strategic shift in the orientation of designers. At the beginning of the decade, American architect and futurist Richard Buckminster Fuller called for a "design science revolution" claiming that "only the design science revolution can solve the problems of clothing, housing, transporting, intercommunicating, and educating all humanity" (1964, 109). In 1962, the Conference on Design Methods in London brought together many designers and other specialists to think about existing opportunities and new ideas for introducing creativity and design methods. They gathered again in 1965 at the Symposium on The Design Method in Birmingham, where the Design Research Society (DRS) was founded. More than two hundred people from various fields participated and the design society became an international multi-disciplinary association. "The purpose of the DRS [...] was to promote 'the study of and research into the process of designing in all its many fields'" (Design Research Society, n.d.). The goals are also stated as follows: "Recognising design as a creative act common to many disciplines, advancing the theories, methods, and practices of design, and understanding research and its relationship to education and practice" (n.d.).

In the view of the DSR, systematic evidence-based research that can be achieved through a set of methods helps designers reach listed objectives. Books such as *Design Methods* by John Christopher Jones and *Notes on the Synthesis of Form* by Christopher Alexander were excellent guides to understanding a systematic approach to design. Jones and Alexander were both pioneers of the design methods movement and their books provided a theoretical framework and a set of tools for design practice. At that time, Alexander sought to establish a considerable closeness between the science and practice of design by providing his theory with a mathematical basis. The consequence of his view was that each

decision of each designer had to be proven by logical reasoning and scientific research.

With this approach, design focuses on cycles of hypothesizing, testing, and acquiring new information to continually open up new possibilities in practice. The end of the decade coincided with Herbert Simon's book *The Sciences of the Artificial*. He spoke of "a science of design" and expected universities to join the movement: "The professional schools can reassume their professional responsibilities just to the degree that they discover and teach a science of design, a body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process" (1996, 113). Design methods were soon being questioned by its pioneers. Thinkers such as Paul Karl Feyerabend, with his book *Against Method*, Karl Popper, and Thomas Samuel Kuhn, were influential in this reconsideration. In the same period, Chris Jones left design citing a lack of creativity in the systematic approach. He returned to the world of design some years later, with new ideas for design methods and a new book, *Essays in Design*. He summarizes:

> Some years ago I wrote a book about designing: it was meant to be my goodbye present to the subject [...] I thought I had been in it long enough, and I was beginning to feel that it was not such a creative or liberating activity as I had once fancied it to be [...] However, I did escape from designing for long enough to learn something from the other arts, the time arts like film, poetry, music, and theatre, to which I became attracted. In particular, I learnt a lot from the composer John Cage and began to copy his methods of composing by chance, giving up deliberate control of the result. (1984, 128)

Alexander was also self-critical in retrospect, stating: "I've disassociated myself from the field [...]. There is so little in what is called 'design methods' that has anything useful to say about how to design buildings that I never even read the literature anymore [...] I would say forget it, forget the whole thing. [...] If you call it 'It's A Good Idea To Do,' I like it very much; if you

call it 'A Method,' I like it, but I'm beginning to get turned off; if you call it 'A Methodology,' I just don't want to talk about it" (1971, 3–7). It is interesting to note that ideas are still alive on both sides of this divide. On the one side, design methods that gradually led to the development of an aspect of design theory that Wojciech Gasparski later called design science: "The science of design (should be) understood, just like the science of science, as a federation of subdisciplines having design as the subject of their cognitive interests" (1990, 1195–1215) are still being developed and taught. On the other side, systematic design methods are criticized. Since 1980, books and articles concerning the latter approach and proposals for alternatives for design methods have increased. Some books merely study and observe the designers' practice, how they meet each project, and how they lead each project towards the result. Among them are for example Bryan Lawson's *How Designer Think* (1980) and *Design in Mind* (1994) and also *How Designers Work* by Henrik Gedenryd (1998). Architect Donald Peter Grant believes that the majority of design theorists rejected systematic design methods and changed their viewpoint, stating: "Most opinion among design methodologists and among designers holds that the act of designing itself is not and will not ever be a scientific activity; that is, that designing is itself a non-scientific or a-scientific activity" (1979).

What are systematic methods in design?

Many designers have defined systematic methods in design. In the article "Knowledge and Design," published in the book *Developments in Design Methodology*, Bill Hillier and his colleagues provide primary definitions of methods and explain that many believed that "design was a problem-solving activity involving quantifiable and non-quantifiable factors. It was thought that research should bring as many factors as possible within the domain of the quantifiable and progressively replace intuition and rules of thumb with knowledge and measurement methods" (1984, 29-3-2). This quote shows how research affected

the design process and, moreover, how design practice moved away from traditional approaches.

Henrik Gedenryd defines the design method as "a normative scheme that specifies in detail a certain working procedure, the activities to perform, and also a specific order in which the activities should be carried out. It is usually very precise, and the designer is to follow it meticulously. It also covers the design process from beginning to end" (1998, 19). What distinguishes one method from another are the different forms of working procedure. However, there are always some basic features that inherently are the same. "The number of design methods (and accompanying diagrams) that have been published is immense [...] when you examine a large enough number of variants, patterns begin to form [...] In many cases, different labels disguise the same ideas" (20).

Gedenryd expresses these features in four unifying principles. The most basic concept among them is separation or division in analysis and synthesis: "That is the foundation of all design methods, and may well be the most consequential idea of design methodology as a whole" (1998, 23). The others are "logical order," "planning," and "product-process symmetry." As Gedenryd explains, the idea of division in analysis and synthesis has its roots in ancient Greece, especially mathematician Pappus of Alexandria (27). This approach later became more precise and comprehensive in the age of the Enlightenment, as our vision of science took shape. It can be seen in the Cartesian principle of breaking down problems into minimum units, each of which are solved to lead to the general solution.

Why are systematic methods in design formed?

The complexity of today's problems

Descartes is commonly known as one of the fathers of the scientific method of inquiry. His science-based observation and experiment method has had a profound effect on the development of modern science. He describes his methodology in part two of *Discourse on the Method*.

> Things made up of different elements and produced by the hands of several master craftsmen are often less perfect than those on which only one person has worked. [...] those ancient cities, that in the beginning were no more than villages and have become, through the passage of time, great conurbations; when compared to orderly towns that an engineer designs without constraints on an empty plain, they are usually so badly laid out that, even though their buildings viewed separately often display as much if not more artistic merit as those of orderly towns, yet if one takes into consideration the way they are disposed, a tall one here, a low one there, and the way they cause the streets to wind and change level, they look more like the product of chance than of the will of men applying their reason. ([1637] 2006, 12)

This paragraph introduces the precedence of rationality for Descartes. He expresses his interest in structured and orderly artifacts instead of organic and untidy ones that have grown over time without planning. Based on these examples, he extends his ideas to governing nations, legislating, and ultimately governing thoughts in an orderly way to explain the structure of his philosophy. Descartes proposes four rules for scientific methodology. The second of these inspired designers to form the first systematic design methods during the first half of the twentieth century: "divide all the difficulties under examination into as many parts as possible, and as many as were required to solve them in the best way" (17).

This tendency in design was caused by being confronted with the inherent complexities of crises in the twentieth century, the complexity of the projects and products of advanced technologies, and an interest in predicting, visualizing, and realizing an unknown future. This led to a remarkable inclination to rationalize design methods and a wealth of interdisciplinary research and the utilization of scientific tools such as mathematics and statistics in the design process. For designers who believed science made the impossible possible, picturing the future did not

seem difficult. They even went so far as to predict apocalyptic battles with space adversaries.

The superior role of the designer

One of the characteristics of these methods, contrary to traditional design practice, was that the result was not under the direct influence and control of the designer. Previously, each designer had left their signature in the outcome of their work. Everything was under their control and other factors barely influenced design. Christopher Alexander, who was a critic of the dominant role designers played in the design process at the time, articulated: "I shall really be trying to show that for every problem there is one decomposition which is especially proper to it and that this is usually different from the one in the designer's head" (1973, 83). Consequently, an attempt was made to replace the work of the designer with a systematic model, making the design process independent of individuals and simultaneously rational, scientific, and reproducible.

Do these methods work in practice?

Although their scientific background and label of research-based design seemed to hinder the critique of systematic design methods, the results were not satisfying in practice and, over time, showed that they could not meet expectations. Surprisingly, many years after the publication of *Notes on the Synthesis of Form*, one of the most influential contributions to design methodology, Alexander's approach had only been employed in one architectural project. In his book *How Designers Think*, Bryan Lawson addresses this issue by quoting Hanson: "It is all the more remarkable since there is only one reported attempt to use the methods and that did not result in any obvious success" (1980, 28). Gasparski, in his habilitation thesis on the theory of design in a praxeological approach, also comments: "Having said this much about design methods, there is but one thing to add: They don't work, and they don't work at all. Despite all the good motives—the need for potent and up-to-date design proce-

dures, the noble cause of being rational, and so on—the failure of these methods is a very solid and widely recognized fact, as is the thoroughness of this failure" (1990, 1195–1215). I address some of the reasons for these perspectives below.

Inflexibility

One of the reasons for the failure of design methods is inflexibility. Some of these methods have a kind of rigidity and hardness that many designers have criticized. Working with these methods is sometimes like preparing a herbarium booklet that, despite providing categorized and relatively extensive information, presents the space of experimentation and experience as inanimate or distant from the flow of life. Endeavors to rectify the weaknesses of these systems and to remove the constraints have led to new methods. The Design Council in the UK, for example, presented the Double Diamond (see fig. 1), a flexible representation of the design process in four general steps: discovery, definition, development, and distribution. This model, which, with a few modifications, is still employed today, is more flexible than the original methods with their linear structure. It allows for the users to return and check multiple times, enabling them to revise and correct errors. This model can be considered a sign of accepting uncertainty as part of design activity. Although even more flexible models have been proposed, the belief remains that the outcome of systematic design can not be trusted. So much so that Chris Jones refers to it as like being trapped within a frame:

> The difficulty of using rationality in design is that it can produce a false certainty which drives imagination away. This can be avoided if rationality is not used to disprove new ideas but to support them, to widen one's initial perceptions, and to see the problem in a new light. I call this "standing on the box of rationality" to see further—instead of being trapped within it in a closed "frame of reference" that is supposed to include everything, but doesn't. (2006, 17)

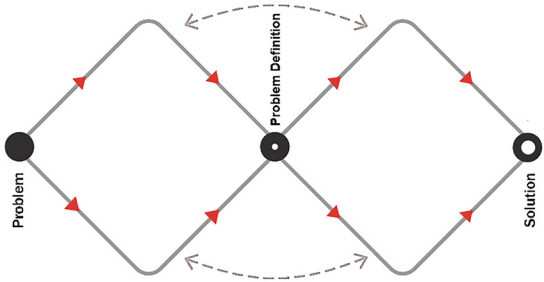

Fig. 1: *Double Diamond model*

Lack of control

Another reason could be the lack of control designers have over projects and their insecure position. With the rise of methods, design lost its place as a practice that relied solely on designers. Every decision requires research support and scientific reasoning. Design methods are usually defined for groups of researchers and specialists and each person is responsible for part of the process. Simplification, classification, task division, and research reduce the individual designer's mastery over the result. It changes the designer's role from the only influential character in a design project to one member of a group who works on part of it. It shifts the designer's creative mind to an analytical mentality. For some designers, this role is passive and unacceptable.

As Whiting points out "the designer has to move from the role of the service provider (reactive to the needs and demands of others) to the role of pathfinder or leader (proactive in determining what those needs and demands should be)" (2011, 3716–3723). In one of his articles, Jones remarks: "Rationality, originally seen as the means to open intuition to aspects of life outside the designer's experience, became, almost overnight, a toolkit of rigid methods that obliged designers and planners to act like machines, deaf to every human cry and incapable of laughter" (1980, 173).

Ambiguity in bringing methods to practice

The picture Chris Jones paints may be too pessimistic, possibly as a result of the limiting of the designer's role, over-quantify-

ing factors involved in the process, and using tools such as cost-benefit analysis, risk analysis, quality function models, or morphological charts. But it is a perspective shared with others. The first similar critiques rejecting the underlying values of design methods were formed in the early 1980s. One of the leading figures in the development of systematic design methods, Bruce Archer, discovered the problems in his original design model a few years after publishing his dissertation and articles in design magazines, by testing his method in practical projects. He finally acknowledged that in his opinion, he "wasted a lot of time trying to bend the methods of operational research and management techniques to design purposes" (1979). Other practitioners remarked that methods are "too complex, inflexible and fail to match their working practices" (Wallace 2011, 247).
Angelika Bullinger came to a similar conclusion, bemoaning their excessively general prescription. She introduces seven reasons for the inefficiency of design methods, including them being too abstract, complex, and challenging to adapt. She quotes Markus Viertlböck in her book *Innovation and Ontologies*: "Although countless tools and methods are available, they are rarely implemented to support the innovation process" (2008, 38). In practice, designers seem to come up with methods only when they cannot solve problems in a certain condition. This usually happens in the concept development and idea generation stages, when it is necessary to reach a creative moment and when designers encounter the question of how to proceed.

Incoherency within the design team

Teams made up of different specialists usually employ systematic methods and the work is divided between them. Problems therefore arise from the disharmony between group members and their application of methods. Researchers who provide data and materials, develop ideas, or analyze the situation are not necessarily the same people who proceed with the next steps. This diversity of members can be problematic. Chris Jones discusses this in an interview with GK VanPatter in *NextD Journal*, explaining:

> Another misconception is to think that wide-ranging problems can be solved by teams of experts uninformed in each other's skills and knowledge. The gaps between specialists are not likely to be crossed by discussions between experts [...] Learning how to mix disciplines is an indescribable process that can occur within the immense flexibility of an informed brain and nervous system—not in the narrower and far less flexible process of discussion in existing language, or in the jargon of specialists who may not understand each other. (2006, 9)

Leaving the realm of creativity

Another problem with methods is their capacity to divert us from the design path. John Luckman sees creativity as the key to recognizing adherence to design, saying that "some creativity or originality must enter into the process for it to be called design" (1967). As Bruce Archer acknowledges in *Systematic Method for Designers*, the designer has no escape route from formulating their ideas, but must always realize that creativity is an inseparable part of design nature. He specifies: "If the solution to a problem arises automatically and inevitably from data interaction, then the problem is not, by definition, a design problem" (1984, 75).

It is not easy to stay in the orbit of creativity when using design methods. Following a predefined structure is fundamentally different from the freedom of action required in creative work. Some methods work like machines that take in raw materials on one side and spit out the product on the other. Since the mold (method) is always the same, products are only different in color and, sometimes, material. Luckman summarizes: "If the alternative solutions can be written down by strict calculation, then the process that has taken place is not designed" (1967).

Alternatives or complementary ways

The proponents and opponents of design methods have reasons for their orientation and one side cannot be conclusively read as completely incorrect or correct. However, it is clear that despite

the benefits of methods, there are problems that cannot be ignored. The question is, is it possible to imagine an alternative to methods in design? Is it necessary to go back to the movements of the 1970s (and before) and reconsider the decisions made then? What dimensions and features could be envisioned for them if there is an alternative? What about complex projects? How can we deal with complexities without methods?
Many consider the evolution of design methods unavoidable and offer some strategic changes for developing them. For example, Van der Linden, Lacerda, and Aguiar explain: "The models cannot be neglected due to its main function as an element able to structure a complex activity to allow the detachment of the professional, which enables him to examine critically the process. Moreover, they allow the teaching of design activity, in that structure the process of beginners" (2011). In the following, I present some suggestions for alternative or complementary views to design practice.

Precedence of intuition over rationality

Intuition has diverse meanings in various cultures and different branches of the sciences. However, the acquisition of knowledge without rational reasoning or unconscious cognition may be a general aspect of a basic definition. Intuition is commonly considered the traditional way for designers to develop creative ideas. The proponents of design methods either rejected intuition completely or considered it complementary to design methods. Wolfgang Ernst Eder explains that "design methodologies act as a framework for guiding the designer's thoughts. They are no substitute for creative thinking, but they can help to spark off the intuitive processes" (2013, 23). One reason for this skepticism towards intuition could be its ambiguity from a scientific point of view. From the perspective of science, a designer's creativity cannot be explained by intuition. Herbert Simon, known as a pioneer in establishing the science of design, explains intuition from his perspective by using the example of a chess player. He considers the remarkable ability to play to be a result of rational reasoning using experiences gathered over the years:

> Most of what we call intuition, this ability we have in everyday life, and the ability that experts have to respond to situations and just act, not even know why they act, (or) have a difficulty in telling how they act, is nothing very mysterious. It's the same thing that enables us to recognize a friend walking down the street, and it's based on an enormous accumulation of experience which in the case of a real world-class expert (grandmaster chess player) involves the 50,000 or more patterns, maybe a couple hundred thousand and a decade or more to acquire them. (Simon 1992)

This stage in design seems familiar to many designers. For them, intuition is usually at the point when the designer is free to create. Archer was one of the first to address the importance of intuition in design. The design model he proposed validates both systematic observation and inductive reasoning in the analytical phase and subjective and deductive reasoning in the creative stage. Archer tries to define the position of both intuition and cognition. In his series of articles, he explains that designers combine intuition and cognition, adding that "there can be nothing unscientific about the traditional reliance on intuition and inspiration in design" (1984, 77). Intuition in design was also crucial for Chris Jones. He believes that intuitive aspects are as important as rational and systematic methods. Jones aimed to change the intellectual default that systematic methods are necessarily in contrast with the intuitive approach. In his view, the culture we inherit seems to keep them separate, while the right way to proceed is to combine imagination with reason (2006).
However, he inevitably divided them in his approach and sometimes even prioritized intuition over methods in practice. Jones believed that rational analysis and creative thinking are both essential in design practice and should not be restricted. The designer's mind should not even be involved in storing data, information, requirements, etc. But because of what could be called the consequences of unlimited trust in either, or because of the totalitarian structure of both, Jones sees a central problem be-

ing "that the ones who put rationality first drove away intuition, and that the ones who put intuition first drove away rationality. [...] The real difficulty, in design or in any creative activity, is how to integrate these ways of thought" (2006, 14).

As the path to intuition is difficult to trace and articulate, it is also not easy to teach. Jones uses a creative technique to convey his intended meaning to the audience in an interview: he talks about things that seem irrelevant and far from the subject of discussion. The hope is that the audience will find unpredictable relationships between unrelated things, free their minds from the limitations of debate, break down boundaries, and from that, reach out to the meaning of intuition. He then states: "My aim in combining rationality with intuition is to find the right levels of abstraction and concreteness with which to describe the reality that exists and the new reality that is to be brought into existence (perhaps more poetically than rationally)" (2006, 18).

Not-knowing, Unlearning, and Exformation

Prioritizing not-knowing over knowing could also be considered an alternative approach. Some believe that the first step in any design project could be based on our not-knowing rather than our knowledge. Starting from the unknown increases the possibilities for the emergence of creativity. The ambiguous nature of the unknown is connected to the fuzzy nature of design, which is supposed to form a misty solution and a misty future. Designers create objects that have the potential to exist, and realizing this potential requires seeing the unknown relationships between seemingly irrelevant things. Every new design project therefore faces infinite unknowns and indefinite solutions. We need to practice unlearning to use this technique, which means we should not solve problems by gathering information or referring to our previous knowledge.

Some scholars, citing the results of psychological research, have argued that obsolete knowledge should be discarded or eliminated to provide space for new knowledge to form (Nystrom and Starbuck 1984). The concept of unlearning sometimes refers to

changes in routines and beliefs (Akgün et al. 2007), and sometimes to patterns, habits, and cognitive frameworks or understanding and behavior (Yang, Chou, and Chiu 2014). Jones sums this up, claiming that "experience you bring to a new problem, is the experience of all the problems, is very misleading. You are happy with it. You are confident in it, but it doesn't relate to this problem, so you have to go through the process of unlearning" (1991, 61). Unlearning can also be seen from Tony Fry's perspective. In a recent article, he introduces six basic premises of futural design education. The fourth assumption in his article supposes: "Directed unlearning design is a precondition for new learning. [...] For this to happen a clearing, an unlearning, of the extant habitus of the designer, and their understanding of design, has to happen" (2020, 166). The concept of "unlearning" as Tony Fry and Jones describe it, as well as the concept of "not knowing" as Kenya Hara defines it, are crucial skills for overcoming the complex problems of today. It means putting aside everything we know to see and realize what we do not know. Jones believes that "unlearning is the essence of designing" (1991, 205).

The sheer volume of information we are confronted with today has increased our fear of the unknown. We are used to having information and being acquainted with things, and we avoid moments of unawareness, although only superficially. By introducing exformation as the conceptual opposite of information, Kenya Hara seeks to replace knowing with not-knowing in the design process, calling it the starting point of any design. "I named this method *Ex-formation* to act as a counterpart to *information*. [...] I'd like to think of the form and function of information, not in terms of making known, but in terms of making unknown" (2007, 370). He states his goal is to open a window to see things again, which will cause the intuition of things that had not been seen before due to acquaintance and, as a result, were not experienced. In the seventh chapter of *Designing Design*, Hara says that the unknown empowers the human mind: "What constantly invigorates the human mind is the unknown;

we aren't animated by what we already know, but we're eager to make the world known" (370).

The projects he created for his students help them to understand how intuition results from encountering the unknown. This includes defamiliarizing familiar things. One of the projects was to replace the water of the Shimanto River with the asphalt of a road, which shows the size and shape of the river much more clearly. He explains: "Creating composites of asphalt roads on the water surface by taking pictures of various scenes up and down the river. Our memory of the size and texture of familiar objects functions as a measuring stick by which we can infer the size or shape of something new or unknown to us" (381). However, as Jones argues, "it is so hard to unlearn" (1991, 205) and it is far from today's design practices, requiring a lot of training effort.

Thomas Wendt, who has studied design from a phenomenological point of view, believes that a person in the state of *Dasein* (being or being there) establishes their relationship with the world through "doing." From this perspective, doing is a medium for shaping consciousness. Experience plays a vital role in this interpretation. Wendt articulates, "Human and the world are inherently connected through doing (and action)" (2015).

Andrew Pickering associates "doing" with profound observation and reflection. That is, being ready for knowing before taking action and being aware of numerous unknowns compared to the superficial and limited number of knowns. This is observation and experience without presumption. Doing without knowledge does indeed leave open ways of emergence and intuition. The etymology of the word *intuition* could be beneficial to understanding the notion. Its root is "to look at" and "watch over" (Online Etymology Dictionary). It means there is something showing itself here that we can look at. Therefore, something unpredictable and unknown emerges through intuition while science, as in the herbarium booklet, makes the world predictable and classifiable. From Pickering's point of view, the purpose of design is to propose a practical solution to a particular problem,

not to generate knowledge that can be "transported back to any particular situation" (2017, 64). He proposes this approach to eliminate the "dangers of science-based enframing" explaining:

> Poiesis is alive to the emergence and unpredictable surprise—it consists of finding out how its object will perform in this situation or that—while scientific knowledge obscures emergence by presuming a fixed and predictable world. In processes of planning and design, science functions as a shortcut to the future. We could say that making this shortcut is the point of science, but it is also where emergence can break through and the dangers of enframing arise. (2017)

Pickering refers to poiesis as a contrasting concept of science and enframing to make his approach practical. "I want to think of poiesis as the deliberate staging of what I call dances of agency." In his article "Poiesis in action: doing without knowledge" (2017), Pickering presents three empirical examples of employing poiesis in problem-solving. Intuition, experience, observation of emergence, and performative dances of agency are crucial in this approach. From the examples, it can be understood that poiesis is "another way to relate to the world," which does not evolve from existing knowledge, i.e. old knowledge, that should rather be eliminated in order to follow the poiesis approach. The things we see, feel, and hear are dependent on past experiences and casual beliefs, they navigate our cognitive processes and are projected on future events (Seligman et al. 2013). Therefore, it is necessary to reduce the influence of old knowledge and the passive experiences that we usually unconsciously face.

Active Experience

As much as flexibility and imagination is needed in design, it should also be a productive experience. As Archer expresses in Systematic *Method for Designers*: "We are thus brought face to face with the reality of the need for rich, wide and fruitful experience among designers, as well as the capacity for flexibility and fantasy in thought" (1984, 77). In this way, experience is

inherently different from hypothesis-testing in the philosophy of science. In poiesis, the person is understood "more as a responsive partner than a dominating other" (Pickering 2017). Like a traveler, they are unfamiliar with the road and face different challenges along the way. The journey is not fully planned in advance or under control, but at the same time, the traveler is not passive and reacts to each challenge appropriately. This kind of conscious experience can be called "active experience." It begins with intuition and observation. Henry David Thoreau, who inspired designers such as John Chris Jones and Buckminster Fuller, considered seeing the primary mode of perception. What he called being "awake" is the opposite to being blind or "asleep." This perception helps develop creative ideas and imagine new relationships between things.

Seeing new dimensions of each phenomenon is an approach that can be employed as an alternative to using systematic methods for reaching creative solutions to each problem. Noel White defines creative activity as the discovery of these relationships, stating: "It is difficult to define the nature of the creative activity, except to say that it has something to do with the ability to associate things not previously associated. Therefore, the quality of awareness over a wide span of activities and experience is important to designers" (1967). If we imagine there are many solutions to each problem, creative ways are possibilities that have not yet been realized.

Active experience helps the designer see relationships that are in more accordance with each other but not necessarily familiar. While a method can sometimes provide valuable information for the designer to reflect on, it does not necessarily help an individual to think and see like a designer. White argues for the concept of uncertainty for multiple probable solutions to each problem and considers creativity in intuition and experience. "Allied to the stimulus toward innovation which designers receive during their training is their acceptance that in most problems there are areas of uncertainty which have to be coped with by means of intuition or the inspired guess, and by accumulated experience based on acute observation" (1967).

Here we can return to Simon's definition of intuition as the ability experts have to respond to situations. He assumed that this ability is based on an enormous accumulation of experience. Pickering's actor seems to perform like Simon's chess player despite the fundamental differences between their views on the design process. A chess player consciously monitors their opponent's moves and knows they have to wait and make the next move according to what is happening. Therefore, an analogous relationship between the two competitors exists. There is no experimentation in laboratory conditions that can achieve generalizable knowledge. Sometimes the designer does not know which experience causes a particular reaction to a new problem. They find themselves dancing freely with the circumstances, responding harmoniously to any action. From this point of view, the way we interact with the world is essential. In a lecture on his book *Design for Dasein: Understanding the Design of Experiences*, Wendt explains, "Dasein essentially kind of loses itself within an action, but it is also self-reflective, in much the same way that someone like a musician might lose herself in a moment but still reflect on practice" (2015).

Conclusion

The need for systematic design methods arose when mass production was no longer a concern for designers and they began facing more complex challenges. Methods developed machines that produced solutions to complicated problems by defining the situation and organizing the information. This proposed process contradicted the design concept. Indeed, it could only bring the designer to the threshold of creativity and no further. The designer would have to offer what machines currently could not deliver. Designers have chosen many different approaches to achieve this. In my article, I focused on the ideas of John Chris Jones, Bruce Archer, and Andrew Pickering, among a few others. In conclusion, I would say that the use of methods cannot be abandoned entirely. However, there are many problems in relying exclusively on methods to reach design solutions. Surprisingly, the original proponents of methodology in design ended up rethinking and

opposing systematic methods. The precedence of not-knowing, unlearning, and exformation constitute alternative approaches that avoid a reliance on previous information. This includes the possibility of the unknown to emerge. I also introduced the principle of active experience, which differs from strict scientific experimentation or the mere accumulation of old, existing, and passive experiences. This article does not cover the various dimensions of active experience and how they can be employed in different design practices. In my future work, I will attempt to find the place of this approach in the design process in order to determine how it can be substituted or integrated in existing methods to solve complex problems.

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Experimentation

From exformation to active experience

Zahra Mohammadganjee

Exformation experiments create new situations for objects by changing their position or their form and features. Registering these new characteristics allows us to portray unfamiliar meanings and unknown qualities, thus disarming the viewer of existing experiences. Without this old knowledge, the object's hidden aspects will become visible. A sense of curiosity and a desire for discovery and intuition are naturally found in what we do not know and not in what we know. Exformation experiments therefore try to break down structures of common knowledge in order to provide the conditions for active experience. In the absence of familiarity, the process of perception becomes longer and more influential.

I employed this technique in the following experimentation. Objects have interrelated qualities, which reinforce each other to form an object's character. These interrelationships accelerate cognition and acquaintance. Jean-Paul Sartre's description of the attributes of a lemon in *Being and Nothingness* is an excellent example of this. "The yellow of the lemon is not a subjective mode of apprehending the lemon; it is the lemon ... In fact, the lemon is extended throughout its qualities, and each of its qualities is extended throughout each of the others. It is the sourness of the lemon which is yellow; it is the yellow of the lemon which is sour" ([1943] 1984, 257). I have tried to utilize this feature by

breaking down connections and removing links. Without these links, the object is no longer recognizable, putting observers in a state of not-knowing. This experience changes the passive observer into an active player, who engages their mind to find new links and connections.

I covered the ginger in white to transform its natural essence from plant to artificial object. The paint removes the details and changes the texture of the ginger's skin, disrupting a connection with its nature and allowing a character change to occur. It is now the ginger's form that draws attention. Variety of form is one of the plant's hidden potentials. I began to record new characters born in this mutual active experience between me and the ginger. In the first series of photos, they were dancers in white with giant deformed bodies. They can be imagined on stage, dancing in pairs or alone, some of them headless but still delighted.

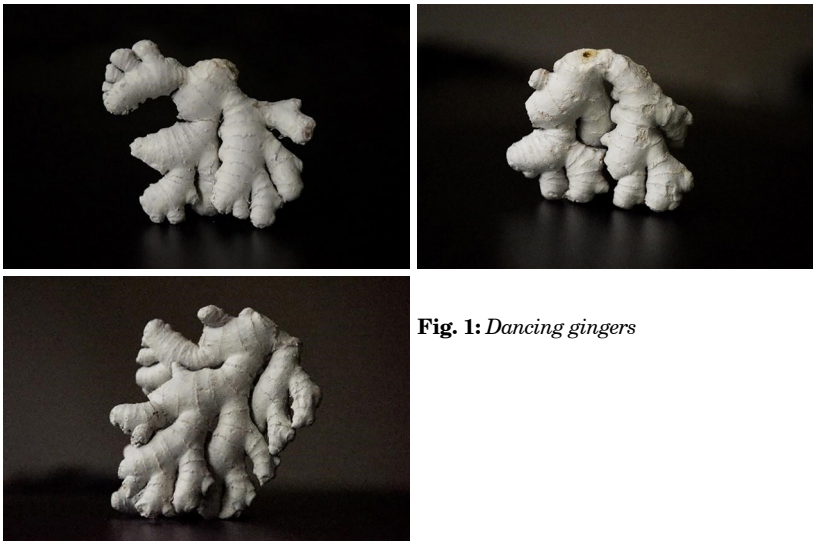

Fig. 1: *Dancing gingers*

I then tried to make a new combination, creating apocalyptic fighters with deadly weapons—the opposite of the first role. A small piece of modern technology added to the multiple arms and legs draws out a legendary creature from the ginger root. Obviously, this would not be their last role.

To show the potential of not knowing, we need to suspend existing knowledge for a while and reveal the unknown features of the object. The idea of applying unexpected changes to tiny things emerged from this thought. I began with seeds and grains. We usually see them in their hundreds or thousands inside containers or individually within the fruit. However, new faces are revealed when we see them outside of this context. I put two beans and two kiwi seeds next to the electronic devices in my studio. This enabled me to see the grains within different frames. With a bit of exaggeration in size, their new character emerged in a headset. Kiwi seeds are tiny, 1.5 to 2 mm in diameter, with a unique texture that only magnification can reveal. Blown up about ten times bigger in Photoshop, I used them to replace my earbuds. The result was satisfactory as a design practice.

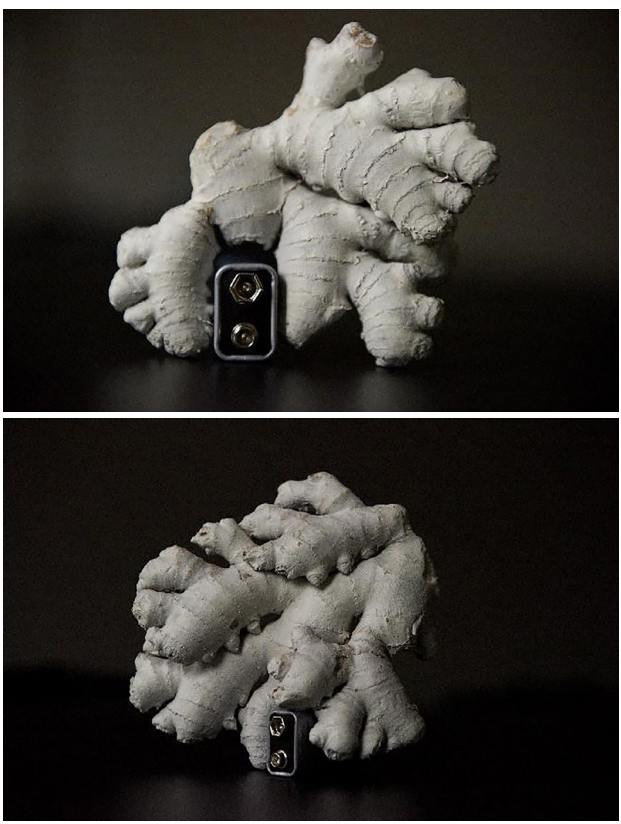

Fig. 2: *Fighter gingers*

The experience of integrating grains and pulses in electronic devices to create one object gradually progressed to the point that it was not difficult to imagine that the beans themselves could be charged directly.

Fig. 3: *Designing a headset through exformation experimentation*

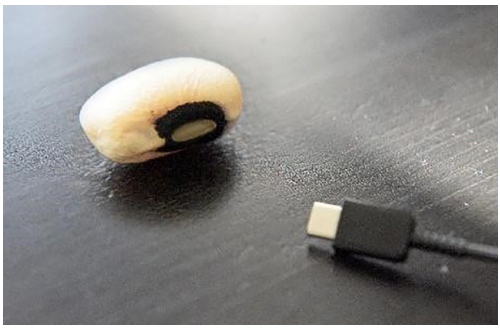

Fig. 4: *A new form of connection*

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Poetic experimentation

Towards experiencing the space of agency

Somayyeh Shahhosieny

Oedipus, unhappy man, pay heed to me, come home!
Oedipus at Colonus, Sophocles

Abstract
Starting from the notions of experimentation and experience and the fundamental differences between them, this article aims to demonstrate how the poetic design of a place can lead to experiencing a space of agency. To this end, the discussion endeavors to illustrate the concept of poiesis in experimentation and praxis in experience. It investigates the relationship between these two notions in the context of space design. In that, the place is defined as the place to live, and those characteristics that are independent of cultures or geographical locations are examined. These aspects are considered from an ontological perspective and are encountered through a phenomenological approach in both experience and experimentation. The essential notion in the article is indubitably that of place, and the main goal is to investigate how the qualities of place that have been removed in the era of industrialization and mass production can be rebuilt and returned. The importance of addressing this issue is that our understanding of place is now detached from its characteristics as the place of living. In conclusion, some of the fundamental qualities are introduced as an instruction for poetic experimentation.

Introduction

We come into the world to live *somewhere*. We leave our mother's dark, tiny, damp womb to find life in a larger home. This has been the most crucial of human challenges since ancient times: where is our place? To have a place means having a will, having a desire to survive, finding and realizing this desire. It always has an ontological quality because to be, is to be in a place. In fact, before any definition, place means to be somewhere. As human beings, we have a profound sense of and attachment to place. This relationship is two-way; just as the place has an ontological quality, existence also means to be in a place. We can not talk about existence outside and detached from the notion of place. Christian Norberg-Schulz believes that place is an incumbent part of existence, stating: "To be born is to be born in a place, to be assigned to the residence. In this sense, the actual place of birth is a constituent of individual identity" (1980: 53).

One of the differences between subject and object lies in the fact that the subject is aware of their existence. *They* know *they are*, while *it* does not know *it is*. Understanding being occurs through understanding of place. Understanding the relationship our body establishes with a place and the relationship our mind forms, creates a conscious perception of our own existence. Therefore, place also means self-awareness of being. The quality of the relationship established with place creates a space that Norberg-Schulz defines as "existential" (1980, 5). Existential space is not identical for all human beings. The experience of different feelings and emotions depends on the quality of each individual's experience of existential space. Existential space is a sediment that remains in our minds from a place. It is formed in us by place and builds our perspective of the world in ourselves. Edward Relph believes that "existential space is not merely a passive space waiting to be experienced but is constantly being created and remade by human activities" (1976, 12).

Norberg-Schulz argues that the concept of place is so fundamental and eternal that it has been tied to human destiny since creation. According to him, man's expulsion from paradise means

liberation from endless emptiness and timelessness. The Greek word *hubris* (human rebellion) refers to the word "build," to establish a place. Although hubris, unlike what is believed in Christianity, does not have any moral implications, it refers to a constant rebellion against the system of gods. Norberg-Schulz writes: "To belong to a place means to have an existential foothold, in a concrete everyday sense. When God said to Adam: 'You shall be a fugitive and a wanderer on the Earth,' he put the man in front of his most basic problem: to cross the threshold to regain the lost place" (1980, 23).

From this perspective, man is always striving to settle down somewhere. He is not searching for a lost paradise, because paradise is nowhere. From a terminological point of view, the Garden of Eden, which is understood as the most critical reflection of the notion of utopia, is nowhere. The Greek word utopia means the place that does not exist, a no-place or a non-place. The term combines *topos* (place) and the prefix *ou* that makes the word negative. In the original paradise, man is in a spaceless place with no boundaries, with no limits to light, air, soil, or water. After being expelled, he becomes acquainted with a new existential dimension, which indicates the notion of enclosure and sets borders for everything. The enclosure gives birth to man. It means to be, to exist as human beings.

But the new definitions of man in the modern world lacked an emphasis on his existential relationship to place. Relph argues that the term "placelessness" describes both an environment without significant places and an underlying attitude that does not acknowledge significance in places. He remarks: "It [placelessness] reaches back into the deepest levels of place, cutting roots, eroding symbols, replacing diversity with uniformity and experiential order with conceptual order" (1976, 143). What we are facing now is an infinite void, the nothingness that Samuel Beckett tries to demonstrate in his play *Waiting for Godot*. The whole scene, the whole view, the entire world of human beings has been tragically reduced to "A country road. A tree. Evening" (1954, 1). Two vagabonds, Vladimir and Estragon, have been waiting for a long time at the roadside to

see Godot. Both suffer from amnesia. The play draws an analogy between their existential forgetfulness and homelessness. Estragon cannot remember anything; he needs Vladimir to tell him his history. It is as if Vladimir establishes Estragon's identity by remembering for him. Estragon also serves as a reminder for Vladimir of everything they have done together. Thus, both men serve to remind the other of his very existence. It should be borne in mind that the play refers to the feeling of homelessness that modernity has brought with it. Beckett does not address the economic poverty of the two vagabonds. Modernity reduces space to a mere external object so that the dialectic between subjective and objective space falls victim to the staggering speed of mass production. Place in the modern age takes the space of action from the subject. By eliminating the context, modernity reduces any phenomenon to generalizable and reproducible formulas, which can be implemented everywhere and at any time.

Kevin Lynch discusses the importance of context in experiencing place: "Nothing is experienced by itself, but always in relation to its surroundings, the sequences of events leading up to it, and the memory of past experiences" (1960, 1). In this respect, context means identity, locality, and history. When the context is omitted, the particular identity is removed. Furthermore, the main problem of our world—or "supermodern world" as Marc Augé calls it in his book *Non-Places: Introduction to an Anthropology of Supermodernity*—is "excess" (1995). Excess prioritizes quantity over quality, leading to mass production and the loss of the originality, identity, and meaningfulness of things. As Augé says: "What is new is not that the world lacks meaning, or has little meaning, or less than it used to have; it is that we seem to feel an explicit and intense daily need to give it meaning" (29).

I read this in connection to place, or more specifically home, and in the broader sense, the city. A city missing the qualities of a living space is antagonistic to human life. People do not only feel uncomfortable in it, but must also fight against its brutal forces. Walter Benjamin correctly recognized that modern cities would fundamentally redefine what it is to be human. In the *Arcade*

Project, he shows that the role of the flâneur is grounded in a new quality of life that modern urban planning created. Benjamin borrows the character of the flâneur from Baudelaire's poems to explain modern urban spaces, including his own personal experience. In Baudelaire's poetry, Paris is described as the capital of modernity, a city with markets, shopping malls, large passages, and shops with spectacular windows. Indeed, "in the person of the flâneur, the intelligentsia becomes acquainted with the marketplace. It surrenders itself to the market, thinking merely to look around; but in fact, it is already seeking a buyer" (Benjamin [1927–40] 1999, 10). Benjamin argues that the flâneur in any place in this city is searching for the feeling of being at home. "He sought his asylum in the crowd" (21). He steps onto the streets without a specific purpose, to walk in any direction (as all directions seem the same) and sees the city while being seen by it. This aimless wandering, rooted in modern urban architecture, was to take on more critical forms in the coming decades.

Modern architecture, which created an extraordinary exhibition of the city, helps modern capitalism instill needs in humankind that did not exist before. The flâneur's movement through the city is a neutral movement with no direction. Relph describes this as mere spatial mobility, resulting from a depletion of the symbolic qualities of place. He argues that such places lack a sense of identity, while for the primitive hunter or medieval artisan, a sense of belonging to the place imbued their whole existence. This article addresses such qualities and defines them as fundamentals in designing living spaces. It also opens a discussion that connects the living space with the space of agency.

Experiment and Experience

Every individual reacts to the world as they perceive it. From a phenomenological point of view, everything appears to the consciousness through experience. The quality of how we react to the world around us depends mainly on these experiences. The more closely involved with a phenomenon we are, the better we understand it. Just as the experience of wearing a dress is different

from seeing it in a shop window, it can be said that the experience of being present in a place and seeing an event or phenomenon gives a person the credibility of a witness. Since human existence is always tied to a place and their presence is embodied in it, this closeness can provide a profound experience of place and a deep perception. Closeness, here, means being inside and enclosed by a place or approaching it. Indeed, human beings can even be the content of the place. This is a unique experience formed in confronting the place, passing through it, and stopping in it.

The experience of place and space is essential when it comes to living space. It is a subjective and objective experience that profoundly influences our mental and physical life. In this sense, creating space is an experimental practice; a mathematical abstraction results from our understanding of notions of space and place. Architects create experimental spaces, allowing others to experience them. Experimentation is a two-way interaction between man and space, between subject and spatial object in designing spaces. Ideally, the architect's work can be relied on to create a space of action or agency, and that is a potential to interact with a place.

Experimentation is a subjective action that leads to the creation of an external object. For this reason, it is a result-oriented process and always addresses the outside world. At the same time, there are two different views: Experimentation can be a scientific experiment or based on intuition in making or poiesis. Scientific laws are universal but not fixed and can be changed based on new findings. Their weaknesses and shortcomings become revealed in practice. For example, a city plan may seem ideal and progressive on paper but not responsive on an absolute scale and in a face-to-face relationship with human life in different situations. In contrast, the approach of poiesis works on a case-by-case basis, paying attention to details, reaching from parts to whole while simultaneously having a universal view.

The results of both forms of experimentation are shareable. However, due to the nature of experience, it is an individual concept, and the knowledge it results in relies on subjective perception. Although one can speak of collective experience, there are always

many personal and unique experiences involved. War, for example, can be a national collective experience while including an infinite number of individual experiences. Our experience can not be the experience of others. While the external and objective product of an experiment is shareable, an experience has no external objective product to be shared. The product of experience is instead a mental sediment. This means the experience is not instrumental. It addresses the inside, and although it is formed in the present, it does not necessarily fit into the present and is even comparable to the past. Living happens in a time and place that passes, but its effect remains in the subject. In this sense, it is not limited to the objective realm, but rather is subjective.

An experience can be passive and repetitive or unique and memorable. The degree of proximity to a phenomenon usually plays a crucial role in the quality of the experience. Regardless of whether a building results from new experimentation or is a reproduction, an atmosphere of experience affects the subject in architecture. The experience of place is to bring human existence to presence. Place can emphasize the presence and existence of humans, and it is the presence of humans that gives meaning and identity to the place. Either humankind has a way into it, or it is made to facilitate things in human life. In both cases, it becomes identified in interaction with humans. It is as if the building also experiences human presence.

Poiesis and Praxis

According to Aristotle, phronesis and techne are kinds of human knowledge that appear in practice in the forms of praxis and poiesis, respectively. Both belong to the realm of action. But just as experience and experimentation are different, poiesis is also different from praxis in the sense of making. Praxis is an action that is summed up in doing or executing, and its purpose is in itself, while poiesis is to make, and its purpose is in what it produces. Poiesis is a creative act that is always associated with genesis: Something is created that did not exist before but has always had the potential to come into being. There is no desire for superiority or domina-

tion in poiesis. It is to communicate responsibly with phenomena and to take appropriate action and reaction. Discovering something that *is* not but could *be*, requires intuitive seeking. It is as if we could see the emptiness and recognize its character so that we can then find its features and shape it. For instance, when there is a small free space between protruding parts of a wall, an empty space that has the potential to be a place to sit, a poetic vision could find the relationship between forms and the environment and also between human and building to embody the lost character of the place and realize the possibility of the space. Before the human being was seen as a mere consumer, poiesis contributed significantly to the origin of human life on earth. Initially, there was no bread, but you can not imagine the world without bread. There was no house, and humankind can not be pictured without houses. We can find the same attributes in these examples: bread as mere nutrition or staple food, the house as a place to dwell, and the bridge as a gathering force, and these could come into existence and be even sacred in many cultures. Norberg-Schulz states: "The existential purpose of building (architecture) is, therefore, to make a site become a place, that is, to uncover the meanings potentially present in the given environment" (1980, 18).

Poiesis can be equated with a moment of ontological euphoria, as Aristotle explains the moment of ecstasy during the metamorphosis of a phenomenon and the emergence of something new. Aristotle's understanding of poiesis is to transform, to bring forth. There is a moment of ecstasy when something becomes something else. It gives a poetic aspect to making. When there is a profound desire for a change, it provides a quality that can change the surrounding atmosphere. This concentration and gathering of powers are motivational. At this point, poetry and poiesis meet one another. Indeed, the Greek root of these two terms is the same. Both come from a word that means "to make."[1] It is interesting to note that in the English language the notion of *maker* or *shaper*

1- *Poiesis*: ποίησις (poiisis) comes from the ancient verb ποιέω/ποιώ (poieo/ poio) that means "to make," "to create," "to compose." And the word *poet* comes from the Greek word *poiētēs*, itself from poiein, meaning "to make."

referred historically to both poet and God.[2] This comes from the creative and intuitive essence of poetry. When we talk about poiesis, there is always a sense of movement and creation that exists in poetry as well. In his book *The Poetics of Space*, Gaston Bachelard states: "In many circumstances, we are obliged to acknowledge that poetry is a commitment of the soul" and, therefore, "forces are manifested in poems that do not pass through the circuits of knowledge" (1994, xxi).

In this sense, poiesis has an experimental nature. Both experiment and poiesis are tied to the intuitive discovery that occurs in a process that is an inseparable part of poiesis. It cannot be classified and subdivided into steps because it is subjective and originates from the subject's lived experience. Therefore, by changing the subject, it can take on a different quality. Despite this difference in experience and the outcome that varies from one individual to another, the common aspect is the desire for action. The result of poetic experience cannot be an action far from poetic space.

Unlike poiesis, mass production does not depend on a particular person and its results are always the same. Mass production is separable to formulated stages that are duplicable. The difference in the sound of hand-made musical instruments produced by different artisans is an excellent example of how the subject changes the making of a particular object. The setar, an ancient instrument played in a large region of the Iranian plateau, consists of two main parts: a bowl and a handle. The bowl is usually made of mulberry wood and walnut is often used for the handle. For both parts to be in perfect harmony, many conditions, including the age of the trees, are essential. Discovering a tree that can produce the desired sound is intuitive and highly dependent on the craftsman's perception of their surroundings. It is as if the tree itself expresses its ability out loud and only needs an ear to hear it. Here, poiesis is to listen to this voice to choose the right tree, see the bowl in an appropriate part of it, and bring it out of the wood. A poetic act happens when sound, wood, empty space, and the

2- Poets were highly esteemed; the "word maker" had been used to refer to God for centuries. "Shaper" too has historically referred to both "a poet" and "God" in English.

movement of the craftsman's hand are coordinated. This is more than mere technique.

Phenomenologists often believe that there is no way of thinking that is utterly distinct from action. The experience of action also affects the subject's orientation and deepens subjective perception. This connection is significant when the intention is to design a space of agency. Ideally, the experimenter, who is represented by the designer, architect, or builder in this article, opens themselves to a comprehensive and immediate understanding that, beyond all their acquired knowledge, leads them to a making that differs from a formulated scientific process. As a result, each architect produces differently designed spaces. The experience of these spaces is also unique. The relation of the two concepts of being and place is such that the quality of place can affect human existence entirely. If spatial experience is poetic, it connects the subject to praxis. It turns the inhabitants of a place into active users who are not passively lost in their surrounding environment. Experience creates perception and motivates inhabitants to act as agents. This means bringing knowledge into practice. If a place is passive and neutral, no motivating experience is created for residents.

Contrary to creating a space of agency, however, technology on a large scale turned construction, which belonged to the field of experimentation, into mass production and reduced the process of building to repetitive pre-planned patterns. Gilbert Herbert, in his book *The Dream of the Factory-Made House: Walter Gropius and Konrad Wachsmann*, explains:

> This is the period when the great masters, Le Corbusier, Gropius, Frank Lloyd Wright, found it necessary to deal with the technological imperatives and social ideology of mass housing, when each in his own manner—Wright romantically, Le Corbusier ideologically, Gropius totally and with deep commitment—explored the potentials of industrialised building. This is the period when European architects of standing in the modern movement (Martin Wagner and Ernst May, Hans Poelzig and Hans Scharoun, Josef Hoffman, Max and Bruno Taut, Otto Bartning) engaged

> with enthusiasm in designing prototypes for industrial production or even total systems of prefabrication, developing them in the greatest of detail. In this crusade they were joined by Richard Neutra, Lawrence Kocher, Albert Frey, Barry Byrne, Buckminster Fuller, and many other notable architects in the United States. (1984, 5)

Modernist architects believed that technology was the embodiment of science, and science an "instrument" for human salvation. Don Ihde, in his book *Technology and the Lifeworld from Garden to Earth*, states that "science-technology, rightly applied and developed [...] would eventually solve most, if not all, human social and personal problems" (1990, 7). When it came to planning cities and residential complexes, modernity also omitted representation from the process of creation and eliminated the subjective experience. Thus, the object produced raises no motivation for action.

Poetic place and poetical experience

The human relationship with place is primarily a spiritual and emotional connection. We often explain this relationship with phrases like:

I feel suffocated here.
This place is very cozy and pleasant.
I would like to come back here.
I belong here/there.
I do not want to spend a night here.
Nowhere is like home.
I feel nostalgia, etc.

These feelings address our experience of place. While an event in a particular place can affect how we feel about it, the place itself can affect us positively or negatively. If the experience of a place is profound and influential, it is involved in forming the identities of individuals. It can even save humans from feeling confused and alienated. When describing the notion of place versus that of placelessness, Relph also speaks of the effect of the experience of places

on the human spirit. "Places are not abstractions or concepts, but are directly experienced phenomena of the lived-world and hence are full with meanings, with real objects, and with ongoing activities. They are important sources of individual and communal identity and are often profound centers of human existence to which people have deep emotional and psychological ties" (1976, 141).

The architect's art is turning spaces into places and transferring this into the human mind. In this regard, Norberg-Schulz considers architecture to be "the art of place," which aims to provide images of the world that reveal the meaning of things. Architecture in this sense is a poetic experience, and the place, like poetry, reveals deep and inexpressible intentions.[3] He states: "Architecture belongs to poetry, and its purpose is to help man to dwell" (1980, 23). Norberg-Schulz believes poetry can concretize those totalities which elude science, and may therefore suggest how we might proceed in order to obtain the required understanding. Poetry in architecture is the creation of mysterious spaces for the subject's discovery, intuition, and action; mysterious in the sense that such spaces are far from being minimal, simple or constructed with straight lines. Not everything is clear at first glance. It takes a while to discover all corners and niches.

Marshall Berman believes that the modern age is the age of nudity, in which humankind removes the external and internal boundaries between themselves and the world outside. This can be seen in buildings too: nothing is hidden or obscured anymore. Everything should be accessible, obvious, without complexity and ambiguity. Indeed, being naked in this way was the attitude that made human beings homeless. Home, in its basic meaning, is the place to hide and veil, to protect us both mentally and physically. Under the suggestive chapter title, "Nakedness: the Unaccommodated Man," Berman writes,

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3- In describing the existential experience of place, Norberg-Schulz states: "When man dwells, he is simultaneously located in space and exposed to a certain environmental character. The two psychological functions involved may be called 'orientation' and 'identification.' To gain an existential foothold man has to be able to orientate himself; he has to know where he is. But he also has to identify himself with the environment, that is, he has to know how he is in a certain place" (1980, 19).

> The modern transformation, beginning in the age of the Renaissance and Reformation, places both these worlds on earth, in space and time, filled with human beings. Now the false world is seen as a historical past; a world is in the physical and social world that exists for us here and now (or is in the process of coming into being). At this point, a new symbolism emerges. Clothes become an emblem of the old, illusory mode of life; nakedness comes to signify the newly discovered and experienced truth; and the act of taking off one's clothes becomes an act of spiritual liberation, of becoming real. (1988, 106)

The analogy between nakedness and homelessness in architecture can be seen in the blanket application of glass, as a material possessing qualities such as transparency and openness. A struggle to transcend all boundaries and frontiers leads to omitting the opposition between inside and outside, home and street, interior and exterior, private and public. The principles of modern architecture defined by Le Corbusier in *Les cinq points de l'architecture moderne*, published in 1927, contains the rule he called "Free design of the façade." This emphasizes that since a building is supported by columns in the interior, the façade can be much lighter and more open or made entirely of glass.

A metaphor for the nudity that emerged in the contemporary world can be seen in *house II*. Designed by Peter Eisenman, one of the architects of high modernism, the house gives no feeling of privacy or concealment. All the walls of the bedrooms are half-filled and empty in the lower parts, the bathroom has no boundaries, and even the softest whispers can be heard everywhere. The owner believed this house is fantastic and impresses all visitors. But one should not live in it! (Blair 2002). This level of nudity in the building made it uninhabitable to such an extent that a year later, Ted Zilius, a former toy designer, completed the half-walls, placed iron frames on the floor openings, and filled windows in the ceiling. He significantly changed the home's look to meet the family's basic needs. The change did not end there, and in the mid-1980s, the flat roofs were replaced by a gently sloping roof.

The poetic place cannot be naked. Poetry always has hidden meanings and layers covered with metaphors. Understanding these complexities is stimulating and sensational and arouses the reader's imagination. Hence, a poetic place is like an unfinished text or poem, completed differently depending on the specific reader; it provides the possibility for dwellers to complete and shape it according to their imagination. In contrast, in modern architecture, the view of time and place is one-dimensional, function-oriented, to the extent that the ultimate goal of any space is determined from the beginning and every space is designed solely for that specific aim. This argument does not apply to all works of modernist architects and designers. I refer to those considered modernists, but those works are not in harmony with the general modernist approach and have affected the shape of today's societies and the quality of human life in general.

A one-dimensional place or "a place which is only fitted for one particular purpose would soon become useless" (Norberg-Schulz 1980, 10). However, the design of the poetic place does not only consider practical aspects. Thus, there is always the possibility for the resident of a place to make changes to it. For instance, they come up with ideas for empty corners and spaces, add parts to the building or change the function of some spaces. Everyone has their own experience of a place and, in every interaction with it, experiences a space of agency. This is similar to what Lynch explains as the expectation of the design of a city. It does not matter if the living space is considered a house or a city. It is necessary to pay attention to some essential qualities in designing both. He interprets the concept of the image of the city as an unfinished quality. He writes: "The image should preferably be open-ended, adaptable to change, allowing the individual to continue to investigate and organize reality: there should be blank spaces where he can extend the drawing for himself. Finally, it should be in some measure communicable for other individuals" (1960, 9).

Moving from one place to another in a city or moving in different spaces is tied to memory and affects the quality of experiencing the place. Jeff Malpas utilizes the term "nesting" to demonstrate the

interconnection between places and their effect on memory. Malpas remarks that "places also contain places so that one can move inwards to find other places nested within a place as well as move outwards to a more encompassing locale. Some of these features of places will become quite important ideas in the ensuing discussion. The nesting of places, for instance, is a significant point of connection between place and memory" (2004, 34). The intrinsic characteristic of space is that it allows movement with each pause in a place. Without places, the space of movement is an infinite expansion with no orientation or point of convergence and unity. It does not lead agencies towards the practice of change-making. The quality that Malpas calls nesting is one believed to be essential for a place as unfinished text. Nesting creates the path for a journey. It is mysterious and veils the place, or better, it hides places within places leading to mysterious spaces, which is an essential characteristic of unfinished architecture. We should bear in mind that mysterious here is the opposite of puzzling or baffling, which represent modern architecture. The notion of nesting (places within places), which is an essential feature for a poetic place, is the quality that Bachelard finds in the term "verticality." He writes that the poetic house where man can be an agent should be vertical with many different places. "In order to satisfy our daydream [houses] have to be differentiated in height" ([1958] 1994, 15). In Bachelard's view, daydreaming is equivalent to agency.

Instead of creating a poetic atmosphere, modern architecture has used other solutions to create interesting urban planning and architecture. Introducing the city as a huge communal house with short-term lives in non-places such as cinemas, theaters, cafes, restaurants, airports, brothels, hotels reduced subjective interaction. In a non-place, as Augé calls it, identity is reduced to what is engraved on a card. The essence of the subject becomes what is written on their ticket. Modern architecture has eliminated secrecy, although it is mysterious in appearance. It creates confusing and dizzying spaces; in them, acting as an agent is an illusion for the subject. An example of the nature of modern architecture can be seen in some of Maurits Escher's works such as "Convex and

Concave", "Relativity" and "Up and Down". In them, the essence of modernity becomes evident in its dealing with place. Everything is like an endless mirage. Stairs, although seemingly climbing, remain in a cycle. As a result, figures appear to be rising or falling but yet frozen in place. The paths and stairs do not lead anywhere, and doors do not open to any side. There, humans, like ghosts, are captivated in a futile struggle to move. Everything repeats itself in a vicious circle. Relph describes the modern experience of such a place and explains that "it involves the sense that nothing is really clear or comprehensible, that events are beyond control and men are trapped in a web of anonymously directed and largely meaningless forces," adding that "absurdity and mockery have in the post-Second-World-War period become a prominent part of a universal lifestyle" (1976, 127).

Eisenmann's *House VI* is an excellent practical example of this view. It is characterized by an ambiguous, contradictory and complex structure that tries to create excitement and curiosity in the audience by proposing unpredictable spaces. It is designed to open different interpretations and tries not to impose the same meaning on all viewers. As in many of his other works, Eisenmann did not treat the building as a place to live. He proclaims: "I am passionate about architecture, not about solving the Falk family privacy issues." *House VI* is like theater stage decor, like a temporary arrangement that conveys special meaning to the audience during a two-hour show. It includes a door too narrow to be entered without turning sideways, a staircase that cannot be climbed (upside down), and a column that butts up against the dining room table. At the end of the show, everyone prefers to leave this space quickly. Such a place can hardly communicate with its surroundings and human nature. In this house, like *House II* and *House III*, the walls and everything else look prefabricated, as if they were constructed as a model. Built of plywood, veneer, and paint, they lack the details associated with conventional houses. Viewed without the external, scale-specific referent, these houses become ambiguous objects that could be either buildings or models. The architect has made every effort to create a mysterious space while conveying a sense of alienation. It's

like dealing with an unfamiliar situation in a spacecraft and enduring everything. *House IV* imposes its will on the subject and leaves no chance for discovery and intuition. Even though the stairs attract attention and curiosity and raise the feeling of astonishment and excitement in the first encounter, they are not functional. A gap in the wall separates the beds of the parents, and one has to turn sideways to pass through the door. There is only one place the dining table can be positioned, which ironically does not convey a pleasant feeling.

However, poetry eagerly returns the human to the place or even binds them to it. It is no longer the place that belongs to them, but now the human belongs to the place. Belonging to a place and giving life to a lifeless body is a powerful emotional connection. The place is far beyond an object produced from materials in poetic space. It has a spirit, as Norberg-Schulz describes it. The spirit of the place prevents the feeling of loss, confusion, ignorance, and boredom that humankind feels today. This spirit is "breathed into" the place by the architect with poetic making.

From poiesis to space of agency

Malpas remarks: "We must investigate space as it presents itself, not only in terms of physical extension or location, nor even merely as space within which the perceptual presentation of an object is possible, but as a space for movement and activity" (2004, 45). Bachelard sees the potentiality of free movement in our daily activities when they are the results of poetic experiences. But how can the living space be made multidimensional, devoid of tedious repetition and how can it become a place for imagination? Finding an answer to this question requires an examination of the relationship between place and human. Our relationship with our place of living is similar to our relationship with our body. The first place we know is our own body, and in this sense, the body is the first home of every human being. We live in our bodies. Although we may forget this fact, there are always things that make a person aware of their body. For example, we become aware of the presence of our body with something like a feeling of pain, although, beyond this awareness,

we always try to protect it from external dangers. *Topos*, which generally means place, in the Aristotelian sense of the word "[…] is always the topos of some *body* and so there must be both a body that is contained and also a body that contains" (Malpas 2004, 24). Just as the body is surrounded by a place, it embraces the human being. This does not necessarily postulate the separation of body and soul in the Cartesian sense, but the type of relationship shows that the two are intertwined. That is, the human is inherently intertwined with place and tied to it whether it is a physical place containing their body or their body as a place.

The potentiality of human action and agency in encountering a place shows the unique nature of that place. We can not understand space except when our body is confronted with a place. Space emerges from the interaction of body and place, and any perception of space comes from this physical encounter. In other words, as Augé puts it, it is the pedestrians who create the street space. "Space […] is a frequented place, an intersection of moving bodies: it is the pedestrians who transform a street (geometrically defined as a place by planners) into space" (1995, 79–80). A physical encounter occurs where a person approaches things to get to know them and bridges the spatial gap between themselves and the thing. For this reason, when proximity is likely to cause damage to objects or humans, boundaries are set around objects so that people are prevented from coming too close. Marked areas in museums or near precipices are examples of this (Fig. 1). The body orients itself towards things. And this points to human existence, spatiality, and directionality. Humans feel different directions and positions within their immediate surroundings. Directionality produces a meaningful place by intending to fill the distances. Movement exerts its directionality through "de-distancing."

Tadao Ando believes that "spatiality is the result, not of a single, absolute direction of vision, but of a multiplicity of directions of vision from a multiplicity of viewpoints made possible by the movement of the shintai" (1997, 453).[4] He calls it "mutual articulation

4- Shintai is the Japanese notion of body. It is understood as an active, pre-reflective, sensational capacity to embrace and feel the world as the content of the very self.

Fig. 1: The border between Mona Lisa painting and visitors in Louvre museum

of the body and the world." The body is a combination of different senses through which our perception of the world is obtained. In contrast to the vision-oriented architecture of the time, Ando states that "architectural space is a phenomenon we take in not only visually but through all our senses, that is, through our whole bodies" (449).

Only by approaching things can we have a correct understanding of the details as well as the dimensions and spatial scales and other qualities. Merleau-Ponty argues that our perception of the world is dependent, to a large extent, on how much information we receive from the environment. This understanding is originally perspectival in that it underlines the role of movement in perceiving a place and presents a "poetics of movement" as Plummer calls it (Yoshida and Plummer 2002). Only some places have the spatial qualities that enable us to conceive ourselves with our bodies and the possibility of mental and physical movement in order to select a point to view the world. The word *viewing* here does not refer to the simple act of looking at something, but rather to experience and be experienced. This dialectic of view (experience) and being viewed (being experienced) is the act of the agent.

Through poiesis, every corner of a building responds to the material, texture, color, climate, light, shadow, the slope of the earth, the neighboring houses, and the whole environment. The diversity

of details multiplies the attraction of a place and encourages a person to discover the hidden layers, dwell in it, and start daydreaming. Bachelard explains that "the great function of poetry is to give us back the situations of our dreams. The house we were born in is more than an embodiment of home, it is also an embodiment of dreams" ([1958] 1994, 15). Poiesis gives depth and meaning to the relationship between a human and space and to the place itself. In places without spirit, it is as if the subject lives in zero time and space. Sometimes even the change of light and shadow, the flow of wind and movements and sounds outside the house have no way inside a place and thus the residents will not have an understanding of the passage of time and the flow of life in the world outside. Sometimes the light is so flat and wide that the borders of the house lose their meaning and sometimes so little that day and night are not recognizable. In such buildings, everything is in its ultimate state of perfection and clarity from the very beginning, and therefore there is no chance for change, completion, discovery, and intuition.

Poiesis in place and space experimentation will make the built space become the space of imagination and daydreaming. In other words, architectural spaces are the products of imagination and intellectual intention before becoming material realities. The experimental space design resulting from this image will therefore affect, alter, and improve the human space experience. That is why we say the experimenter must utilize something beyond scientific knowledge. "In this reverberation, the poetic image will have a sonority of being" (Augé 1995, xvi). Only through this kind of making would any capacity for action be a creature of spatial experience. As Malpas explains, "action thus plays a crucial role in the possibility of experience, and in the possibility of the mental life of any sort whatsoever, and it is through consideration of the requirements that attend on the possibility of agency that we will be able to arrive at a clearer and more detailed understanding of the nature of the connection between experience, thought and spatiality" (2004, 109).

Fundamentals in designing a space of agency

As a general notion, humans have no place, weight, age, ethnicity, color, and time. However, every person has special characteristics and exists in a particular time and place. To understand places of human habitation as a general concept, one must take away the factors that reduce it to a particular example (a particular person). Here, I have studied some of the characteristics of the place where humans dwell that are independent of the variables mentioned above. I called them fundamental qualities that are not limited to a particular era. Understanding and implementing these qualities lead to poetic experimentation in place and space design and create a space of agency, which results from an experience of space and place that brings imagination, learning, and knowledge into practice.

I tried to study elements such as borders and gathering places in Takayama in Japan, Kashan in Iran, Rome in Italy, and Ladenburg in Germany. I found out that these elements share architectural features in different cultural and geographical contexts. One of the reasons for choosing these four cities was the uninterrupted and continuous flow of life in them and the adaptation and completion of buildings and cities over time, based on the needs of each era. While preserving old buildings and using them as places to live, the capacities of each space have been used actively, enhancing the quality of the lives of residents. Indeed, the three principles mentioned here are just examples. However, each of them may be addressed separately by researchers and architects.

Permeable borders

We see borders in our first encounter with a house or a city. They belong to the most visible parts of a building and cities and make up the overall shape of both. But what matters here is the quality of the border that has a significant role in shaping relationships. Borders can be rigid and impenetrable or fragile and porous. They can facilitate communication or prevent it. Modern cities are full of non-places, designed to pass, not to pause, travel not to settle, get lost and not to get acquainted, and to separate not connect. I

have tried to show this contrast with a simple sketch of interactive and rigid borders in urban plans in figure 2. Borders seek to create boundaries that address outer and inner spaces. They embody a sense of beginning. The beginning of the connection between humans and the place of living and its components. The beginning of human communication and, on another scale, the communication of places. From a phenomenological point of view, the boundary starts at the human body, and each boundary can be a place. The boundary of each place is the first point of connection with another place, and the border constitutes the exact spatial and temporal point of this connection. The border is the beginning of one place at the end of another. It is nothing but the connection of those two places with one another. Thus, this point, where places meet or intersect, evokes commonalities instead of divisions. A border is not a line separating spaces from one other. As in the geometry of adjacent faces that are connected by a shared edge or line, borders make the connection between spaces. Borders, like a piazza, are places where different identities meet. While there is no other possibility for borders than to separate the different identities of places or people from one another, there is also no other way for those identities to meet than at these same borders. This encounter is the beginning of all interactions that facilitate communication.

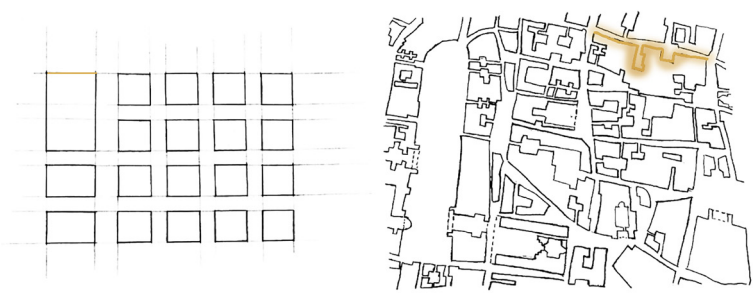

Fig. 2: The contrast between interactive and rigid borders in the city; right: a sketch of Rome city center.

Ancient cultures employed different ways to achieve this aim. In Takayama, the borders are not rigid and non-interactive. They

create a relationship between indoor and outdoor spaces. In many other cities in Japan and many other Far Eastern countries, the boundaries between internal and external spaces range between 0.5 and 1.5 meters, with several different elements forming the border. Vessels, benches, windows, wicker curtains, wooden nets, indentations, and protrusions are elements that create the border despite the emphasis on privacy and protecting the inside from the outside. It is hard to define whether the border belongs to the interior or the exterior. Figure 3 shows that there are no clearly marked sidewalks in this city, so that the street level is shared by cars and pedestrians. The space between the water canal and the building shapes the barrier. This composition removes the feeling of alienation from passers-by and creates intimate and inviting spaces. In Rome, spiraling alleys, countless fractures, and the spilling out of life from inside homes onto the streets blurs the concept of the boundary between the two spaces. Sometimes clothes hanging on lines or creeping plants that arch between houses connect the two sides of an alley. They make the border between houses and the street invisible and uncertain. Using the external spaces of the home and furnishing them creates cozy and pleasant areas that showcase the private life of Italians.

Fig. 3: An example of permeable borders in the city of Takayama, Japan

The next example is Ladenburg. Behind the large wooden doors of many houses in this small town, a roofed, semi shelter-like space exists at the border, which, in contrast to the concept of a wall or barrier, is a space to meet and communicate. It is as if the border is pulled in at this point and gathers everyone

inside. This often becomes a gathering place on summer afternoons. When the border is not rigid or impenetrable, and when openings like a door or window are inviting with the help of a step, bench, or indentation, it creates a possibility of communication at the threshold.[5] Standing on the threshold means standing on the border to communicate. The threshold, in some languages, is a metaphor for introduction and prelude, meaning the beginning of a relationship. In Persian, "wall-to-wall neighbors" are two neighbors whose borders intersect. But despite the repetition of the word *wall*, the term emphasizes the intensity of closeness and familiarity of the two neighbors, not the separation and differentiation between them.

The border, with its many expressive capabilities, is the first layer for identifying a place. Openings are an essential border component and are very influential in this expression. In the past, cultural, historical, religious, and ethnic identities were often represented in this layer, and border characteristics determined which cultural or religious rituals were established in the respective place. This quality can be invisible and non-physical when, for instance, the aim is to encourage self-control and forbearance, just like the conventional walls and doors in Buddhist temples. The purpose can also be to promote humbleness and respect, for example when a person needs to bow to pass through short doors in holy places in Iranian architecture. It can encourage praise and glorification, like entrances across high walls in Roman structures. The quality of the border reveals, to a great extent, the mysteries of the building.

Convex spaces for gathering, stopping, and interacting

One of the first attempts to modernize cities was to change the concept of streets and alleys. In its new definition, the street became a two-dimensional way. The new routes were broad and wide-sighted, and the buildings along them were sometimes so gigantic and separated from each other that they had no connection with passers-by. Marshall Berman quotes Le Corbusier referring to a time when he felt that the streets belonged to people, and they used to walk and

5- Here, a sill or the lower empty space of the door.

stand in the middle of the street and argue or play games and feel at home. However, this happiness did not last long. Soon, people were swept away by the cars. In fact, Le Corbusier himself became one of the originators of the concept of the highway system. Berman states: "What he wanted to do in Paris and New York was to basically kill the streets, tear them all down, and put up giant slabs connected by highways" (2001). There was no longer space for people on the street anymore, and the feeling of being at home there soon vanished. The feeling of comfort in the neighborhood comes from the interaction between people and the street, and also sufficient knowledge of the surrounding environment and details of volumes around, which, although larger than the dimensions of the human body, are easy to grasp. The feeling of acquaintance in narrow alleys comes from bringing people closer to the buildings and inevitably to the inhabitants of those buildings.

To return a three-dimensional identity to the street, in addition to the acceptable dimensions of the surrounding buildings and indirect paths, there must also be openings for gathering, stopping, and interaction: convex spaces in which all other points can be seen. Laura Vaughan describes the convex space "in the sense that moving through space, interacting with other people in space, or even just seeing ambient space from a point in it, all have a natural and necessary spatial geometry: movement is essentially linear, interaction requires a convex space in which all points can see all others, and from any point in space we see a variably shaped, often spiky, visual field we call an isovist" (2007, 203). In convex spaces, one can stop as the street or alley is not blocked and the flow of movement is not restricted. These spaces can accommodate short- or long-term pauses. Yet, such openings should be inviting, too. Qualities such as light, shadows, material, and color play significant roles in inviting people to stop and interact. The small town of Ladenburg is rich in such breaks and inviting spaces. Sometimes the formation of these spaces is the result of the orientation of buildings that are not necessarily in a straight line with each other, leading to the creation of triangular spaces. Inviting spaces usually have the form of tri- or rectangles (Fig. 4).

Fig. 4: A sketch of convex spaces on the plan of the city center of Rome (top left), and three examples of convex spaces in Ladenburg, Germany

Active form

Modern urban planning reduced the concept of place to a point in Euclidean space. The city consists of countless repetitions of the same cubs that are emplaced next to each other regardless of their specific temporal and spatial characteristics and without any connection between them. Inevitably, the inhabitants of such cities are like humans programmed with similar reactions to the same conditions and similar interests, needs, and abilities. They are trained to suppress any curiosity and creativity in areas that are not defined for them. In modern urban planning, four human activities were recognized: accommodation, employment, transportation, and leisure. Specific places were considered for each of them, and the city was accordingly divided into zones. Needs were deemed basic and straightforward and the simplest of forms were chosen to meet them. There was no room for residents to make changes. Everything was designed at a high level of transparency and simplicity in the service of speed, convenience, and efficiency. This can be seen in Le Corbusier's principles of modern architectural and

urban design. He suggested a "cellular" system as dwelling units for planning modern cities (Darden 1956, 31). In this respect, he also defined the fundamentals of contemporary towns (Fig. 5).

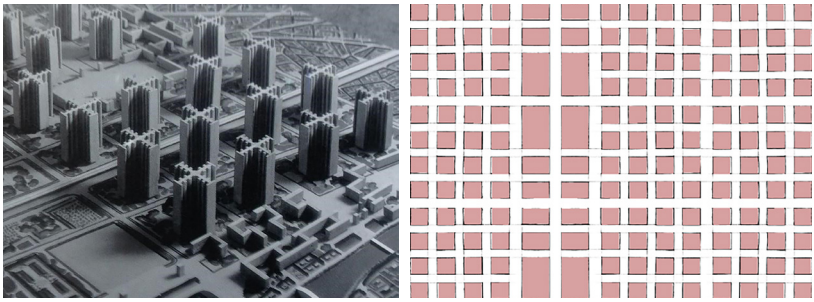

Fig. 5: left: Model of the Plan Voisin for Paris by Le Corbusier displayed at the Nouveau Esprit Pavilion (1925). Right: A plan sketch of a modern city

In contrast to Le Corbusier's cellular system, a city can combine various visual forms that constantly expand and change. In such a city, there are always possibilities for the evolution of the buildings and the environment. Also, the spaces in them seem full of ambiguity and mystery due to the many details, even though sometimes, at first glance, they appear devoid of any logic and order. With a little attention, however, the order and reason behind these details can be found. Active forms encourage residents to re-think all the corners and volumes and interact with them like pieces of a puzzle to change or to use as they desire or need. The complexity and non-compliance with geometric order and abstraction in the formation of houses in the exemplary cities I studied were not caused by the designer's (or craftsman's) unfamiliarity with such methods. Rather, they relied on a different understanding of the concept of place and the complex dimensions of human existence. This can often be seen from the intricate geometry and abstraction used to decorate such buildings in the ancient cities of Iran, where geometric order exists but is created poetically. As seen in figure 6, the Abbasi house plan has, to some extent, filled the form of negative space. The perimeter of the house does not follow any known geometric shape. But the decoration of the walls has such precise divisions

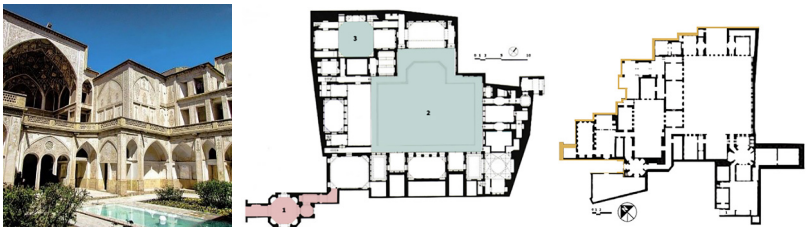

Fig. 6: The plan (middle) and a photo of Abbasi house in Kashan, Iran (left). Right: plan of Shokuhi house in Yazd, Iran. Both plans demonstrate the unknown and intricate geometry.

that it recalls the magical cosmic order. The Abbasi house has been built to realize the basic qualities without following a programmatic urban design.

The model in figure 7 shows how broken lines, active and various visual forms increase the connection and the quality of the relation between people and space and how new needs can be met in the context of active forms. The presence of corners, broken lines, and openings in each building create details that can always be explored. These details allow residents to act creatively to meet their unforeseen needs and involve themselves in using and interacting with all the spaces. Without there being any direct intention to design them for children, active forms allow them to play and find spaces for their imaginations in different spaces of the building. Active forms predict stairs to sit on, small places for plants, a table, and chairs of a restaurant, an Italian-style drinking fountain, or even a place to present the products of a family business—a place to meet new demands. Active forms enliven the sense of desire by stimulating human interest in creativity. As for children, the dream of building a castle results from seeing a hidden corner, and this desire is so strong that they make it real with the help of primary tools. The existence of an unexpected corner or indentation in the building can be a stimulus for the imagination, followed by a wish or desire, and ultimately action. Active forms can be seen in interiors and exteriors and can change human beings from passive users to creative agents.

Fig. 7: A model that shows how new needs can be met in the context of active forms

Experimentation and poetry in the work of an architect

For the architect to build a poetic space, it is necessary for them to be in the position of an experimenter and not a designer confined behind their desk. In this way the architect avoids predefined patterns, is not afraid of trial and error, and considers a detailed and exploratory look beyond the common agreements and standards to see the inherent elements of making. The result of their work depends on the specific conditions of each building. They know poiesis as a gradual evolution and believe that part of this making occurs during the building's lifetime and is done by its residents. This making is rooted in the lived experience of the experimenter. Lived experience cannot be learned but must be lived. It is the experimenter's intuition, the direct touch of the world like a poet. It does not only mean an individual lived experience, but it also includes a collective living experience in its broadest sense. Because "the spirit of a place lies in its landscape" (Relph 1976, 30).

Tadao Ando, a self-taught architect whose works have a special connection to the elements of nature, believes that architecture should not speak too much. It should remain silent and let nature speak in the form of sunlight and wind. Architecture must be domestic and not hostile to or against the world. It should fill only the space and form that the cosmos has predicted for it and nothing beyond it. The architect must be silent. This silence makes them aware of the sounds, smells, movements, changes, subtleties, and details present and flowing around him. For this reason, the architect's ears and eyes should be trained with profoundly lived experience.

Ando learned this as a child in a carpentry workshop. Japanese carpentry was intertwined with architecture as the master architect was usually a carpenter, and Japanese architecture, Nihon Kenchiku, has been typified by wooden structures. Wood enriches the building due to its exceptional and natural warmth and irregularity. Choosing the suitable wood for each part of the building requires a lot of experience and patience. This consideration of details can only be realized through experimentation, silence, careful discovery, and intuition, which are assets that architects like Ando, who have a different worldview and do not limit the possibilities of making to purely academic knowledge, possess. Lived experience leads to poetic experimentation in space design. Werner Blaser, a Swiss architect, refers to the Greek term *techne*, which, as mentioned before, implies making and states that "Tadao Ando, the builder of meditative architecture, creates buildings with 'techne' whose beauty and contemporaneity are compelling" (2001, 59). Ando believed in understanding the essence of phenomena. His knowledge and understanding of natural elements rely on listening to their whispers and recognizing their relationship with the building. For example, his particular knowledge of light comes from the experience of living in houses where specific walls, called shōji, are made of paper. Such translucent walls allow light to diffuse through the space and create shadows and patterns. For him, light is the origin of all beings. It gives things depth and thus helps them appear, or more precisely, it makes things appear as phenomena. He believes architecture, as the scene in which phenomena can be revealed, purifies light and brings it to consciousness. Architecture helps light be perceived as light to show its character and capability. However, light is perceived because of darkness. "There must be darkness for light to become light" (Ando 1993). Darkness allows light to be seen and manifested essentially. Excessive light kills the light, and extreme darkness kills the darkness. To perceive the world, both light and darkness must be simultaneously present. And this is evident in his buildings. The use of water, playing with shadows, lights, special design of private spaces, windows projected to the sky, and the use of the capabilities of the uneven surfaces

of the ground as well as the use of pure geometry have made his architecture active and poetic.

He calls his architectural approach pure geometry. While imagining each piece he creates, attention to the detail of the building's natural surroundings dictates the shape of the outcome. The theory of pure geometry means designing a building to such perfection that it looks beautiful and allows people to experience every element of its surroundings. He helps others rediscover natural and subconscious elements like water flow, wind, and light as he rediscovered them. Many of Ando's water-centric buildings exemplify his ability to create multidimensional and poetic spaces. He is usually careful in showing high technology in his works and intends to go beyond it to highlight spiritual and poetic aspects of a building. As he puts it, "What I always have in mind is not a life of abundance made possible by technology but a life of abundance that transcends technology, a life of abundance that allows for heterogeneity" (1993). In this regard, Pallasmaa points out that Ando's work represents the poetry of ascetics, concentration, and reduction, which today is an essential counter to the architecture of abundance and irresponsible "freedom" (2001). Taking all the statements mentioned above into account, one can say that, as Taki remarks, Ando is a builder rather than an architect. "I think of Tadao Ando as a builder rather than an architect […] At a moment when 'architects' are increasingly devoting themselves to superficial decoration, the appellation 'builder' may be read as a term of praise" (Pallasmaa 2001, 11).

One of the unique features of his architecture is the silky touch of the concrete surfaces of walls. Ando explained in an interview with Betonprisma that he believes "architecture is something to be experienced with all five senses—not just the eyes" (2011). He implemented everything he learned within the carpentry workshop to achieve his desired quality of concrete using precision and polished wooden molds. The quality of many of the spaces created by him is given by the fact that they encourage people to approach the respective buildings and discover their different parts. Touching the surface of the walls, sitting in the cozy corners, watching the sky from the openings, and approaching the bright spots are actions transmitted from the

architect to the residents. This recognition is the beginning of communication, imagination and understanding the spirit of the place.

Conclusion

Many thinkers describe modernity as a condition of homelessness that is opposite to dwelling. Adorno even states that dwelling in the proper sense is now impossible—the house is past. The significant turn in everyday human life accelerated the formation of non-places. As Heidegger described, it has reduced human life from dwelling to residing, and it has disconnected man from his living environment. In the term Dasein, by emphasizing the interconnectedness of existence and place, he describes the place as an essential part of human existence created by his presence in this world. Understanding this entanglement seems complicated for the modern human because of a lack of experience of the place of living. The unity of place and human existence in Norberg-Schulz's explanation is due to the attempt to find identity, that is, to find a place of belonging. In this way, a person perceives their existence when they dwell somewhere and, as a result, establish their sense of belonging in the world.

If we accept that despite many similarities, every human is different, the place where they live—inevitably tied to their existence—must be unique as well. The decision to rethink their living space, to decide on it, to change it, to feel its spirit, and in a word, to act as an agent, must be theirs. I tried to highlight aspects of housing and dwelling neglected in the mass production of housing during the last century by applying the perspective of architectural phenomenology. Everything can serve the residents to provide a space of agency, from geometric planning to light, color, texture, and smell. In this way, I found it necessary to consider the notions of poiesis and praxis to describe how experimentation in place design can lead to experiencing the space of agency.

The focus of my future work will be on the fundamentals mentioned above. I will have an artistic approach to testify how the form, material, or shadow and light in designing spaces strengthens the relationship between human and living space.

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List of Figures

Remains of the day

Somayyeh Shahhosieny

Finding openings, cozy corners, and convex areas in the old town of Ladenburg is not difficult. I selected one of these corners where I could experience different feelings during the day and night. The central courtyard leads to a narrow alley on one side and one of the city's main streets on the other. From the corner where I chose to record my video, commuting to the restaurant, whose main entrance was from the main street, is apparent: customers eating and talking around tables, waiters taking care of this small ambient, the concentrated light in the horizon of my vision and different degrees of shadows on the walls, ground, and whatever is in the yard (Fig. 1). I should add the conversations that are heard vaguely and unclear from afar. During the day, however, the courtyard was full of passers-by, and I saw more movements in a crowded street and also in the yard that was the shortest passageway to connect people from the narrow rear alley to the shops in the main street and main square of the old town. The yard also hosts the children and becomes their central play area during the day.

My different day and night experience of the same space was caused by the visual removal of a depth (a main city street) that was the site of much of the day's commuting. A comprehensive experience only can be gained from within a whole spectacle, as Merleau-Ponty states:

"The superficial pellicle of the visible is only for my vision and for my body. But the depth beneath this surface contains my body and hence contains my vision. My body as a visible thing is contained within the full spectacle" (1968, 138).

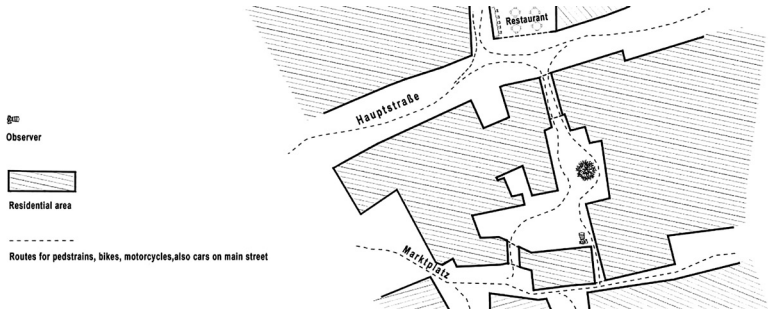

Fig. 1: Observer's location in relation to the main street and the restaurant

The movement of my body during the day, in the spaces between places and things, completed my experience and returned the hidden dimension to the vision and experience of the space.
From the perspective of my position, the elimination of depth (the main street in front of the restaurant) was a visual illusion created by a play of light and shadow. The illuminated end in the frame I captured takes the warm brightness from the hidden street and not the restaurant's light. From where I was standing, the restaurant seemed to be at the end of a cul-de-sac, with a courtyard in front of its main entrance hosting overnight guests, and a neighbor, who frequently visits the restaurant, seemed to be in a hurry to get the latest news of the neighborhood. She is standing on the main street, not at the end of a cul-de-sac (Fig. 2) and when she wants to get by my camera, her glance at me shows that my presence there did not surprise her. At the same time, she seemed unaware of it. Her glance proves my experience that everything around me is watching me, as I watch the world from this corner. I am also gradually perceived by the things around my body and penetrated to my depth by them. "I who see have my own depth also" (Merleau-Ponty 1968, 135). I compensate for this illusion by combining the sounds of the day in the video, linking my daytime experience to the night. This

peculiar combination reflects the potential of such space design for its residents.

Fig. 2: Screenshot of a frame in the film

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The making of the observer

Visual perception and spaces of action in natural and artificial environments

Tobias Bieseke

Abstract
This essay is about the extension of human perception through technical manipulation. It focuses primarily on the description of visual perception. The ways in which technical extensions also lead to an extension of the possible spaces of action for a receiving subject are investigated. Promising research results and intentions are presented here, but in the future the focus will be on our own technical experiments, allowing us to explore the connection between visual perception and the resulting possibilities for action, such as the feedback scheme between recipient and actor.

The magnetism of narratives - A brief history of a research question

The following report is based on my own personal experience during research for a potential graduation film. In this brief introduction, I will explain how I coincidentally discovered the effect that I call *reality hybrid* and how it is connected to narratives.

In 2013, while looking for a story that could serve as the plot for a final project at college, I came across the anthology *Das Jahr 1913 - Aufbrüche und Kriegswahrnehmungen am Vorabend des Ersten Weltkrieges* (The year 1913 - awakenings and perceptions of war on the eve of the First World War), edited by Detlev Mares and Dieter Schott. Through reading this book, I became aware of the Free German Youth Day, which had taken place on the Hoher Meißner mountain in northern Hesse from October 10 to 11, 1913. This meeting of about 3,000 young people from German youth alliances was held in the spirit of the *Lebensreformers* (life reformers), the *Wandervögel* (hiking birds) and various other student movements. The intention was to send a signal in opposition to belligerence and general "hurrah patriotism" (jingoism) on the occasion of the one hundredth anniversary of the Battle of the Nations at Leipzig. Some participants may have sensed at the time what was in store for their generation. Among them were many contemporary visionaries such as the philosopher Walter Benjamin, the life reformer and co-founder of Monte Veritá Gusto Gräser, the artist Fidus alias Hugo Höppner (Fig.1) and the cultural politician Adolf Grimme, to name but a few. The young people came together, hiked, discussed, danced, and became the center of a youth movement that would continue around the world for several generations.

Fig. 1: *Lichtgebet* (Light prayer), a painting by Fidus, which hangs in Jugendburg Ludwigstein.

Curious about the spirit of this generation, I traveled to the Hoher Meißner one hundred years later in order to visit Jugendburg Ludwigstein, which houses the Archive of the German Youth Movement. The trip proved to be extremely exciting. In addition to many biographical details of those who participated, the archive included notebooks, photos, diaries, video documentation, paintings, and graphics. One photo shows Gusto Gräser (Fig.2) in a long robe with long hair and a full beard talking with some *Wandervögel* in Hessian Switzerland, as the area is called locally. Gräser is often seen in photos in the setting of a mountain, evoking associations with the Sermon on the Mount. One of those he shared his thoughts with was the writer Hermann Hesse, who visited Gräser in a cave near Arcegno at the foot of Monte Veritá.

Fig. 2: Gusto Gräser in conversation with Wandervögel (hiking birds) at the Free German Youth Day, 1913.

Gräser must have seemed like the resolute embodiment of Hesse's own unrealized ideals. Vain, needless, consistent, and thoughtful, he stood before Hesse and the latter had to realize with certainty that he sought the attention of the public with his works but rejected the theatrical staging. Hesse lived with Gräser in the cave for some time, renouncing publicity, alcohol, and cigarettes. Instead, he absorbed the ideas that would later inspire him to create the characters of his great novels. While reading this story, it occurred to me that the Hoher Meissner might be something of a parallel to Monte Veritá near Ascona in Switzerland. I imagined

there may also be an equivalent of the cave at Arcegno at the Hoher Meissner and started looking for it.
During my research I discovered Hohlstein, also known as the Kammerbach Höhle, at the foot of Hoher Meißner. As it turned out, the cave, charged with myths, had its own story. Rare bats hibernate here, which means it is only accessible in spring and summer. The key for the locked cave can be borrowed from the town hall in the neighboring community of Hilgershausen. I was asked to explain my motivation for visiting the cave in detail to a local tourist guide. I found out that this specific cave is supposed to be the one in the well-known fairy tale Frau Holle (also known as Mother Hulda or Old Mother Frost in English) (Fig. 3).[1] According to the guide, Frau Holle, who is believed to live in the *Anderswelt* (otherworld),[2] corresponds to the Nordic myth of Hel.[3] These stories reminded me of the rabbit hole through which Lewis Carroll's Alice enters Wonderland or the red pill in the movie *Matrix*, which is supposed to provide access to the

Fig. 3: Wooden statue of Frau Holle in the snow on Hohe Meissner.

1- Fairy tale directory KHM 24
2- Cf. https://de.wikipedia.org/wiki/Keltische_Anderswelt
3- Cf. https://de.wikipedia.org/wiki/Hel_(Mythologie)

true world behind the curtain of a simulated reality. The goddess Hel, however, guards the world of the dead and has nothing to do with the friendly grandmother image of Frau Holle. According to the guide, these pagan myths often attract spiritual fanatics who misuse the cave. She made sure that I had no such motivation before she let me have the key for a few hours in exchange for my ID card.

Charged with all these mythical narratives, I visited the cave, accompanied by a friend, with a strange feeling. Outside, I found traces of candles, a woven wreath, and figures made of natural materials that had been placed on a stone. We descended the stone stairs to the cave's entrance. Cold, damp air hit us as I opened the lattice gate with the key. We switched on our torches and entered the cave. The floor was a little slippery and sloped downwards until it became flat and then sloped upwards again. I examined the cave with a flashlight and spotted several pareidolic shapes (Fig.4). The slope was rocky, so we had to climb. The space was

Fig. 4: Pareidolia effect. Actually we only see an illuminated rock but our brain complements the image to a human being.

somewhat reminiscent of an auditorium, with seats sloping upwards. Front and center was a slightly larger stone that resembled a podium. From there, I overlooked the entire cave. A cairn was

stacked on top of it (Fig.5). In some places, the walls were blackened by soot and carved with messages. Pieces of wood scattered on the floor were overgrown with small white fungi (Fig.6). On

Fig. 5: Stacked cairn.

Fig. 6: Wooden trunk overgrown with small white fungi.

the left side of the cave was a pool of water. It was clear, and the bottom consisted of light-colored limestone. There were branches lying on top of each other on the bottom, apparently thrown into the water to check its depth. This had to be the small pond said to constitute the gateway to the *Anderswelt* or the well that leads to the realm of Frau Holle.

I had arrived in a cave full of pagan superstition instead of finding an equivalent to the cave near Arcegno. Is this what you get when you drift associatively? Then something unpredictable happened. As I scanned the edge of the pond with my flashlight, there was a brief, shock-like interference—a moment when I saw something that could not possibly be there. I called my friend to check too and again, for a fraction of a moment, a strange image jumped out. My friend also puzzled over the phenomenon. It looked like a shard of light penetrating deeper into the ground than was actually possible. After some experimentation, we found a vantage point from which the optical effect could be reproduced. We discovered that there was an angle from which the flashlight on the water's surface created a mixed image of the reflection of the cave's ceiling and the bottom of the pond. The bright gap we saw was a

concentration of light, which, together with the bright bottom of the pond, created the impression that something was going deeper and beyond the boundary layer of the water (Fig.7). We filmed

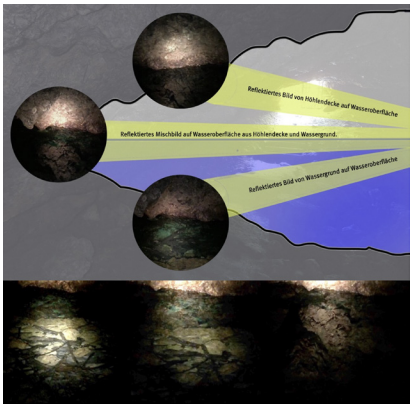


Fig. 7: Upper graph: Mixed image effect in the pond of Hohlstein Cave. Top cave ceiling, middle mixed image, and bottom water background. Lower series representation. Left: Water bottom. Middle: Mixed image ceiling and ground. Right: Cave ceiling.

the effect as best as we could with our smartphones, 4 vacillating between deception and disappointment. Eventually, in my aimless search, I randomly discovered an effect that I initially called reality hybrid.[4]

I chose to name it in this way because it made clear to me how narratives can affect our perception. The starting point of a narrative is random. It begins where a narrator (observer) turns towards certain events and starts to absorb them, and it ends when the observer turns away. In my case, this is shown with the arbitrary start of a book about the year 1913. A narrative does not need stringent causality, it can be associative, and the connections are set arbitrarily. The narrator recognizes different patterns and makes sense of connections between them. This can be seen, for example, in the association between the caves at Monte Veritá and Hoher Meissner: the connection is made relatively arbitrary. Narratives help us to foresee possible courses of events, or they prepare their outcome. They possess a form of charge that generates something like a magnetic field. This magnetism either attracts or rejects us. The story of Monte Veritá exerted a pull on me, while the descriptions about Nordic

4- Part of the video with the visual effect: https://youtu.be/L-VeLKNg1rY

myths made me recede. Magnetism even affects the framing of the cognitive system and influences our perception. If I had not looked for something in the cave's small pool that could explain the myths of the otherworld, I would probably not have noticed the effect of a mixed image in the reflection of the water. I was prepared to see something that would strike me as special and eventually it really happened. A self-fulfilling prophecy was mentally initiated. The short moment of a supernatural, mythical sensation occurred when the short moment of deception suggested something, as if the gate to another world would open in front of us. The gates of our reality into alternative realities lie in the desire to find the access that leads behind reality, from where the world can be manipulated, just as Frau Holle makes it snow when she shakes out her bed. This fantasy of omnipotence is a deception, but the feeling of this deception is homologous to the feeling we can have with such optical effects. The reality hybrid event we witnessed in the cave was based on the technical artifact of the flashlight, which became a medium by interacting with the environment. Nevertheless, it should be noted that without the narratives of myths and fairy tales this experience would not have been possible.

In his book *Verschwörungsmythen* (conspiracy myths), the religious scholar Michael Blume blames Plato's allegory of the cave for the fact that many people prefer to succumb to deception rather than trust the assessments of common sense:

> The entrance into the Platonic cave—and hell—is now digitized and widely established in popular culture as the "rabbit hole" (after *Alice in Wonderland*) and ingestion of the "red pill" (after the *Matrix* film trilogy). The richer, the more splendid, and the more interactive media are available to our children and young people, the easier it is to fall into "alternative realities." (2020, 16; translated by the author)

One may doubt whether the ways of deception lead to hell, but they definitely can lead out of collective reality. However, it is also a fact that these interactive media are now part of everyday life, and we have to find a responsible way of handling them.

Umwelten and technical milieus

By *Umwelt* we generally understand the subjective habitat of an organism. It is a notion that Jakob von Uexküll developed in his "environmental theory" at the beginning of the twentieth century. Uexküll argued that each organism lives in its own species specific, subjective frame of reference. Previously, it had been assumed that humans and animals lived in the same world. The concept of *Umwelt* is therefore to be strictly separated from the environment of an organism. While the environment takes in living beings as objects, the *Umwelt*, on the other hand, is actively shaped by them. Therefore, a living being cannot be separated from its particular *Umwelt*. Every organism has specific sensors that are used to perceive the state of the environment and effectors that are necessary to change parts of the environment. The effector therefore is the logical counterpart to the sensory organs. Sensors and effectors are connected in a feedback loop from which the reality of the organism emerges. In Uexküll's terminology, the sensory input is processed by a memory organ (*Merkorgan*) and the effectors are controlled by an effector organ (*Wirkorgan*). As an example, he cites the perception of a tick, which is neither based on an optical nor an acoustic sensor but only on olfactory nerves sensitive to butyric acid. Since every sebum-producing creature releases this specific odor, it might therefore serve as a potential host for the bloodthirsty tick. The inherent behavior of an intentional living being with cognitive properties thus represents a self-contained perceiving system, even if this only means the search for one specific chemical compound (Uexküll [1934] 1983, 6).

The important aspect in terms of the topic discussed here is the fact that humans actively change their sensors and effectors with the help of technology and thus determine their perceptual world as well as their subjective experience to a considerable degree. This article deals with these technical interventions in the natural feedback loop between sensors and effectors.

With respect to Uexküll's object of investigation, animals also make use of artificial mechanisms in order to extend their spaces of action ([1934] 1983, 25). For example, the spider spins a

web that visually eludes the fly's compound eye (Uexküll calls this an *Ortemosaic*) because the threads run parallel to the facet lines. Accordingly, the web becomes invisible to the fly and it unexpectedly flies into the trap. Here, the spider creates the action space of a potential trap by means of image obstructing technology. The fly's perceiving system is deceived with the illusion of a barrier free flight path. Accordingly, deceptions work for certain perceiving systems (in this case those with compound eyes) and not for others. The example shows how the manipulation of perception can lead to existential competition. Whoever dominates the perception as well as the cognition of the opponent is at an advantage.

Three examples of technically generated reality hybrids

Paul Milgram describes the possible variations and compositions of real and virtual objects as a continuum of reality and virtuality. He calls the area between these two extremes—where the real and the virtual mix—*mixed realities* (Milgram et al. 1994). The two extreme points, real and virtual environments, are not part of the mixed reality spectrum themselves. From this technical perspective, mixed realities are identical to what I call reality hybrids. However, the term *reality hybrid* does not focus on technical apparatus but on human perception and the possibilities for action that arise from it. It is thus broader and at the same time non-technical, as my cave example illustrates. The mixed realities addressed by Paul Milgram are realized by means of technical devices (including smartphones and VR glasses) such as augmented reality (AR) or virtual reality (VR) using a head-mounted display (HMD).

Head-mounted displays and body tracking

In 1968, Ivan Sutherland invented the first HMD at the University of Utah. With HMD technology, the user controls the point of view and navigates by body movement. The occupation of the field of vision enables the isolated, personalized reception of an artificial environment (Fig.8). In order for the recipient to become

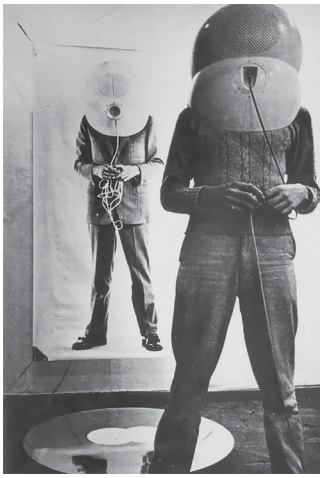
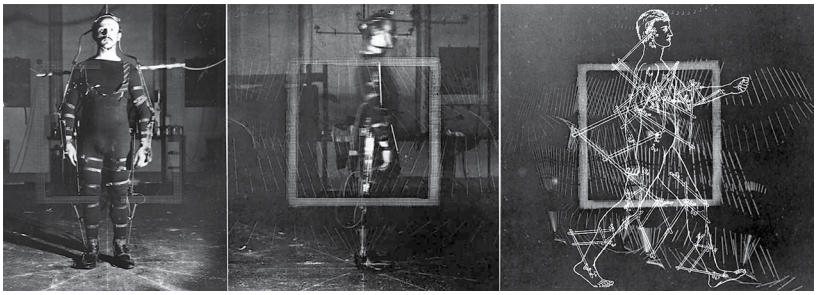


Fig. 8: TV Helmet by Walter Pichler (1973). An early design of a Head-Mounted Display.

Fig. 9: Motion analysis method developed by Wilhelm Braune and Otto Fischer using Geissler tubes and long-term photographic exposures for coordinate-based analysis of human gait (1895).



visible in virtual space, they need a technical representation of their body. This is achieved with the use of a motion tracking suit, a data glove or an HMD. Wearers of such suits describe them as a virtual second skin. The technology of a motion tracking system is based on the approach of movement researchers Wilhelm Braune and Otto Fischer, who used fluorescent *Geissler-Röhren* (Geissler tubes, Fig.9) for the sequential recording of movements in darkened rooms in the form of isolated photos. These movements were transferred into a coordinate system and thus became analyzable (Braune and Fischer 1895). This observation, however, only provided information about the pattern of a movement in profile. Nevertheless, the principle of sensors on the extremities has endured to this day. In 1954, Palestinian choreographer Noa Eshkol and her husband, architect Avraham Wachman, developed a notation system based on similar relationships of movements. However,

these do not represent points in a coordinate system, but show the possible vectors of relationships between radials of the human movement spectrum (Fig.10). Today's motion tracking systems, which recognize the course of human movement on the basis of coordinates and the relationship of limbs to each other, function

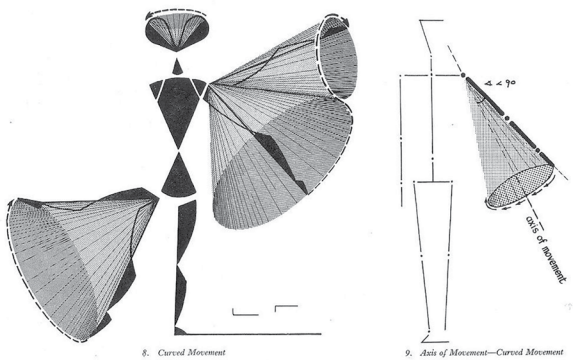


Fig. 10: Radial relations of the Eshkol and Wachmann body movement spectrum for dance notations.

according to a similar principle. In 1983, the computer scientist Jaron Lanier and his team developed the data glove (Lanier 2018, 181). This glove can precisely localize hands and fingers in space and transmit them virtually. The technical representation of the wearer opens up space for expanded possibilities of action. The detection of movements can thus be transferred into a virtual environment and applied to a humanoid structure. Another important technical aspect are the object tracking sensors (gyro sensors), which can be used to link physical and virtual objects to spatial coordinates. This technique is important to create a connection between the physical and virtual environment and get a virtual representation of physical environments. Through these techniques, subjective objectivity can be experienced by several actors with the help of artificial environments.

Video walk

A video walk may come confusingly close to reality due to it being embedded in the regular everyday life of the public. The work

Alter Bahnhof by Janet Cardiff and George Bures Miller on the occasion of documenta 13 in Kassel in 2012 serves as a concrete example (Fig.11). In Alter *Bahnhof*, the audience follows the navigation of a video on a smartphone in the same location the video was shot, while listening to sensual sound design and a narration

Fig. 11: Screenshot from Alter Bahnhof Video Walk by Janet Cardiff and George Bures Miller, documenta 13. Interference between environment and media image.

by Janet Cardiff via headphones. The video occurs directly embedded in the depicted environment. By occupying the acoustic senses and supplementing the field of vision with similar, but not identical events, moments of cognitive interference are created between the media content and the direct environment. Through the synchronicity of the event level, hybridization can occur. Thus, viewers report individual events in which the video is cognitively confused with the environment. These events are not reproducible and remain a subjective experience. The confusion occurs at points of analogy through movement, position, or connection. The opening of a sliding door occurs in exactly the same way as in the video, while the smell of the station coincides with the visual associations. Through the immediacy of the chains of events within the environment, the media content loses the effect of its staged determination. Due to the concrete video images, the content is static but enters a synergy with the environment. This synergy creates randomized, exclusive individual moments that may simultaneously seem predetermined.

Facade mapping

The last example describes the visual integration of projections on physical surfaces in so-called facade mappings. Here, several projectors are connected to form a composite matrix to provide a large-scale building projection. Using the Light Detection and Ranging (LiDAR) scanning technique, detailed measurements of surfaces can be made in order to precisely warp the projection to the surface topography. The survey allows an optical intervention on the projected surface of the building. This method was used in a projection mapping at the Dortmunder U. The regular facade was projected onto the building and animated at the same time. Through the building's own projected surface, the media projection forms an optical connection with the direct environment. Thus, a face (or any other plastic object) can emerge out of the surface of the building convexly as an image with depth (Fig.12). The facade,

Fig. 12: Facade mapping on the Dortmunder U 2019.

which is divided into blocks, is pushed outwards by altering depth perception. The surface of the solid space dissolves and is virtually translated into a flexible, floating surface. The optical synergy between facade and projection turns the surface into a medium. On the one hand, it becomes a physical medium for reflecting light, because without a scattering object, projection would not be possible.

There are no finite waves of light that can be directed to particular positions in space in order to illuminate them, point by point, and form an image with a swarm of incandescent particles.[5] On the other hand, its individual structure makes it a medium itself, which limits the possibilities of performance. The observers who touch the wall assure themselves of its physical existence in order to become aware of the difference between cognitive representation and physical environment. This hints at the importance of haptic contact for visual perception, which will be elaborated on in the following section.

State of research and tracks to follow

Jonathan Crary, an art historian at Columbia University, traces the roots of objectivity (literally: through the objective lens) back to framing within the camera obscura (1646):

> The camera obscura [...] impels a kind of askesis, or withdrawal from the world, in order to regulate and purify one's relation to the manifold contents of the now "exterior" world. [...] The monadic viewpoint of the individual is authenticated and legitimized by the camera obscura, but the observer's physical and sensory experience is supplanted by the relations between a mechanical apparatus and a pre-given world of objective truth. (1996, 49f)

It is striking that the original image cast by the camera obscura is circular, because square frames were later artificially set as standard apertures (Fig.13). This selection clearly shows that the framing is a formal and thus constructed abstraction of the environment. The goal is to mask the blurred and doubtful outlines, so that the image of objectivity appears clear and free of doubt. Immersion, on the other hand, occurs when the perceiving subject is unable to frame and thus lacks demarcation. The visible border of the frame is the contact boundary between natural and artificial reality. If this line is invisible, the imagination becomes

5- Even with the latest three-dimensional volume holography technology, which to all outward appearances really does look as if it were freely projected into space, tiny nanoparticles actually act as projection surfaces (Smalley).

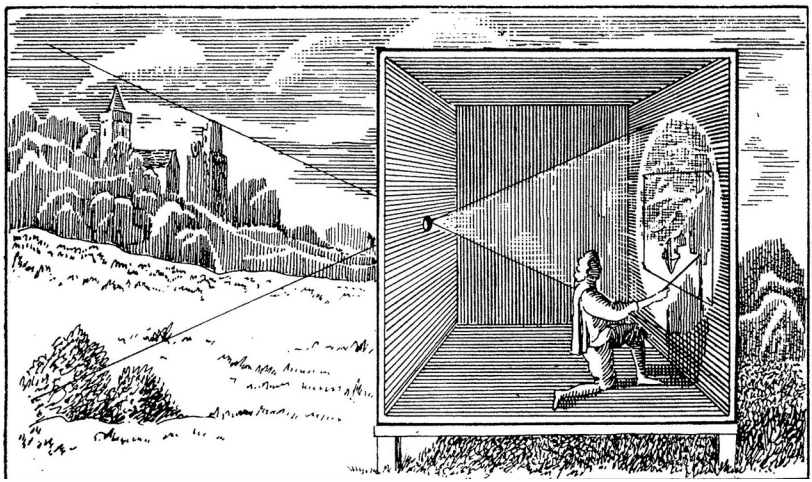


Fig. 13: Within the camera obscura, an image of the environment is taken whose circular projection is delimited by means of a frame. Here a selection is made by means of framing.

frameless and no clear distinction between the physical environment and the technical representation exists on a mental level. An immersive mixed perception arises in the observer, which should be referred to as perceptual synthesis.

The Swedish neuroscientist Henrik Ehrsson deals with the multi-sensory model of body ownership. One object of research is the out-of-body illusion, a subjective state of mental disembodiment, that can be evoked using VR technology (cf. Ehrsson 2007; Ehrsson et al. 2007). Ehrsson and his colleagues experimentally investigated the "relationships between [...] self-location in the local environment and the multisensory representation of one's own body" under clinical conditions (Gutersdam and Ehrsson 2012; cf. Ehrsson 2012). Boundary conditions of the experimental setup are synchrony of perspective (by using HMD), space (same environment), and stimulation of the same receptor regions (synchronous touching of a body part) under the condition of a humanoid physique (manikin). The test person knows that the foreign body is not them, but links self-perception to the external (third) body. Ehrsson distinguishes between the out-of-body effect and the body-swag illusion (Petkova and Ehrsson 2008), which is methodologically similar. Here those tested experienced an inhabitation

of another person's body. These studies show that partial bodily self-localization can be transferred to a third body via illusion.
In a similar field of research, the director of the Human Interactions Lab, Jeremy Bailenson of Stanford University, has achieved remarkable results. Among other things, he dealt with discrimination by age, skin color and gender (cf. 2018, 90). Bailenson attempted to create experiences by dressing people in different avatars within VR, with the intention that this should generate empathy by using simulation neurons. The resulting body transfer was to trigger a change in self-perception and intensify empathy with the environment. Bailenson found that wearing a black avatar significantly increased racial stereotyping, as he empirically demonstrated by measuring specific reaction times in an Implicit Association Test (Greenwald, McGhee, and Schwartz 1998). The fact that later research in Barcelona by Mel Slater reached the opposite conclusion with a similar experimental design (Peck et. al. 2013) shows that a body transfer experience cannot be simply generated by copy and paste. Slater's result clearly showed that prejudice is reduced and empathy intensified through the use of VR. Bailenson attributes this to the unstable motion tracking system, which created a dysfunctional relationship with the avatars through frequent latencies. These interferences and transfers from imaging techniques to perceiving systems imply how changeable, moldable and fluid subjective perception is. Another reason for the problem of self-identification with a virtual avatar could be the "uncanny valley" (Mori 2017) or, as Lanier calls it, the "acceptance gap" (2018, 277) that arises when a technical simulation of a real person is used. People react with rejection to technical simulations of people that are very close to the optical representation of humans but still distinguishable from real people.
The physical environment precedes the construction of reality. The perceiving system, however, does not evaluate every signal from its peripheral and tactile sensors as relevant for instantaneous perception and therefore filters according to intention. Uexküll already explained a similar aspect by saying that the *Suchbild*

(search image) precedes the *Merkbild* (memory image) (cf. [1934] 1983, 83). This statement by the cognitive psychologist Ulric Neisser is complementary in this respect:

> In my view, the cognitive structures crucial for vision are the anticipatory schemata that prepare the perceiver to accept certain kinds of information rather than others, and thus control the activity of looking. Because we can see only what we know how to look for, it is these schemata […] that determine what will be perceived. (1996, 26)

The *Suchbild* (search image) is often preceded by the *Suchton* (search tone). These acoustic signals are stimuli for the guidance of our point of view—"The observer follows the sound"—and shows the connection between seeing and hearing. Crary attributes the awareness that haptics, acoustics, and optics correspond to separate individual sensors to the "separation of the senses" that took place in the nineteenth century as part of the industrial remapping of the body (cf. 1996, 30). The differentiation of the senses refers to the individual components from which an image of reality is composed. The mental image of the physical environment grows out of reciprocal feedback loops that the individual enters into with their environment. Their movement patterns enable them to construct cognitive maps, allowing them to navigate their environment (Neisser 1996, 106). Tactile stimulation, on the other hand, describes the immediate stimuli that occur via haptics, vestibular perception, and physical feedback. This occurs primarily on the skin, which is equipped with quantitative somatosensory perception. Crary traces the conscious differentiation of the peripheral and tactile senses back to the philosopher John Locke's question of whether a person born blind and later given sight could visually recognize an object without touching it (cf. 1996, 66). Regardless of the answer to the question, the scrutiny shows the separation between sight and touch and their referential cognitive connection. Crary, following the philosophers René Descardes, George Berkeley, and Denis Diderot, concludes that vision is an analogue of the sense of touch (cf. 1996, 67). The reciprocal dynamic between the senses is a referential link to verify impact. Nevertheless, considering

proprioception, Neisser argues that humans do not need to visually register their bodies to be aware of them (cf. 1996, 94). They can imagine their posture and position in space with their eyes closed and locate themselves within their environment.
One example showing how difficult it can be to differentiate between cognitive illusion and physical environment are the studies of the neuropsychologist Danai Dima and the result that patients with schizophrenia, who are generally less susceptible to various

Fig. 14: Hollow Mask Illusion: 3D scan (model: Teodoros Adewale Adebisi), perspectives °0 frontal, °90 left and °180 rear. The °180 view shows the optical effect depth inversion.

sensory illusions, do not fall prey to the so-called hollow mask illusion (or depth reversal) (Dima 2009; Hendrich 2017) (Fig.14). In 2009, she contributed to a publication in which this effect, which had already been established in previous studies (Schneider et al. 2002), was analyzed using functional magnetic resonance imaging (fMRI). According to Dima, it was verified that subjects "overwrite the actual virtual information" (Hendrich 2017; translated by the author), as it was expected, since they are unable to differentiate between a concave and a convex curvature of a mask during the optical deception of depth reversal. Despite the conscious knowledge that a face must be concave in perspective to the line of sight, the brain assumes a convex curvature, because in everyday life we only know faces that are curved outwards. If you look at a central mask object at eye level while it is rotated 360° from a fixed point, the optical effect of depth inversion occurs. This phenomenon is explained with the following quote:

> Our top-down processing holds memories, like stock models […] All the models in our head have a face coming out, so whenever we see a face, of course it has to come out. (Buchen 2009)

Dima's brain activity studies show that schizophrenia patients are not fooled by depth reversal and those brain areas involved in top-down knowledge-based processing are not activated (cf. Goldstein 2015, 59, 143). Schizophrenia patients, in this case, see what there is to see, i.e. either a concave or a convex shaped mask. The sensory illusion is not activated because no classification into imagination guided structures is used. The corrective generates the illusion. The paradox of this realization is that the "healthy" mind succumbs to the deception. This example illustrates the interference between mental reality formation and the physical environment. In the final section, these interferences between the subjective *Umwelt* and the environment are examined for the spaces of action that arise from them.

Spaces of action

According to the initial theoretical research presented in the previous sections, we can summarize that every perception involves a scope of action. In order to investigate the potentials of the spaces of action that result from technically enhanced perception, different experiments will be developed and tested. These experiments are derived from the initial findings of the examples of reality hybrids mentioned above.

The example of HMD in combination with body tracking systems forms the basis for self-representation in virtual spaces. Here, a relation between the physical body and a synchronized virtual body can be established. Modifiable parameters such as age, skin color, or body configurations (limbs, etc.) could provide insight into the cognitive connections between visual perception and haptic self-perception. Hence, in further experiments, subjects would be given a self-representation in virtual space using a motion tracking system and a HMD for various experiences of self-awareness. The possibilities of virtual representation make it

possible to vary parameters such as shape, color, movement, and depth perception in conjunction with haptic self-perception. One could, for example, expand or contract the vertical field of view, which changes the potential action space. It would be worth investigating how these effects affect concentration or overload in perceiving the environment and what actions such a field of view might enable. These experiments are primarily concerned with proprioception within virtual spaces. Self-representation in VR provides the basis for all further experiments.

The example of the video walk in the third section shows that mixed realities are not only the result of different media (virtuality and reality), but that the unity of place and perspective can also lead to a cognitive mixing of levels of reality. These levels of media overlay will be examined for the cognitive patterns of effect in relation to the possibilities of transparency and transmission. It is necessary to investigate which parameters favor a continuing perceptual connection between reality and mediality and which spaces of action then emerge for the individual. Certain experimental setups, namely HMD-based AR applications, could create a mixed image of mediality and reality, where medial content is implemented into the visual perception of reality. This content (consisting e.g. of live videos or virtual representations) can thus be examined for the potentials of mixed realities. In this context, effects of a *Fernsicht* (distant view) create possibilities for extended action spaces by means of the transmission of images. For example, the simulated transparency of a wall could allow a view of a room behind it through a live camera. In this context, it would be interesting to investigate what cognitive classification is given to such an imaging technique. The direct visual transmission from proband A to proband B, where both see the same environment of proband B, through which they are navigated, seems to be promising for this purpose. Proband A would be audiovisually connected to proband B and could support them either by extending the field of perception (observing the rear) or as an instructor with special knowledge (for example, repairing a machine). Such experiments could provide insight into

the possible action spaces of mixed realities, and their implementation in visual perception.
The third and last example of facade mapping shows the connection between haptics and visual perception. A visible yet untouchable object is usually not categorized as real and will be cognitively classified as unreal. Our conception of the unreal has a direct influence on our interaction with the world. The transformation of abstraction into interaction becomes relevant in these experiments. To achieve intuitive interaction with media content in virtual space, it is helpful to connect the interface with the physical body. Haptic feedback creates a connection between the seen and the touched, which is classified as more real. To investigate this, experiments examining the relationship between haptic and virtual representation are important. Within a virtual environment, in which the individual is immersed with an HMD and a body tracking system, physical objects can be tracked by gyro sensors. For example, the person could physically adjust a chair, which receives a virtual representation via a gyro sensor, in the virtual environment. In this case, it would be necessary to investigate how these physical objects affect the virtual representation in the perception of the individual.

Conclusion

It is expected that these experiments can provide inferences about reality classes of experiences in virtual spaces. The findings of this research would therefore create expanded spaces for action in didactics or cultural media. In conclusion, the three experimental areas to be examined in the further course of the thesis can be summarized as follows:

1. Visual perception of self-representation in virtual space.
2. Perceptions of the visual mixture of reality and virtuality.
3. The effects of haptics on visual perception within VR.

The results of these experiments should provide information about which potentials are created by which technical extensions and which action spaces are opened up. In detail, the direct effect of the sensor on the effector and the resulting feedback loops

must be investigated. A hypothesis about the interrelationships of such reality hybridizing settings is illustrated in the graph attached (Fig.15). The expansion of the subjective *Umwelt* (environment) can broaden the sensory perception of the recipients and make them actors in a world beyond their natural reality.

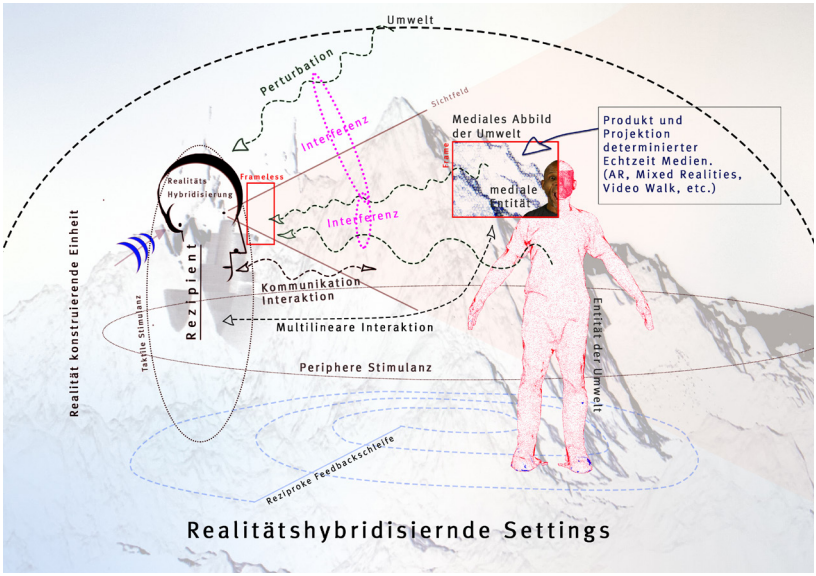


Fig. 15: Hypothetical representation of hybridization between recipient and medial environment.

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Figure 10: Curved Movement, Notation, 1958, Noa Eshkol and Avraham Wachmann. Accessed January 14, 2022.
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Figure 11: Screenshot from *Alter Bahnhof Video Walk* by Janet Cardiff and George Bures Miller, documenta 13. Accessed January 14, 2022.
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Figure 12: Screenshot from facade mapping of Dortmunder U by Stephan Hauptmann, 2019.

Figure 13: Camera obscura, artist unknown. Accessed January 14, 2022.
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Figure 14: Screenshot of hollow-mask illusion, Teodoros Adewale Adebisi, 2020.

Figure 15: Hypothetical representation of reality hybridization by Tobias Bieseke, 2020.

Horizon inversion

Tobias Bieseke

The optical illusion of depth inversion occurs according to a relatively simple scheme. If the viewer looks at an object in the form of a face mask centrally and at eye level, during a 360° circle with a fixed point, the optical effect of depth inversion[1] occurs. The topography of the mask face visually emerges when looking into this mask from behind. This happens regardless of whether the camera rotates 360° around the centered object at the axis center or whether the object itself rotates around its own axis. This effect is also known as the Hollow-Mask illusion.

We observed a similar effect in a project for a concert hall in Bochum. In experiments for a video installation, there was an optical jump in the perception of perspective. Rather than being caused by optical interference between back and front, in this case it was from above and below, which we will describe as horizontal inversion (Fig.1).[2] For this, a controllable camera moves 360° around a human subject. An optical jump in horizontal perception occurs when the 180° point is crossed. In this case, the optical perception changes abruptly from a bottom-view to a top-view perspective. This is about the same angle at which the effect occurs when the effect of depth reversal is exceeded.

1- Depth inversion or Hollow-Mask illusion effect: https://www.youtube.com/watch?v=01LMFFpAWYM

2- Horizontenumkehr: https://youtu.be/apgaMuSSU3o

A similar effect of horizontal inversion has also been described for the Necker cube as a *Kippfigur* (tilt figure). In contrast to the Necker cube, however, it must be noted that the optical change here is coupled to a movement and it is not a static change of cognitive classification.

This effect is demonstrated here using images of violinist Marko Genero of the Bochum Symphony Orchestra recorded by Kinect. The point cloud of the musician shows the change of perspective from below to above in a bottom-view circle, which is why we speak here of a horizontal inversion. The optical illusion gives the impression of a perspective from above, although the viewer is constantly looking from below. The representation of the shadowless dots does not have a closed surface, which additionally strengthens the optical impression of the perspective jump, since the viewers can relate the dots to a possible optical surface themselves. This effect suggests that it is not only thought structures guided by imagination that can change perspective, but also the cognitive completion of an incomplete account.

Fig. 1: Effect of horizontal inversion (from left to right): 0° frontal, bottom-view perspective impression; 90° perspective transfer; 180° top-view perspective impression; 270° perspective transfer.

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Figure 1: "Marko Genero," video sequence, screenshot, 2020.

Adversarial poetry

The tools of resistance

Christian Heck

Abstract
A large number of current "social movement prediction models" are automated using Natural Language Processing (NLP) methods. Poetry presents probably the greatest challenge to this computational way of processing texts in natural language. It has a high density of ambiguity and usually plays by its own rules.
This article aims to provide an introduction to the concept of adversarial poetry, i.e. a practice of subversive resistance by composing politically motivated texts in such a way that they are misinterpreted by common NLP prediction models.
It is not only governments and their secret services that are interested in surveillance through recording and analyzing the structures and individual actors in social movements. By evaluating social media accounts, private companies and platforms such as Twitter or Facebook have also created their own instruments of domination to automatically detect "abnormalities" and pass them on to the relevant authorities in natural language. As a result, activists must create new spaces to communicate on the web under the radar of surveillance. This requires self-determined and self-organized platforms for participation within socio-technical spaces of action. Spaces that are always based on text, since computers are semiotic machines.
The literary currents and movements of the last century were, so

to speak, the forerunners in a development of alternative forms of language that are very difficult for computers to read today. In connection with the social dynamic of hacktivism, strategies can be developed that provide activists with the possibility to play with contemporary instruments of domination.

It is possible—if you know which rules to break and how to break them without bringing down the overall set of rules—to destabilize this socio-technical space of action. How to appropriate this space with poietic rule-breaking will be the subject of the following chapters.

Introduction

Those who change their use of language act and effect differently. "We have become accustomed to the fact that one must speak differently at markets than, for example, at political meetings, that religious speech is inappropriate in court" (Nassehi 2019, 164; translated by the author), and also that a scientific style of expectation must disregard which denomination someone belongs to or the color of their skin. The sociologist Armin Nassehi speaks of "certain forms of social intercourse" from which compact patterns of action emerge (2019, 164; translated by the author). These, in turn, bring with them corresponding specialized knowledge and special language (jargon), forms of reflection and milieus (cf. 165).

Political language, or political speech, constitutes one of these special languages and "this language is not just any instrument of politics, but the condition of its possibility" (2010, 6; translated by the author), as Heiko Girnth, who works at the *German Language Atlas* research center at the Philipps-University of Marburg, introduces "Dossier: Sprache und Politik" (Dossier: Language and Politics). He goes on to claim that "ultimately, anything that is of public interest can become political" (6; translated by the author). Politics can thus permeate all areas of social life.

However, the concept of *public interest* can be used as an example to play through the endless specialized language and everyday language differences in the meaning of words, which all too often lead to communication problems between political actors and citizens. "The everyday language way of reading is based, in some cases, on concrete experience, but it is mostly the result of cultural memory," Girnth continues (6; translated by the author). Political language, in turn, often works with ideological vocabulary, i.e., our value systems, certain thought patterns and concepts such as *freedom, justice or peace*. Buzzwords, such as *democracy* or *terrorism* or *public interest* and word combinations, neologisms, and metaphors are often used to convey political issues more easily against a background of

already familiar experiences.
The use of such linguistic techniques could be described "as social techniques to relieve us of the burden of establishing consensus and agreement" (Nassehi 2019, 206; translated by the author) – they are supposed to facilitate and, in some cases, even relieve us of laborious consensus building and grassroots democratic processes. But they can also be seen as a necessary attempt, i.e., as a form of social life, of social togetherness. Certain intentions are represented by certain individuals and groups (not only in political speech), and these intentions are usually communicated in such a way that an expression of opinion occurs in the sense of an interpersonal understanding.
This communication consists, according to John R. Searle, "in the grasp of my meaning" (1998, 145). Searle speaks of an intention to communicate, namely "the intention that the hearer should recognize my meaning intention. The communication intention is the intention to produce in the hearer the knowledge of my meaning by getting him to recognize my intention to produce in him that knowledge" (145).
We are very concerned to continue to maintain our respective intentions of meaning and understanding for human readers while the authors of adversarial poetry try to destabilize our socio-technical spaces of action by a priori inscriptions of poietic (primarily syntactic) rule breaks into them.
This is where Searle's communication intention meets three general principles for writing adversarial attacks:[1]

- The author wishes to continue to ensure a grammatical fluency of language, albeit ordered according to their own specially created grammatical rules.
- The conventional meaning of the sentences should be preserved as far as possible, which means that when words are replaced by synonyms in pre-trained language models,

1- An adversarial attack, in the context of adversarial poetry, is a perturbative input designed to fool machine learning models in NLP, i.e., to misinterpret or misclassify the original input (text).

for example, they should be in the same *word space*.[2]

— Ultimately, of course, the main goal remains "human prediction consistency" (Jin et al. 2019), i.e., that readers continue to recognize the author's intention, that they do not only express the words and sentences written down but also mean them.

In every single step of adversarial poetry writing, respective meanings have to be preserved for human readers but reinterpreted differently by the prediction system. The interpretation sovereignty, not only over our words but also over the effectiveness of our future actions, should be reclaimed in this manner. For this purpose, direct references are made to a range of current scholarly research in computational linguistics and digital humanities, social and political sciences, and current AI research with a focus on deep learning and NLP.[3] Studying this research reveals the hurdles and obstacles that must be overcome if we are to create linguistic freedom through poetry and work out self-determined and independent movements in society. It also indicates the particular screws we must turn in order to destabilize language models implemented in social movement prediction applications. It points out how little we actually know about the structure and properties of these vector spaces, despite the widespread use of word embedding. Above all, looking at the current research shows that neither the mere transfer of our words into another text genre—in our case poetry—nor that of adversarial hacking to scramble neural word embeddings

2- Word embeddings are based on the idea that, in contrast to formal linguistics and the Chomskyan tradition, contextual information alone is a viable representation of linguistic elements. Depending on the language model, each word is represented as a vector in a semantic vector space (word space) of about 100 to 300 dimensions, based on the textual context in which the word occurs. This technology has become one of the most popular tools in the NLP research communities since the advent of Google's Word2vec (Mikolov et al. 2013), as these embeddings are easy and convenient to use and provide state of the art results. It is an integral part of almost all the applications and research presented in this paper.

3- Natural Language Processing (NLP) is a mixed science. The field consists proportionately of computer linguistics, computer science, and artificial intelligence: the science of algorithmic processing of language, the science of processing data, and the science of artificial intelligent behavior.

in language models can be a panacea in view of state-of-the-art poetry analysis methods.

Numerous approaches to writing adversarial poetry can be found in political poetry and in the experimental literature of the last century. Although their respective lines of tradition were largely separate from one another, both pursued one and the same goal. Both worked to replace, or at least destabilize, the functioning of old and established specialized languages, linguistic customs and systems through the creation and the use of a new language. This objective lies at the heart of the activities of the avant-garde movements and bohemian milieus, poets, politicians, writers, and artists listed in the following two chapters.

As we know, (not only) from German history, enforced changes of language use can reduce our possibilities of thought in a devastating way. In order to reduce the possibilities of thought, one must reduce the possibilities of expression and create simple linguistic schemes, preferably clearly evaluated opposites, as linguist Jürgen Schiewe proposes in reference to literary scientist Viktor Klemperer's treatise *LTI*: *Notizbuch eines Philologen* (cf. Schiewe 1998, 213). Klemperer, himself a survivor of the Holocaust, vividly drew "an oppressive picture of the language of the Third Reich, the 'lingua tertii imperii'," or in short: LTI (Schiewe 1998, 213; translated by the author). For him, the LTI was an important part of political domination, a language "that became literally fixed in all its basic features" with the publication of Hitler's *Mein Kampf* in 1925 (Klemperer 1947, 25; translated by the author).

But changes in language use can also expand our possibilities for thinking, by creating a participatory and free space in which society can unfold through collective action. Representatives of both traditions, political poetry as well as experimental literature, were convinced of the idea that a new use of language is the prerequisite for being able to think something new.

Experimental literature

Stein on NLP

> If one wants to understand how art and technology relate to each other in our European tradition, one has to go far afield. Today we are used to seeing intuition and rationality as opposites. The common origin of poetics (poietike - the creative, poetic art) and technology (techné) in Greek poiesis, on the other hand, has been largely forgotten. (Trogemann 2016; translated by the author)

There is probably no more beautiful essayistic approach to *techné* and *poietike* in Western literary history than that of Gertrude Stein in her "Poetry and Grammar," a passionate literary description of writing. What Stein showed in her own unique language is that technology is a way of thinking and doing, for which she was often criticized, particularly, because her literary discoveries always tasted of the scientific laboratory (cf. Brinnin 1964, 177).

Since its origin, modern literature has had a connection, albeit mostly ambivalent, to the exact sciences. It has always referred to them, implicitly or explicitly, be it to assert their otherness or to gain some form of legitimacy. This tendency developed over the twentieth century and practiced its very own exploration of fundamental scientific questions (cf. Maniez, Ludot-Vlasak, and Dumas 2012).

"Poetry is really loving the name of anything" wrote Gertrude Stein, continually doing everything to "creating it without naming it" (Stein 1998, 232, 237). One can love a name, one can feel a name, and one can also know it: "nouns are the names of things and so nouns are the basis of poetry" (234). She proposed that this was already the case in the times of Homer, of Chaucer, and in the writing of the Bible, which were all "drunk with nouns, to name to know how to name earth sea and sky" (233). Today we no longer know this. After hundreds of years and after thousands of poems have been written, we must learn to free ourselves from nouns. But they have remained the basis of poetry. Only differently. Poetry has changed its form, its grammar, its respective use in the word order to give life back to the noun.

Many aspects of our everyday life today are beyond our horizon of

experience. Typically, this concerns ideas and concepts that confront us with insurmountable linguistic boundaries (cf. Duerr 1974, 32). These limits have always had to be overcome. For we constantly get to know these terms anew and experience them by using them, by moving through them (cf. Wittgenstein 1984, 9). And in our everyday life we probably move in the conceptual realm of new technologies more than ever.

To grasp the respective significance of those terms for our everyday lives (at least in public debates) presents us with enormous challenges and requires us to venture into uncharted territory; a terrain in which, astonishingly, precisely these conceptualizations lead to stability problems in language models (cf. Pierrejean and Tanguy 2019). It is hardly comprehensible to the public how little we as researchers know about the structure of these vector spaces. Nevertheless, they are widely and instrumentally implemented in societal interaction. According to Wittgenstein's *Philosophische Grammatik*, the semantic representation within these models we use is not their meaning, but the way this use intervenes in our lives.

In the course of the last century, modernist poets developed their own usages and grammatical rules, many of which were completely unreadable by literary conventions. This led to the point of structural indistinguishability to our everyday language and to utilitarian or literary prose.[4] Hence, it is difficult to align this way of writing with the computational procedures for poetry analysis. Therefore, NLP researchers try to work out techniques and language models which bring these new rules, especially created by respective poets, into a strict form or to recognize a new grammar within it—for example, equating poems with the syntax constructions of prose texts (cf. Barakhnin and Pastushkov 2019) with the help of chunks and syntax groups (Noam Chomsky theory). For the writing of adversarial poetry, this would mean trying to avoid strict word order.

4- Texts written for a specific purpose are classified as utilitarian prose: the speech, the conversation, the letter, the article or the factual text (legal texts, instructions for use, etc.). Literary prose refers to texts that are commonly referred to as narratives or stories.

For this purpose, much of the current research in this area enters a space between language combinatorics and algorithmically processed language: "If we define a text as a combination of elements (letters, words, lemma, interpunction, POS, n-grams, etc.) we can count these elements and compare texts to find a pattern which might be characteristic for authorial style or genre," explains Nanette Rißler-Pipka from the field of digital humanities in her paper "In Search of a New Language: Measuring Style of Góngora and Picasso" (2019). Here she tries to extract countable structures from the poems of both authors in order to identify possible hidden rules behind the structure of the texts.

Pablo Picasso in particular was known for his combinatorial play with language. Like Stein, he knew how to play with new syntaxes, creating new words and trying out new grammatical orders. Just as Stein herself was inspired in her writing by the impressionism of Cézanne and, above all, by Picasso's cubism, her experimental writing techniques naturally inspired her closely acquainted painter friends as well;[5] techniques that Stein developed from her preference for diagramming sentences. This also holds true for her unusually direct reference to the concrete world of things. Stein constantly attempted to recreate concrete objects through unconventional new names and to depict their visual characteristics within the framework of individual sentence structures or object related rhythms. Through these rhythmic-syntactic operations she led her readers to the semantic level of meaning only (cf. Kirchner 2001).

Those who write in rhythm

Numerous artists and writers of the last century studied Stein's work and her way of writing. Among them were representatives

5- Gertrude Stein and her partner Alice B. Toklas, together with Stein's brother Leo, presented their collection of works of modern art by Paul Cézanne, Henri Matisse, and Pablo Picasso, among others, at their apartment at 27 Rue de Fleurus (1903–1938). Writers and artists such as Georges Braque, F. Scott Fitzgerald, Guillaume Apollinaire, Pablo Picasso, James Joyce, Thornton Wilder, Ezra Pound, Francis Picabia, and Henri Matisse met there regularly on the renowned Saturday evenings.

of the *Stuttgarter Schule* such as Max Bense, Ernst Jandl, and Reinhard Döhl.[6] They became familiar with Stein's writing techniques primarily through Helmut Heißenbüttel's public presentation of her work.

Heißenbüttel began his Georg Büchner Prize Speech 1969 as follows: "Eine Rede ist eine Rede. Eine Rede ist eine Rede heißt eine Rede ist eine geredete Rede das heißt sie muß geredet das heißt gehalten werden" (1970, 42). In doing so he introduced Steinese, that repetitive, sparingly punctuated literary language, into the German poetic repertoire (cf. Melin 1985, 497).

The *oulipotique* writing style of the Oulipo circle of authors was also strongly influenced by Stein's combinatorics.[7] Among other things, Oulipo set itself the task of examining the formal aspects of Lettrism, which in turn explicitly dealt with the smallest units of our natural language in terms of content: letters. Isodore Isou, the founder of Parisian Lettrism in 1942, deconstructed poetry into mere sequences of letters, which he recited in Parisian bars provoking numerous scandals at the time.

Kurt Schwitters, a Dadaist poet, painter and spatial artist, had taken decompositional Lettrism—avant la lettre—to the extreme a few years earlier in his "i-Gedicht" ([1922] 1974). In that poem, name and thing merge into one through his play with the levels of signified and signifier. His elementary material had always been letters, numbers, colors, and notes, and by analyzing them he came across the elements of language. But the Dadaists were not only the intellectual fathers of the Lettrists[8] —their artistic work always opposed the ruling political system. Dadaist

6- The *Stuttgarter Schule* included Max Bense, Helmut Heißenbüttel, Reinhard Döhl, Ludwig Harig, Franz Mon, Ernst Jandl and several visual artists and musicians. They published concrete poems. Language did not serve them primarily to describe an event, but the words and letters were used as a means of visual and also acoustic expression. Their artistic production was closely linked to scientific research in the field of literature, sign and information theory (cf. Rosen 2004).

7- The French, Italian, US-American, and Transylvanian writers' circle Oulipo (Ouvroir de littérature potentielle) was founded in 1960. The members of Oulipo pleaded for a new formal poetry and experimented with a procedural or rule-governed poetics, often creating elaborate numerical constraints that a particular text had to follow.

poetry—following formal instructions—is also in this tradition of experimental literature, with its constant attempt to create a construct consisting of a combination of randomness and control (cf. Paul 2015, 11–13).

There are some notable Beatnik concepts as well: in his 1970 essay "The Electronic Revolution," which helped Gilles Deleuze to develop his idea of the society of control, William S. Burroughs put forward concepts of how we can grammatically scramble the dominant form of society in order to unscramble the syntax of control. These included instructions like deleting the copula "is/are" to disrupt fixed identities or replacing definite articles like "the" with indefinite articles "a/an" to avoid reification. In replacing "either/or" with "and," Burroughs ignored the law of contradiction (cf. 1970, 33–35).

A few years before Oulipo's literary experiments in France, Jack Kerouac introduced the term Beat Generation to the New York literary scene. The authors who identified themselves primarily with this self-imposed generation not only named themselves in analogy to the Lost Generation (F. Scott Fitzgerald, Ernest Hemingway, Gertrude Stein and many others), they were also often called "those who write in rhythm," because they, like Stein, poetically appropriated language technologies of their time. Their poetry seemed to be aware of what the political theorist Hannah Arendt described a few years later in *Vita Activa:* "that man must have already become accustomed to this rhythm of the machines, as it were, when he even conceived such a thing as a machine in his mind" (1981, 136; translated by the author). For as long as one writes with and through machines, their mechanical processes and their discrete units of time also take the place of our own body rhythm. It was therefore necessary to be able to write language that carries "all the history of its intellectual recreation" within itself (Stein 1988, 238).

"Whoever wants poetry must also want the typewriter," Arno

8- The Lettrist Michèle Bernstein explained in 1983: "Everyone is the son of many fathers. There was the father we hated, which was surrealism. And there was the father we loved, which was Dada. We were the children of both" (Marcus 2009, 175).

Schmidt wrote in his monumental work *Zettel's Traum* (1970; translated by the author). The typewriter rarely replaced the handwriting of writers, just as rarely as Gutenberg's printing press did before or our computers do today. Instead, it "rather displaces and redirects it toward writing, inventing, and thinking about other things" (Dick 2013, 86).

Today it is the code poets who, just like the Lettrists in the past, deal with the smallest units of our natural language, but they do so in the digital realm. They are the ones who read and write the natural language texts as well as the encoded texts, who think about all these abstract intermediate levels between things and our thinking. They read texts that they cannot see and make them appear through their work.

Code poets are constantly moving between what was and what is to come—in other words, the a priori knowledge that is inscribed in digital technologies. This knowledge is inextricably linked with early industrial history, namely with the abstract modeling of social groups, algorithmic problem solving, and statistical prediction procedures. In short, purposive rational thinking (cf. Trogemann 2019). Code poets move through these texts, first a posteriori with the aid of formal scaffolding, into these language models with neural embeddings, then on to the input representation, until they finally arrive at the respective vectors of meaning, the word embeddings.

They also weigh up and estimate, at best, the respective consequences of their writing: the potential byproducts of the literary code. This means, in the writing of poetry, to clearly differentiate between syntactic codes, which according to Umberto Eco represent the knowledge of the constructions, and the semantic codes, which refer to their respective function (Eco 1994, 329).

Code poets assign their cultural value to the code when writing. If they were to remain solely with the semantic codifications of their texts, they would be unable to provide readers with anything they were not already prepared for. The text would only give solutions worked out in a predefined form. Finally, it would lock any free space for the participation and imagination of the

reader or the activist in the respective space of action: precisely in that space in which the algorithms to be used are embedded (cf. Trogemann 2010).

What code poets do can be called code poetry or code literature. There is another alongside these two relatively young genres: conceptual literature. The best-known representatives are the author and literary scholar Hannes Bajohr in the German-speaking world and the writer and conceptual artist Kenneth Goldsmith in the English-speaking world. Goldsmith himself explicitly places his writing in the Steinian tradition and often refers to reading her monumental work *The Making of Americans* in one go as "like trying to read the Web linearly" (2011, 305). In his book *Uncreative Writing*, Goldsmith elaborates a concept which he describes as "the art of managing information and representing it as writing" (446). This is a concept that is (not only) forced upon us by our communication in and through social networks in which we now continuously parse, sort, forward, channel, tweet and retweet expressions. Goldsmith suggests that "what we're experiencing for the first time" in our everyday lives "is the ability of language to alter all media, be it images, video, music, or text" and thus the social habitualizations accompanying its use (65).

Brain works

Gertrude Stein studied in what was, at the time, the emerging fields of psychology and brain science at Radcliffe College (1893–1897) at Harvard University and then at Johns Hopkins School of Medicine (1897–1902). In her studies of brain science, Stein, together with Florence Sabin (the first professor of medicine at Johns Hopkins Medical School), produced repetitive brain models and diagrams over and over again in detailed handwork (cf. Stein and Barnes 1950, 148). As a member of the School of Medicine's inaugural class of 1897, she joined the first generation of students to learn about a new experimental focus in medical education. Under the direction of Professor Franklin Mall, in whose laboratory Gertrude Stein later conducted independent research

(1901–1902), Johns Hopkins Medical School was the first American medical institution to teach anatomy in the dissecting room rather than the lecture hall. This was a groundbreaking shift from a descriptive teaching method to an experimental one of analyzing, observing, treating, viewing, tabulating and classifying (cf. Mall 1896, 86).

Stein and other experimental writers, such as William Carlos Williams, who was also a practicing doctor during his time as a writer, integrated many concepts and models from early neuroscience and brain research into their experimental literary works and created entirely new approaches to language through their poetic language techniques. Central to this are Stein's well-known stylistic devices of repetition and abstraction (Farland 2004, 118).

At the beginning of the twentieth century both the disciplines of modernist poetry and modern neuroscience discovered a new space to assemble fragments into meaningful arrangements to replace what they believed to be the obsolete systems of the nineteenth century (Ambrosio 2018).

A few decades later, William S. Burroughs, probably the most ambivalent Beatnik, also incorporated his very own forms of cognition from the neurosciences into his work. The *Dreamachine* Burroughs developed in collaboration with artist Brion Gysin, for example, made direct reference to the experiments of neurophysiologist and roboticist William Grey Walter, who studied the stimuli triggered by perception of a strobe and its direct influence on the electrical activities in our brains (cf. Walter 1953).

Through discovering synaptic spaces, the syntax of our formal technical languages, especially that of artificial neural networks, thus entered a new millennium, hand in hand with early poetic language techniques and experiments.

Political poetry

Anarchistic decision making (ADM)

Poetry is dynamite for all orders of this world!
Heinrich Böll

The meetings at Café Stefanie in Munich organized by the satirical magazine *Simplicissimus*[10] were to the *Schwabinger Bohème* what the famous Saturdays in Gertrude Stein's salon in Paris were to the avant-garde of the early twentieth century. Among the bohemian milieu of Munich-Schwabing at the turn of the century were intellectuals, expressionists, Dadaists, cabaretists, poets, publicists, and anarchists such as Heinrich Mann, Emmy Hennings, Frank Wedekind, Franz Blei, Paul Klee, Otto Gross, Erich Mühsam, Gustav Landauer, Ernst Toller, and Kurt Eisner. The latter four were to become important political players a few years later. They attributed great revolutionary power to the poetic word, art, and education for social change, and to this end they took political office as members of the Munich council republic in 1918 and 1919.[11] The achievements of this bloodless revolution, which led to the end of monarchy, not only included the main goal, the installation of democracy, but also women's suffrage, the eight-hour workday, and other milestones on the way to social equality and justice.

For lyricist Gustav Landauer in particular, poetry and poetic forms of expression were a prerequisite for the creation of communitarian, free and just societies. Only through a concomitant linguistic reconstruction did it seem possible to him to destroy the dominant, ruling language with its strict and rigid terminology. He believed deeply in the political capacity of poetic language (cf. Mokrohs 2018). For him, it created something new by allowing for blur, paradox, and contradiction. Landauer derived the creation of a new, anarchistic model of society from these precise blurs of poetry. Individuals were meant to destroy fixed

10- *Simplicissimus* was a satirical weekly magazine with editorial headquarters in Munich, published from April 4, 1896 to September 13, 1944.

11- The Munich or Bavarian Councilors' Republic was proclaimed on April 7, 1919 and represented an attempt to establish a socialist councilors' republic in the Free State of Bavaria, which had been founded shortly before. It lasted about four weeks.

terms and given concepts, come to an understanding of themselves and join similarly minded people to establish self-governing communities of production and life (Friedmann 2019, 5). Landauer advocated a form of anarchism understood as the absence of coercion, domination, and hierarchy, which could only be fought for collectively and without violence: a liberation from egoistic individualism in order to be able to develop as independent and self-reliant individuals.

Hannah Arendt's grassroots-democratic, council-political concept of power also held that politically free action could only come about through collective action in the public sphere. For Arendt, the (communicative) power potential of emancipatory movements, which can oppose repressive instruments of domination, led, in the sense of her *Vita Activa*, through collective action in public space towards empowerment. The movements that emerged from this period are not only an integral part of modern societies, they have also shaped them in their present form. They oscillate between urban and media space and march on data highways and paved streets. Networking in socio-technical environments that are familiar to them, they open up new social and political spaces for action.

However, these social and political spaces also present new challenges that must be overcome in order to create a public space from this media space. To put it more concretely: textualizing and co-defining utopias and political goals can only happen in anarchic moments and grassroots democratic processes in the plurality among people and in the recognition of the needs of the respective counterpart as well as in the ambivalence of existence (cf. Arendt 1981). This entails accepting others in their otherness and beginning to understand them in their own way.

In socio-technical networks we are someone different than out there on the street. Each one of us is many: many digital identities. We are algorithmic narratives that move and act according to codes and laws different to those in the analog world. Some have to adapt their language a little less there; indeed, behavior and uses of language are even promoted algorithmically (cf. Fielitz and

Marcks 2020). Others, as in the following example, are made unreadable by rating and ranking algorithms.

The occurrences in the US city of Ferguson in 2014 and 2015 did not appear in the virtual space of Facebook.[12] This is not because these incidents were not "spectacular"; on the contrary, the riot control after the murder of Michael Brown was martial. But Facebook's Edgerank algorithm filtered out the topic because, according to Facebook, it edits news according to personalized relevance. The Black Lives Matter protest in the aftermath of Michael Brown's murder thus became virtually invisible in this socio-technical network (cf. Tufekci 2014).

Especially in times of social unrest, socio-technical networks and spaces of action are increasingly observed, measured, and controlled, not only for the sake of functioning or for their own business interests, but also to measure the reactions of the public and to estimate the duration and severity of the associated protests. Thus, according to some social media researchers, the data extracted from social network analysis is quasi-isomorphic to the organizational structure of social movements. Given the central role of the Internet in social structures or movements such as in the early days of the Arab Spring or the Zapatista Movement in Mexico,[13] a map of network connections is, in effect, a map of the social and organizational relationships that constitute the most significant part of those movements (cf. Garrido and Halavais 2003, 2). Still others attempt to empirically capture

12- 18-year-old Michael Brown was shot and killed during a police check in Ferguson on August 9, 2014. A police patrol stopped him because he was walking on the road instead of on the sidewalk. During the discussion, a shot was fired from the patrol car. Brown fled and was shot in the back by a police officer. Michael Brown was unarmed and was black. Citizens of the city gathered for a vigil the very next day, most of them black. They were confronted by 150 police officers in armored gear. The atmosphere heated up and the situation got out of control. Street fighting and looting broke out. On August 11 and 12, the police used armored vehicles, stun grenades, smoke bombs, tear gas and rubber bullets against the angry crowd.

13- The Zapatistas in Mexico are an insurgent group of predominantly indigenous people who rose up against the government's neoliberal and neocolonial policies in 1994 and created an alternative autonomous space, characterized by self-management, grassroots democracy, collective ownership and distribution, gender justice, and a sustainable approach to nature.

the differences between offline and online movements, by examining the activities of formal and informal organizations and identity groups involved in protests for example (cf. Fowler and Steinert-Threlkeld 2016).

Messages from the jungle

When Colombian writer Gabriel García Márquez asked Subcomandante Marcos, the self-proclaimed spokesman for the Zapatista Army of National Liberation (EZLN) about the place of literature in his life, the latter replied that as a child he thought of language "not as a way of communicating, but of building something" (2001). Marcos conceived of his poetry and prose as weapons to mobilize readers for the rights of Mexico's indigenous population but also more generally against neoliberal economic policies and for autonomous self-government. Like Landauer, he relied on the power of the lyrical in political language. One of the ways he practiced this was in the way he created his hybrid literary language to explain the identity of the guerrillas and their goals, for example, by using colorful symbolism to describe the actors, but also to describe intertextual threads woven between his stories and the *Popol Vuh*, or poems and texts of García Lorca and Jorge Luis Borges.

Until his public farewell in May 2014, the Subcomandante communicated in irregular intervals with articles, letters, and poetic communiqués, which still circulated around the world by fax in the early days of the EZLN. Quite quickly, however, the ELZN networked digitally, reaching the Western industrialized nations as well as other emancipatory movements and NGOs in Mexico and around the world via the Internet. As an emancipatory movement, their organizational forms and goals have made them a model for many transnational social movements, such as the anti-globalization movement, the counter summits against G20 meetings, Anonymous, Reclaim the Streets, the São Paulo Forum, and many others (cf. Zimmering 2020).

The poetology of the Zapatistas emerged at a very interesting historical moment – not least in view of the mainstreaming of

the Internet. They set a technological infrastructure and also reflected it very consciously with their messages from the jungle (Woznicki 2020).
Spanish sociologist Manuel Castells wrote in his study *The Information Age* that what made the Zapatistas special, was their use of information technology to build an international network of solidarity (1997).

Black Lives Matter

As I began writing this article, riots spread from Minneapolis to cities across America. Yesterday, a police officer in Minneapolis killed George Floyd. An African American man who was paying at a kiosk with a counterfeit $20 bill. The owner called the police. Four officers came. One of them knelt on Floyd's neck until he stopped breathing. He died of the consequences a short time later.
The murder of George Floyd was certainly not planned by anyone. Like so much that happened in Minneapolis and the United States in 2020, it was not planned, but was somehow predictable. Yes, even predicted, and yet nothing was done about it. Because it was not foreseen.
In 2018, the information science research paper *Using Linguistic Cues for Analyzing Social Movements* attempted to use the emancipatory movement Black Lives Matter as a case study to analyze the relationship between traditional media such as news articles and the communication trajectories in Twitter that began with the hashtag #BLM and #Ferguson (Rezapour 2018). For this, the researcher Rezvaneh Rezapour accessed a dataset from the Center for Media and Social Impact in Washington (Freelon, McIlwain, and Clark 2016). In her methodology, Rezapour used an interesting aspect to ultimately apply the process of sentiment analysis to her dataset.[14] She assumed that people

14- Sentiment analysis (opinion mining) is a computational analysis of the views, attitudes, opinions and emotions of people on a subject or object. It is a subfield of text mining and refers to the automatic evaluation of texts with the aim of identifying an expressed attitude as positive or negative.

connect to movements and events by expressing their feelings and changing their language. She acknowledged, although she did not directly refer to current research, the research on linguistic alignment in text-based communication, "that people tend to adjust their language use to one another both in terms of word choice and sentence structure" (Wang, Reitter, and Yen 2017). She also drew on diverse studies from psychology (Campbell and Pennebaker 2003). Rezapour pursued the hypothesis that "individuals mostly use I and *my* in their everyday life to describe events or express their opinions. However, to emphasize their participation, people use more we and *our* to show their involvement in the process of change or movement" (2018).

In writing adversarial poetry, this would mean, in direct contrast, using "we/our" more often as pronouns to express one's political opinion and "I/my" to emphasize participation in a movement process.

According to Rezapour's research findings, the use of pluralism is widespread in the passages that have far-reaching effects or are more generally focused on society such as:

"'You think we WANT to protest? Nah. We wanna live. We protest because we are being slaughtered. #ferguson,' anonymous3" (2018). Individualism is more common in posts that present opinions or emotions: "'I'm in tears sitting here at my desk #ferguson,' anonymous4" or "'I can't believe what I'm reading... R.I.P #AntonioMartin #policebrutality #civilrights #BLACKLivesMatter,' anonymous5" (2018).

Four years earlier, the United States Department of Homeland Security was also interested in recording and analyzing the structures and individual actors in this emancipatory movement. According to reports by the research platform *The Intercept*, it evaluated social media accounts on services such as Facebook, Twitter, and Vine in order to obtain information about protesters' whereabouts (Joseph 2015). In this way, instruments of domination are networked and linked in botnets that automatically detect abnormalities and pass them on to the relevant authorities in natural language. Actors in emancipa-

tory movements in these new spaces therefore also need new strategies and tactics to protect themselves and their counterparts from possible repression. To communicate with one another they need to use anonymization and encryption tools, e.g., Tor[15] and PGP[16] or their own (poetic) symmetric encryption method,[17] at irregular intervals. This means consciously changing the common use of language by using alternative codes and techniques. Repressive instruments of domination preventively limit the political power of emancipatory movements, not only in the virtual world, but also on the streets, up to the point of the absolute political inability to move.

With the advent of information technologies and computer-assisted communication, there has also been a revival in the analysis of social networks. In disciplines such as the life sciences, economics, psychology, or the digital humanities, this computational modeling of text analysis processes has become a central technique for deriving reliable insights about social phenomena from data obtained through observation. These predominantly computational linguistic insights flow unobtrusively into applications for the private sector, government agencies, intelligence agencies, police departments, and the military. Quite often they are used for speech biometric procedures. At the turn of the millennium, it was precisely these procedures that successfully merged with cognitive technologies such as deep learning to extract people and political movements from socio-technical networks, identify them, and predict their next moves.

15- Tor is an anonymization tool for improving privacy and security on the Internet. It can be used to prevent services from tracking you, or to connect anonymously to news sites or instant messaging services that are blocked by local ISPs. Tor's services allow users to post to websites, blogs, forums, etc. without revealing their location or digital identity. The network has proven crucial for emancipatory movements around the world.

16- PGP (Pretty Good Privacy) is a program developed by Phil Zimmermann in 1991 for encrypting and signing data. His goal was to allow citizens and civic movements especially to securely exchange encrypted messages (even from access by intelligence agencies).

17- German political prisoners on the Isle of Men, for example, used Schwitter's Ursonate as an encoder to exchange information during World War II.

Today this must always be kept in mind when one is forced to move outside of predefined norms and rules, i.e. when one does not or cannot follow cultural-technical rules, or when one is consciously dedicated to not following and playing with these rules, the social, and the machine codes. Nevertheless, the wave of protest movements in the twenty-first century grows year after year. Despite all the new technologies of domination emerging in our millennium, protesters do not seem to stop reinterpreting them as a basis for hacking and appropriation, i.e., inscribing their own rules and their own language in technologies. The Black Lives Matter movement, for example, have attempted to establish an anti-sexist and antiracist vocabulary. However, the meaning vectors of pre-trained models are primarily trained with the broadest possible textual material from the Internet and thus are not attuned to the nuances of this vocabulary. They therefore cannot interpret out-of-the-box language usages that correspond to these new cultural norms (Hao 2020).

As Alicia Garza, a central figure of the BLM movement wrote "Hashtags do not start movements—people do" (2020, 8). It was Garza herself who made sure the #blacklivesmatter hashtag became popular on social media after the acquittal of the neighborhood watch coordinator George Zimmerman, who murdered Trayvon Martin in Sanford, Florida on February 26, 2012. In her recent book *The Purpose of Power: How We Come Together When We Fall Apart*, she writes about her own active politicization and how grassroots work in black neighborhoods in San Francisco.

When might unrest occur?

We can see from the history of global protest and resistance movements that most started on a small scale, very locally, with interpersonal events on streets and in cafes, in squats or schools, in cities and in forests. If we take the global Fridays for Future movement as an example, we find it is inseparable, at least in German-speaking countries, from the first forest occupations in Germany and the later professionally organized peaceful resistance actions of the

civil disobedience movement Ende Gelände. This included regular concerts, readings, VoKüs (people's kitchens), peace camps and forest walks attended by thousands of protesters who came to Hambacher Forst in North Rhine-Westphalia and planted trees and collected acorns with their children.

But, as is usually the case with new movements, only a few excerpts and snapshots exist from these early developments. Occasionally, songs and poems, fanzines, manifestos, minutes of meetings and collected notes emerge. Then there are magazines and brochures and countless other pieces of literature, some grey, some illegal, books, also leaflets and posters, badges, stickers and other devotional items. There are tweets, Facebook posts, WhatsApp, Telegram, forum posts, mails and mailing lists, blog posts, articles in alternative and encrypted channels, video clips, podcasts, talk shows and other audiovisual recordings, GPS data, timestamps, log files, and traces and information collected by the smartphones and computers of protesters while writing.

Archives and processed documents of protests and social movements of all kinds are created from this material. These virtual documents also constitute material to inspire our models of future society. Most of these archives have emerged from the movements themselves. They are more or less directly connected to them and based on the voluntary work of individuals or groups of people who collect them during the movement's activities or painstakingly reconstruct them afterwards.[18]

Other archives and databases have been created by intelligence agencies and the military as the basis of so-called crisis early

18- The Bibliotheks-Verbundkatalog antifaschistischer Archive is an example of such an archive in the German-speaking countries (http://bibliothek.antifa-archiv.org/). Other include Verzeichnis Freier Archive, Bibliotheken und Dokumentationsstellen in Deutschland (http://afas-archiv.de/verzeichnis-freier-archive/) or Portal der deutschen Umweltbibliotheken (http://www.umweltbibliotheken.de/). Others worth mentioning are Archiv des Informationszentrums Dritte Welt (https://www.iz3w.org/projekte/das-dritte-welt-archiv) in Freiburg im Breisgau, Antifaschistische Pressearchiv und Bildungszentrum (apabiz) in Berlin (https://www.apabiz.de/) and of course Bibliothek der Freien (https://www.bibliothekderfreien.de/), the largest library on anarchism in the German-speaking world.

warning systems. They are called automated event databases: ICEWS (Integrated Crisis Early Warning System),[19] a project funded by DARPA, and GDELT (Global Database of Events, Language and Tone)[20] by Kalev Leetrau (Yahoo) and Georgetown University are two such systems.

EMBERS AutoGSR is another system for creating automated event databases worth mentioning (Saraf and Ramakrishnan 2016). EMBERS (Early Model Based Event Recognition using Surrogates) was designed by ten institutions and over seventy academics to provide "anticipatory intelligence" in support of US national security decision making. The system was supported by the IARPA (Intelligence Advanced Research Projects Activity) OSI (Open Source Indicators) program. The objective of EMBERS was to forecast (predict) population-level changes using open-source data feeds, such as tweets, news/blogs, Wikipedia, and others. It has gone through various iterations over the years and expanded from monitoring Latin America to also covering countries in the Middle East and North Africa. EMBERS was "deployed" by security agencies for several years, but only as a research activity. In many cases, the system was able to predict a high percentage of civil unrest events, such as the impeachment of the president of Paraguay in 2012, the World Cup protests in Brazil in 2013, and the violent student protests in Venezuela in 2014 (Muthiah et al. 2016). The EMBERS system has produced forecasts since November 2012, "automatically emailing them in real-time to IARPA upon generation, which have been evaluated by an independent test and evaluation (T&E) team (MITRE)" (Ramakrishnan et al. 2014). Using human analysts, MITRE corporation compiled a gold standard report (GSR), a monthly catalog of events, by surveying newspapers for reports of civil unrest in 10 Latin American

19- ICEWS (2007) focuses primarily on monitoring, accessing, and predicting events of interest to military commanders and is now being further developed by Lockheed Martin Corporation.

20- GDELT focuses on capturing a large dataset of events in terms of both categories and geographic distribution. The goal is to capture a large number of events without worrying about false positives.

countries: Argentina, Brazil, Chile, Colombia, Ecuador, El Salvador, Mexico, Paraguay, Uruguay, and Venezuela.

AutoGSR, part of the EMBERS project, was developed to automate the validation of riots and civil unrest by using minimal human effort. The system processed data in Spanish, Portuguese, and English 24/7 for six months and encoded unrest in the Latin American countries listed above. It used ranking algorithms to detect new actor roles and for automated updates of their actor dictionaries. After these respective actors were recognized using the named-entity recognition method,[21] an algorithm placed them into the training dataset of a Word2vec language model. Based on this, a kind of role recommendation determined whether a news article (or other texts) might contain a future unrest in code, i.e., certain features are recognizable, such as "When might an unrest occur?" "Where?" "With whom?" and "Why?"

Literal untargeted adversarial black box attack

Adversarial hacking

> As we move into a world where all social, economic and political systems are to some extent technological, we need to extend our way of thinking. Come learn how to hack—and then defend—society's core systems: elections, the market economy, lawmaking, tax policy, journalism and more. (Schneier 2020)

Since adversarial poetry gradually focuses on established technologies (Word2vec) in NLP, it is possible to hack a relatively wide range of prediction applications from the outside without needing information such as the particular parameters or even having access to the respective model architecture. Instead, the authors can apply a so-called black-box attack. This type of attack does not manipulate (in our case) the model architecture in which the respective criteria for the machine production of meaning are anchored, but it changes the respective input x, i.e. the characters of our natural language texts. Likewise, in adversarial poems the interest does not aim at guiding the output of the respective model towards a specific goal but rather tries to scramble its machine interpretation so that next steps are incorrectly predicted based on the underlying data material (the text). It is therefore called an "untargeted attack."

However, not needing to know the respective parameters does not mean not having to know the structure of these models. As we have seen in the previous examples, we are well served by having at least a rudimentary knowledge of how AI prediction systems work; a knowledge of these models and algorithms in general, but also of their use in particular. In adversarial attacks, whether a black box attack or white box attack, it is necessary to know the structure of the models to be hacked very precisely. In this sense, the term "black box" should not be confused with its classical meaning, in which nothing is known about the interior, in our case the artificial neural structure of the system in question. We need to know the system and we get

to know it mainly through research papers: if, for example, an institute for machine learning shows us in their research that there are significant differences in the semantic representation of concrete nouns (in short, things that can be seen, touched, and felt) and abstract nouns (things that we can only think), we can exploit this knowledge (Pierrejean and Tanguy 2019). We can see in this specific research result that the increased use of abstract nouns, or mental terms in texts, destabilizes the word embedding space of language models. The poetic potential of these techniques was explored in previous subchapters. Employing these insights on the code level, specifically towards specific needs and against the functionality of the language model under attack, is called adversarial hacking or attack.

Research on adversarial attacks began to gain popularity through neural computer vision systems (Szegedy et al. 2014). However, adversarial poetry focuses on natural language texts. These types of hacks are also called paraphrasing attacks. They turn out to be harder than adversarial attacks on images as the model input usually consists of words that inherently form a discrete space. This means that a particular input x usually consists of discrete symbols such as characters or words. Hence, we cannot just take ten percent more or less of the word "anarchy" in a sentence, but we can play with its meaning and concept on several levels. Since there is no simple metric between two utterances, one of the biggest difficulties is replacing words using computational methods in such a way that the fluency of the language remains and the reader is still able to grasp the intended meaning. To do this, we need functions c in our code that guarantee that both expressions, i.e., the original input x and the misleading expression we insert, have the same meaning (semantics). Also, the original syntactic properties must be preserved (writing style, sentence structure, etc.), i.e.: $c(x,x')$. There are various research approaches and studies on how this can be accomplished. We will take a closer look at one of them in the following.

Thought vectors

A team of researchers at Stanford University devised a method that replaces words in a sentence that are in the same embedding space, in such a way that they produce large perturbations in the embedding space but not in the flow of the sentence, in short "Greedy search and counterfeited embedding swap" (Kuleshov et al. 2018). These perturbation effects change the predicted class of the text and can cause its complete reversal. To maintain correct grammar, only words that do not significantly change the probability of the sentence under a language model are changed.

The researchers first wrote a semantic identification method to detect semantic similarities in the text using thought vectors. Thought vectors act like word embeddings, only that they map sentences instead of words with similar meaning close to each other. These thought vectors were then transferred as average values of the individual word embeddings. Accordingly, the original thought vector v had to be similar or equal to the vector v' to be replaced. However, thought vectors do not capture syntactic similarities, only semantic ones. For example, all words in the sentence can be rearranged and still result in the same word vector average. To preserve syntactic similarity, the team superimposes different language models like LSTM (Hochreiter and Schmidhuber 1997) over the vector representations to guarantee that a grammatically diced sentence in x, for example, is also used in x' in the same diced way. Once the syntactic similarity is set, a special optimization algorithm finds and replaces the words that should ultimately mislead the system. For this purpose, the researchers implemented the Greedy Optimization Method in their hacking model.

Thus, a technical description of adversarial poetry could be as follows: "literal untargeted adversarial black box attack." While experimental literature and political poetry open up a syntactic playground, primarily in natural language and its social codes, adversarial attacks show us how we can use these language games specifically to hack repressive technologies implemented in society.

Conclusion

In the twenty-first century we have seen that as soon as social subjects and social movements aim for political visibility, they become inscribed in opaque layers of new technologies, whether this is their intention or not. The tactic of adversarial poetry presented in this article aims to show that this does not necessarily mean submitting to the laws of these technologies. In this sense, it serves as an interface between aesthetic practice and technological and political critique. Adversarial poetry is a space for individual and collective positioning vis-à-vis constitutive inequalities and the patterns of domination inscribed in modern liberal democracies and their instrumentalities.

But writing adversarial poetry requires experimentation and expertise on multiple levels to maintain the respective intentions of meaning and understanding for human readers. Not only because poetry is not the most common genre for political writing but also because the linguistic formation of spaces of meaning to be filled by the reader can no longer be found on the phenomenological level (cf. Heilbach 2000). At best, adversarial poetry opens up cultural spaces as places of expression where those to whom political spaces remain largely closed have an opportunity to articulate themselves: spaces of emancipation, empowerment, and visibility.

However, there is no question that without appropriate interfaces, this writing process will never be truly viable. For further elaboration, much more than just dialogue between political activists, cultural workers, and the respective research communities, such as AI research, computational linguistics, digital humanities, social network and movement research is needed. A tableau for this kind of collaboration needs to be actively formed. A tableau to initiate further debates about approaches of this kind of political subversion in think tanks and research labs as well as in alternative cultural centers, in theaters, and on the streets.

Perhaps in this kind of collaboration we can find a way towards a more participatory open space within and outside socio-technical spaces of action.

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Experimental approach for a literal untargeted adversarial black box attack

Christian Heck

In this approach, the goal will be to literally trick an NLP model so that the subjective information in an expression reverses its classification. In short, an opinion, emotion, or attitude about a topic or person that is normally interpreted by the machine as negative or bad will be "misinterpreted" as positive.

A framework called TextAttack is used for this purpose (Morris et. al. 2020). TextAttack is an open-source Python toolkit for adversarial attacks, adversarial training, and data augmentation in NLP. It was developed by the Qdata lab at the University of Virginia to allow both researchers and developers to test and investigate the weaknesses of their NLP models. To this end, code from more than 15 papers in the literature on NLP adversarial attacks has been implemented in the framework. Developers can use these as so-called "recipes" to generate a specific type of adversarial example: adversarial perturbations. Here, TextAttack iterates through a dataset (list of inputs to a model) and looks for an adversarial perturbation for each correctly predicted example.

As described in the chapter "Thought vectors," the following experimental approach uses the Kuleshov recipe to generate perturbations that are grammatically valid and semantically similar to the original input (Kuleshov et. al. 2018). The "input" is a scraped tweet from the CMSI dataset used by researcher

Rezvaneh Rezapour for her research (Rezapour 2018): "Do you think we WANT to protest? Nope. We wanna live. We protest because we are being slaughtered. #ferguson."
According to her research, people connect to movements and events by expressing their feelings and changing their language, as described in the chapter "Black Lives Matter."
The NLP model targeted in this experiment is an LSTM model (Hochreiter and Schmidhuber 1997), trained on the Yelp Review Dataset. The Yelp Review is a binary sentiment classification dataset containing 1,569,264 samples from the 2015 Yelp Dataset Challenge (Zhang, Zhao, and LeCun 2016).
The following code example shows how a sentence that (according to sentiment analysis) has %87 negative connotations can be turned into one with %64 positive connotation after an attack is performed on it. This can be done by exchanging only one word, when "think" becomes "imagine."

```
whoami@machine:~$ textattack attack --model lstm-yelp --recipe kuleshov –
interactive
Loading datasets dataset yelp_polarity, split test.
Loading pre-trained TextAttack LSTM: lstm-yelp
Attack(
  (search_method): GreedySearch
  (goal_function): UntargetedClassification
  (transformation): WordSwapEmbedding(
    (max_candidates): 15
    (embedding): WordEmbedding
  )
  (constraints):
    (0): MaxWordsPerturbed(
        (max_percent): 0.5
        (compare_against_original): True
      )
    (1): ThoughtVector(
        (word_embedding): WordEmbedding
        (metric): max_euclidean
        (threshold): 0.2-
        (window_size): inf
        (skip_text_shorter_than_window): False
        (compare_against_original): True
      )
    (2): GPT2(
        (max_log_prob_diff): 2.0
```

```
      (compare_against_original):  True
     )
   (3): RepeatModification
   (4): StopwordModification
  (is_black_box):  True
)
```

Running in interactive mode

Enter a sentence to attack:

„You think we WANT to protest? Nah. We wanna live.“

Attacking...
%64) 1 <-- (%87) 0)

You **think** we WANT to protest? Nah. We wanna live.

You **imagine** we WANT to protest? Nah. We wanna live.

Enter a sentence to attack:

„We protest because we are being slaughtered. #Ferguson“

Attacking...
%73) 1 <-- (%72) 0)

We **protest** because we are being slaughtered. #Ferguson

We **demonstrate** because we are being slaughtered. #Ferguson

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On the creation of virtual communities

Tiago Ive Rubini

Abstract
Artistic and cultural aspects at the dawn of the commercial Internet are the main subjects of the following paper. Special attention will be paid to their role in global networks of home computers, and how certain metaphors such as *neighborhoods* and *sit-ins* are pertinent in this case. In order to better understand how important user-generated content was for the development of digital services in the early 1990s, I will discuss the project *One Terabyte of Kilobyte Age*, developed by artists Olia Lialina and Dragan Espenchied. To reflect upon how material and linguistic resources were articulated in the Global South in this period, I will discuss artist and researcher Brian Mackern's *NetArt Latino Database*. Finally, I will turn to *Floodnet*, a digital artwork made by the group Electronic Disturbance Theater, and its effectiveness as a means of online civil disobedience. The principles of so-called open-source culture, such as the collective construction of knowledge and criticizing power relations within digital culture, are crucial in this debate.

Introduction

In the first semester of 2020, Google announced the COVID-19 Community Mobility Reports service, with localization data of users from 131 countries. The apparent intent of the service was to disclose how often people go to places such as shopping malls, parks, beaches, public transportation stations, and so on, especially during lockdown periods connected to the COVID-19 pandemic. The information came from users who agreed to store their location data history in Google's servers, and according to the company the numbers are used in an anonymous way, even though it is possible to check out quite specific demographic details from the reports.

Over recent decades, our homes and daily lives have become important sources of information for digital services. This process, as invasive as it may be, was not imposed in a crushingly authoritarian way, as George Orwell's Big Brother would have done it to people like Winston Smith in the novel *1984* (1950). It came out as just the opposite, more in the vein of the characters in Aldous Huxley's *Brave New World*, who crave Soma, a drug used to control people in a soft and pleasurable way, not requiring an institution to repress or make any sort of threat (1932).

Why do we feel happy to share information about ourselves with companies and unknown people, even having fun with that, even though this could mean giving up our privacy? Is there a way we could use the same tools to emulate or experience public space with all its political properties, like an *agora* from ancient Greece?

I do not intend to directly answer such questions, but rather to acknowledge that user-made content and online behavior is complex, heterogenous, and should not be dismissed. This activity also offers new possibilities for self-expression and the creation of new forms of communities and interaction.

Bruno Latour claims that there are no plain, fixed groups. Groups are processual. In his book on the Actor-Network Theory called *Reassembling the Social*, Latour states that "social aggregates are not the object of an *ostensive* definition—like mugs and cats and chairs that can be pointed at by the index finger—but only for a

performative definition" (2005, 34). By *performative*, he means that "they are made by the various ways and manners by which they are said to exist." Keeping Latour's statement in mind, I will discuss certain cultural constructs of the commercial Internet in the 1990s, how it was developed by and affected users, and also give examples of how it was used as an artistic platform.

In the course of this essay, I will analyze certain specific linguistic resources in a number of net.art processes.[1] First, the metaphor of *neighborhoods* will be applied to analyze GeoCities, the most important part of the artwork *One Terabyte of Kilobyte Age*, which was produced by artists and researchers Olia Lialina and Dragan Espenchied. Then the metaphor of *fanzines* will be used to discuss lo-fi net.art processes, especially in relation to artists in Latin America dealing with the effects of material and economic scarcities, in comparison with wealthier areas like Europe and North America. For this, artists and authors such as Brian MacKern, Lila Pagola, and Gustavo Romano will be discussed. Finally, the paper will reflect on Electronic Disturbance Theater's artistic process *Floodnet*, to talk about the act of civil disobedience through digital technologies, and how they were inspired by so called sit-ins and the fight against the necropolitics aimed at indigenous people in Mexico.[2]

Open source neighborhoods

GeoCities was a service founded under the name Beverly Hills Internet in 1995 by David Bohnett and bought by Yahoo in 1999 for over 3 billion US-dollars. Starting with 10,000 users in 1995, GeoCities had over 1,000,000 users by 1997. In 1999, it was the third most visited website on the Internet (Milligan 2017, 137). The GeoCities headquarters in the USA were closed in 2009, affecting around 38 million user-made websites. GeoCities hosted

1- I consider *net.art* an appropriate term for art that is hosted on digital servers and is interested in discussing how digital networks operate. The net.art movement is represented by artists such as Ubermorgen, Vuk Ćosić, Brian Mackern, and Mariela Yeregui. More information on net.art can be found at https://anthology.rhizome.org/.

2. For more details on the involvement of Ricardo Dominguez and Electronic Disturbance Theater in the Zapatista movement, see Benjamin Shepard and Stephen Duncombe's interview with the artist entitled "Mayan Technologies and the Theory of Electronic Civil Disobedience."

free websites with up to 15 megabytes, worked with FTP servers and an online and intuitive interface for editing HTML code.

GeoCities initially worked as a kind of neighborhood—a network of "cities," where each region represented a specific interest. For instance, Area 51 was composed of websites made by sci-fi fans, and West Hollywood was the place for LGBTQ+ themes. Bohnett is himself a gay man, and according to Internet historian Ian Milligan, this is one of the reasons he built GeoCities: to feel heard in the technology market as a non-heteronormative person (2017, 138). When talking about how GeoCities changed the way people use and make sense of the Internet, Milligan says: "The web was no longer something understood by the public as being a passive area of consumption; it was presented as something that you could live in. Most importantly, it was easy to move in" (2017, 139). The service was regarded as open source in its conception, to the point that its founder felt like it should always be free of charge and as open as possible, so that everyone could participate without any sort of restriction.[3] It is also notable that, since its conception, GeoCities tried to construct websites and their distribution in a way as similar as possible to households and neighborhoods in order to remind users of the sensation of walking around populated areas. The service even experimented with the streaming of public spaces through their servers, way before Web 2.0 interfaces like YouTube or what we now know as the Internet of Things (IoT) even existed.

The North American GeoCities database, which is believed to contain all the user-made websites from countries in the West, amounts to close to one terabyte in size. Volunteers from the Archive Team[4] organized this data to be retrieved from a torrent file, which was downloaded for months by Olia Lialina and Dragan Espenchied for the project *One Terabyte of Kilobyte Age*. This artistic process is a massive and complex study of how users socialized, expressed themselves, and produced cultural

3- Bohnett talks about this on the *Internet History Podcast*, which can be accessed at http://www.internethistorypodcast.com/2015/05/david-bohnett-founder-of-geocities/.
4- For more information, see http://archiveteam.org.

processes based on digital technologies, especially the GeoCities service. Lialina and Espenchied created a system that publishes screenshots from the service's user-made websites every 20 minutes. The system began publishing the images on a Tumblr blog in 2013 and is still running in 2022.[5]

Lialina and Espenschied believe that the AOL (America OnLine) service was one of the most important steps in making the Internet enjoyable for non-specialists (2009, 10). AOL granted access to the Internet for people with no technical background and hardly any skills in online etiquette, making it a place packed with naive users, who could nevertheless find their way around and make their lack of experience work for them. In other words, "there is nothing one user can do, that another can't given enough time and respect," as Lialina points out in her book *Turing Complete User* (2021, 26). For the present paper and research, it is significant to notice that Lialina and Espenschied see the activity of users as sources of knowledge and various cultural perceptions instead of dismissing them as plainly awkward and passive actors of digital services.

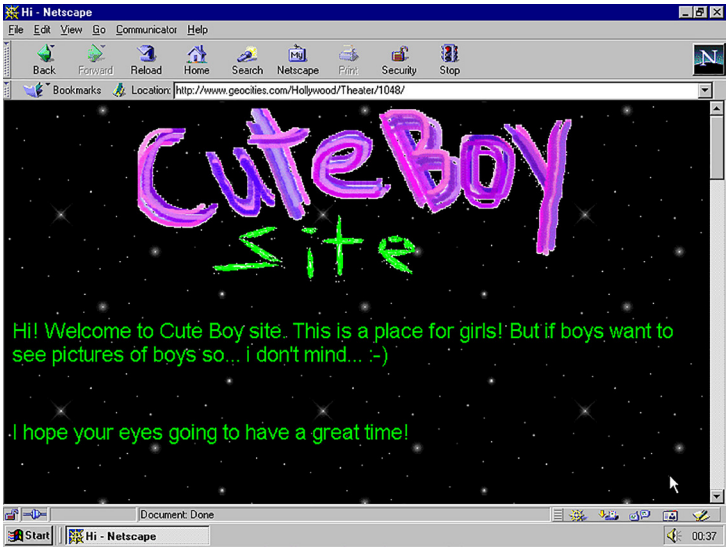

Fig. 1: Screenshot of a user-made website uploaded to the One Terabyte of Kilobyte Age Tumblr blog.

5- The blog can be visited at https://*oneterabyteofkilobyteage*.tumblr.com/.

One interesting take on the linguistic resources applied by users can be perceived in Lialina and Espenschied's commentary on the well-known "under construction" sign that appeared frequently on websites that were not meant to be considered as fully and finally developed. This sign started being substituted by an "always under construction" sign, meaning that the website would always be in a developing stage, which did not mean that visitors should expect something totally different every time they dropped by (Lialina and Espenchied 2009, 20). This is more coherent with how the Internet works, since it is never "finished" or closed. The so-called beta state, which usually refers to a state of testing in digital interfaces, bears the same logic.

When researcher Annet Dekker talks about methods to preserve the memory of net.art processes, she explains that it is important to take into consideration a wide range of factors such as social interactions and the usage of multiple platforms. This makes it easier to facilitate a fair comprehension of online-based artworks, which in turn exist and act in intense and hypertextual dynamics. More specifically, she says that "most online cultures are detached from the notion of a discrete and autonomous object, since they are shaped and constructed by (non)human processes that together form a connected network of information with multiple access points" (Dekker 2019, 11).

This uttermost respect for users' activities, regardless of their repertoire, age, origin, gender, or race is a key factor in understanding how open-source culture can be applied as a form of collective construction of knowledge. Below, I will point out to what extent the time and respect that Olia Lialina talks about plays a fundamental role in the criticism and malleability of sociotechnical networks in digital culture and net.art.

Low-tech as a linguistic resource in Latin American net.art

Latin American net.art from the late 1990s was deeply influenced by personal websites such as those discussed in the previous example. Most artists in this context had little to no interest in making art that looked like the websites of big Internet companies.

Instead, they had a taste for a DIY approach, as can be seen in *Epithelia* by Argentinian artist Mariela Yeregui and several others.[6] Artist and researcher Gustavo Romano points out that this style of digital art is very similar to an amateur and unpretentious form of communication: fanzines. In his essay "Madonna, Water Maps and Botanical Gardens," written for Brian Mackern's *NetArt Latino Database*, he talks about the neologism *fanzinisation* as something "based on the work of Iñaki Larrimbe" and corresponding to "the act of dismantling an object, situation or system, putting a new ideological twist on it and reassembling it with the resources at your disposal and with the help of your friends" (2008, 15).

An important aspect of fanzines is that the mediation between authors and readers happens in a very informal atmosphere, leaving little to no space for hierarchic systems based on academic background, territorial status, or other social markers. Also, fanzines are very diverse or heterogeneous since there are no restrictions or requirements to their content. The only prerequisite is the willingness to express something. My quick take on Latin American net.art in this part of the paper comments on a set of artworks in a similar way to Ian Milligan's perspective on how to study GeoCities personal websites, and that is to regard them as a vibrant, unconnected assemblage (2017, 138).

Researcher Lila Pagola states that commercial Internet was definitely not a synonym for home Internet in Latin America in the first part of the 1990s. Most people accessed the Internet from university labs or expensive cybercafes. This possibly explains why a number of artists in Brian Mackern's *NetArt Latino Database* have an academic background, such as Mariela Yeregui, Giselle Beiguelman, Lucia Leão, Diana Domingues, and Marcus Bastos. Brian Mackern himself is an Uruguayan artist working with digital and electronic art. He organized the NetArt Latino Database, which consists of several artworks from the late 1990s and early 2000s. For this database Mackern chose to map the works of different Latin American artists by arranging them in a way inspired

6- More information about the artwork can be found at https://anthology.rhizome.org/epithelia

by Joaquín Torres García's 1943 drawing *América Invertida*. The piece's title can be translated as "Inverted America" and works as a commentary on geopolitical tensions involving the Global South. Torres García was a firm believer of the artistic and cultural independence of Latin America, to the point of founding a School of the South, about which he states:

> I said School of the South; because, in reality, our North is the South. There should be no North for us except the polar opposite of our South. That is why we now turn the map upside-down, thus giving us a true notion of our position rather than seeing ourselves as the rest of the world wishes. From now on, the tip of America, stretching outward, insistently points to the South, our North. (Pagola 2008, 32)[7]

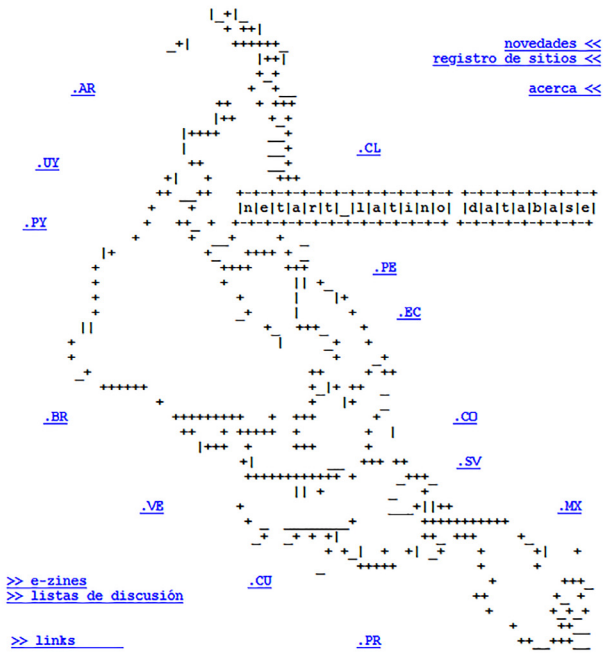

Fig. 2: Screenshot of the Net Art Latino Database website. The image fea- tures Brian Mackern's reinterpretation of Joaquín Torres García's drawing In- verted America.

7- The excerpt here is a translation by Lila Pagola. The full text by Joaquín Torres García, in Spanish, can be accessed at http://www.artemercosur.org.uy/artistas/torres/sur.html

Mackern's criticism of the Global North is a statement about the very foundations of digital art, which should be regarded with skepticism. For instance, he believes that the use of low-tech aesthetics in the Global South is very different from European and North American low-tech. In the case of the former, this sort of strategy is a way of overcoming a dramatic lack of resources, while for the North American and European contexts, it has to do with the saturation of information and resources (Pagola 2008, 39). I believe this is a powerful linguistic resource applied by artists in net.art: not caring if an artwork resembles the work of a common Internet user. It has nothing to do with being amateur or professional, since the level of experience, technical knowledge or available material resources does not really matter. What is really important here is to create speech acts that will somehow, by their very existence, criticize the distinction between specialists and non-specialists, or even those with plenty of material resources and others who have to creatively overcome their lack of resources.

When I talk about a speech act, I take into consideration J. L. Austin's definition of the "perfomative sentence" (1975, 61). The author suggests that discourse often shapes the world through its potential to behave as action. In other words, discourse not only describes things but it also actually shapes them by engaging their meanings and cultural contexts in material processes. I therefore consider the activity of users in GeoCities as a source of inspiration for a critical positioning by Latin American net.artists, who regard the construction of collective knowledge as a non-hierarchic, vibrant, and unpretentious process of creating new ways of self-expression.

Preferences, passion, and consensual hallucination

In his book *Cyberculture*, Pierre Lévy proposes that the idea of cyberculture specifies the set of techniques, practices, attitudes, ways of thinking, and values developed with the growth of cyberspace. The author defines cyberspace as the space of communication opened by the global interconnection and memory of computers. Nowadays, it is more challenging to find the boundary

between digital and analog realms, since this global interconnection involves much more than only computers. *Cyberspace* does not seem to be the best term to talk about the ubiquitous way with which digital information circulates, as Ivan Satuf points out in discussing the metaphor of the *cloud* in cyberculture studies (2016, 203). When we think about the term *cloud*, it is interesting to regard subjective and cultural aspects of the pre-Web 2.0 Internet, like GeoCities' neighborhood sensation and the geopolitics of digital technology as pointed out by Brian Mackern.

It is common to think about cyberspace as virtual reality, a space one connects to through multiple devices wired to the body, like the digital cowboy Case, lead character in the 1984 cyberpunk novel *Neuromancer* by William Gibson. In this parallel world, people act in ways completely different from reality, with bodies and abilities that cannot be recognized in the physical realm. They act according to a sort of "consensual hallucination" (Gibson 1984, 51).[8] The apocryphal promise of digital technologies would be to temporarily disconnect people from the world as it is, creating alternatives as multiple digital paradises where it is not necessary to worry about beauty patterns, money, and so on, in an eternal canceling of problems and material discomfort. In *Neuromancer*, as well as Ernest Cline's *Ready Player One* (2011) and many other science fiction novels, the most precious possession is language: subliminal messages, lines of code, easter eggs, and secret floppy discs and algorithms with the power to create or destroy worlds. The cyberspace in *Ready Player One* is a parallel world called Oasis, where everyone looks like the kind of information and culture they prefer to consume. In this novel, the more a user knows about subjects like media and pop culture, the more power they have in Oasis, their cyberspace. The creator of Oasis actually resembles a typical GeoCities user: a geeky fan of pop culture, rock music, video games, and sci-fi movies.

8- "Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts . . . A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the non space of the mind, clusters and constellations of data. Like city lights, receding . . ."

I would like to bring up another significant concept by Pierre Lévy that may have gone through some changes: collective intelligence. In an interview on a Brazilian television show in 2001, Lévy said he believed that social interaction is the basis of the collective construction of knowledge throughout the web. The rising umber of virtual communities with a high diversity of themes especially caught his attention. Having them in mind, he believed that sociability would increasingly depend on social connections that are not based on territory, but that are to do with processes of collective intelligence, of knowledge exchange and collective imagination. Everyone would be able to participate in these virtual communities according to their preferences, passions, and interests.[9] Lévy may have been too optimistic about the absence of geographical barriers, since they influence not only how physically close we are to each other but also how distant we are when it comes to material and social conditions. Nevertheless, Lévy was right to say that passion and interest may be more accountable than expertise when it comes to the collective construction of knowledge. Furthermore, I believe there is no separation from what was once called cyberspace to contemporary public spaces. Both of these notions are affected by epistemic tensions regarding what is considered intelligent, collective, political, and creative. I will elaborate on this in the following discussion of the artwork *Floodnet*.

Floodnet, collective performance and digital civil disobedience

> Unlike a number of other performance artists who have explored the relation of the body to technology through the literal encounter of individual physical bodies to machines—Orlan's livecast surgeries; Stelarc's cybernetic experiments—EDT, in turn, has placed the very notion of "embodiment" under rigorous question, and sought to understand the specific possibilities for constituting presence in digital space that is both collective and politicized. (Dominguez 2003, 131)

9- The interview is available in French, with Portuguese subtitles, here: https://www.youtube.com/watch?v=-FeTywlM47s&t=58s

EDT 1.0 (Electronic Disturbance Theater) was initially made up of Ricardo Dominguez, Stefen Wray, Carmin Karasic, and Brett Stalbaum. One of the motivations for its creation was an attack in December 1997 that caused the deaths of 45 indigenous people, including pregnant women and children, in the Mexican state of Chiapas. The episode became known as the Acteal massacre. The victims had been members of an organization called Las Abejas (The Bees), which was supportive of the Zapatista National Liberation Army. They were attacked by a group of paramilitary gunmen trained by the Mexican army.

Then Mexican president Ernesto Zedillo publicly condemned the attacks and denied any connection to the crime but, as journalist Colin Lecher relates in a piece about EDT's work, witnesses stated that the shooters had sympathy for the president's political party.[10]

In order to criticize and shed light on the Mexican government's complicity in the killing, as well as the silence of the global community, EDT created the performance act *Floodnet*, which consists of a so-called DdoS (Distributed Denial of Service) attack.

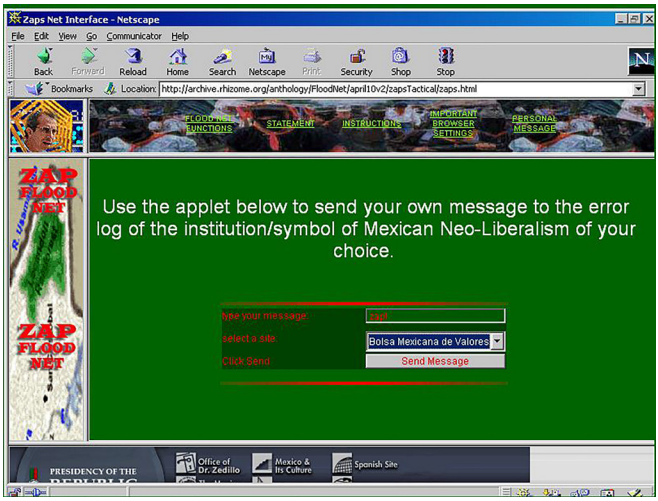

Fig. 3: Interface of the Floodnet application as it was in 1998. Image taken from Rhy- zome.org's Net Art Anthology.

10- The Mexican government took responsibility for its participation in the Acteal massacre 23 years later. More information about this can be found at: https://mexiconewsdaily.com/news/government-apologizes-for-its-role-in-acteal-massacre/

Floodnet was performed by the group on nine occasions between April and December 1998.[11] Strategic websites, like that of the Mexican government and the country's stock exchange, were chosen and then attacked via DdoS. By requesting responses from web pages every few seconds in an automatic way, the JavaScript application overloaded servers. This disturbed navigation significantly, posing questions and inciting curiosity about matters specific to the targets and the network they formed.

To make *Floodnet* happen, EDT convened artists and activists to participate through ordinary computers connected to the Internet on a determined day and time. Artist and programmer Carmin Karasic designed the interface in the most intuitive and user-friendly way possible, making sure that thousands of people felt capable of participating in the action. One of those features was the possibility to customize error messages, causing browsers to return error log phrases such as: "human rights were not found on this server."

The group presented the artwork at the 1998 edition of the art and technology festival Ars Eletronica, which takes place annually in Linz, Austria. The targets, on this occasion, were the websites of the Mexican presidency, the Frankfurt Stock Exchange, and the Department of Defense of the USA. The initiative was called SWAR (Stop the War in Mexico). There were participants from Italy, Japan, Malaysia, among various other countries, and there were also identified interactions from computers in education and military institutions in the USA. A few hours after it had started, SWAR was interrupted by an application made by the Pentagon that Brett Stalbaum called a "hostile-applet."

In 2001, activist groups from Germany utilized a version of the tool developed by EDT in a protest called Deportation Class, as is detailed by researcher Richie Bartels (2015, 27). The organizations Kein Mensch ist Illegal and Libertad! protested against the use of airplanes belonging to the airline Lufthansa by the German government to deport immigrants. They managed to engage around 13,000 participants and eventually got the airline to stop making seats available for deportation.

11- These details were obtained from Carmin Karasic's website: http://carminka.net.

The objective of the protest was to effect the sales of Lufthansa's tickets over the Internet and call attention to the xenophobic policy in question. There were also protests organized in the headquarters of the airline, in stockholder meetings, and press conferences. Since the DdoS attack was announced by the activists in advance, Lufthansa could prepare, providing extra servers for their website,and making sure that they would have relatively functional traffic during the virtual protests. However, the repercussions of the case in the media were enough for the protests to be considered successful. Another interesting effect of this initiative was the acquittal of the activist Andreas-Thomas Vogel, who faced the accusation of leading the protest. Initially sentenced to 90 days in prison, Vogel was declared innocent by German courts, who considered the online protest a legitimate form of political expression.

In his master's thesis "The Virtual Sit-in," Richie Bartels discusses the genealogy of civil disobedience in the light of digital technology. He sees sit-ins as forms of nonviolent protests. This particular term evokes the idea of resistance without violence, by sitting in a given space, occupying it. Also, it relates to the idea of a blockade, in other words, to block the access to physical places like buildings or offices. The author describes civil disobedience with reference to three main characteristics. The first is that it has to be public, since civil disobedience acts cannot be secret operations. Besides that, it is expected that such acts require attention and adherence from passers-by, or should at least invite them to start conversations about the subjects the protest is dealing with. The second principle concerns non-violence, meaning that the protest must be peaceful from a mainstream perspective. Activists who practice civil disobedience do not necessarily oppose the constitution, but actually want to change it, even if they have to accept its punishment as a form of showing resistance. As an example, we could think of Martin Luther King Jr. accepting prison as a form of political resistance and production of meaning. Third, it is necessary that acts of civil disobedience be justifiable and conscious, never serving futile interests. The fact that acts of civil disobedience are oppositions to the law inside the law demands a certain moral legitimacy to be announced and practiced.

Floodnet obtained great results, not only as an artwork but also as a speech act that functioned in a "happy" or smooth way (Austin 1975, 14). That is, it succeeded in engaging tens of thousands of people that did not have to be technical experts in order to create a new form of self-expression and protest. It affected a significant number of people and groups online and was even influential for other political purposes beyond its initial intention—from criticizing the way indigenous people were treated in Mexico to how immigrants were treated in Germany. In other words, it had satisfying material effects in comparison to what EDT had in mind in its original conception.

Conclusion

Net.art can create speech acts that affect culture, so it is fair we regard it as an important actor in the networks of science and technology. Its mediation potential, or as Bruno Latour puts it, its capability to transform technical processes while engaging them as platforms, is a useful tool for collective work. Nevertheless, one of its most important features is its ability to engage all sorts of people in its processes, from specialists in art and technical skills to the general public. Through the examples used in the paper it is possible to see how common user experiences can be sources of knowledge and inspiration even for seasoned artists such as Olia Lialina, Dragan Espenschied, Gustavo Romano, and Brian Mackern.

Collective knowledge does not necessarily have to do with a massive attempt to create specialists in technical skills. It rather has an affective dimension that has to do with passion, interest, and the formation of groups.

One of the major contributions of art to reflections on technology is the idea of collectivity as a form of digital corporality or presence. EDT, in this matter, showed a viable way of artistically working the collective and logarithmic body instead of updating conceptions of modern art and technology without questioning outdated matters of vanguardism and heroism. The transformation of Floodnet from artwork to activism is a remarkable example of the performative effects of discourse and acts of speech.

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Daily affirmations

Tiago Ive Rubini

This is an experimental take on the creation of infinite spoof social media posts. The artwork entitled *Daily Affirmations* produces endless meanings within a specific format which has gained a lot of visibility in recent years: textual Instagram posts.
The piece uses a few elements from the p5js JavaScript library. I began by choosing a textual resource that was very common. It ended up resembling the structure: hypothesis-antithesis-thesis. Although *Daily Affirmations* consists of very simple and to-the-point texts, it does have the quality of making you reflect, even if the ideas are random.
I took inspiration from humorous Instagram accounts with a lot of textual content such as @reductress and @afffirmations.[1] These accounts make fun of the fact that complex problems can hardly be solved with a few posts or words. I find this a very interesting way of thinking about how user-made content can be meaningful in a collective sense and sort of lonesome when it comes to individual expression.

1- https://www.instagram.com/reductress/?hl=en and https://www.instagram.com/afffirmations/?hl=en.

Fig. 1,2: Examples of spoof social media posts produced by browser-based artwork.

This piece was initially intended to be part of an online event called NaNoGenMo, or National Novel Generation Month, in November 2021.[2] This was a community-based activity, where users would upload codes that generated novels of 50,000 words. I came up with the browser-based p5js code and adapted it to work with Processing to make an application that would generate a PDF book with more than 600 pages, with 6 posts each.
For the browser-based version I used short lists of words, or strings, with names of characters, places, verbs and objects chosen arbitrarily. For instance:

var subjekt1= [“Maria”, “Laetitia”, “Anna-Varney”, “Oswald”, “He”, “She”, “It”, “The mayor”, “The president”, “A gentleman”, “A lady”, “London”, “Pasadena”]

var verb = [“destroys”, “brings”, “fabricates”, “analyses”, “criticizes”, “likes”, “reads”, “breaks down”, “prints”, “thinks about”];

var objekt= [“bagels”, “trips”, “autos”, “other people”, “others”, “grownups”, “workers”, “artists”, “authors”, “students”];

var modalVerbs = [“Does”, “Did”, “Doesn’t”, “Didn’t”, “Should”, “Must”, “Could”, “Couldn’t”, “Might”, “Won’t”, “Will”, “Would”, “Wouldn’t”];

Each post has an icon that serves as a spoof illustration. In

2- https://github.com/NaNoGenMo

order to make the icons, I chose a free font that consists of simple images with ornament-like features, so that the posts seem more inspirational. I made strings with the letters from the occidental alphabet to randomize them and used their value for the code.
The browser-based version of *Daily Affirmations* can be found at https://editor.p5js.org/iverubini/full/seAX5ibyX . New posts are generated each time the page is updated or refreshed. The code is available at https://editor.p5js.org/iverubini/sketches/seAX5ibyX .
The version discussed so far is a prototype for the Processing-based version of the code. For this second version, I used names from sci-fi novels connected to the act of being surveilled (*1984*, by George Orwell), the contradictory enjoyment of being surveilled (*Brave New World*, by Aldous Huxley) and comedic, unpretentious takes on sci-fi and technology such as the movie *Rocky Horror Picture Show*. These included: Winston, O'Brien, Big Brother, Mr. Charrington, Syme, Parsons, Goldstein, John, Bernard, Helmholtz, Lenina, Mustapha, Fanny, Henry, Linda, The Warden, Riff Raff, Columbia, Frank, Magenta, Rocky, Brad, Janet, etc.
For the Processing version I worked with txt files more than word strings, so I could use word banks to make more diverse posts. I also added hashtags to the posts, making their meanings sound more random. The font I chose for the icons resemble the more childish side of Instagram use.

Fig. 3: Example of the final appearance of the *Daily Affirmations* posts.

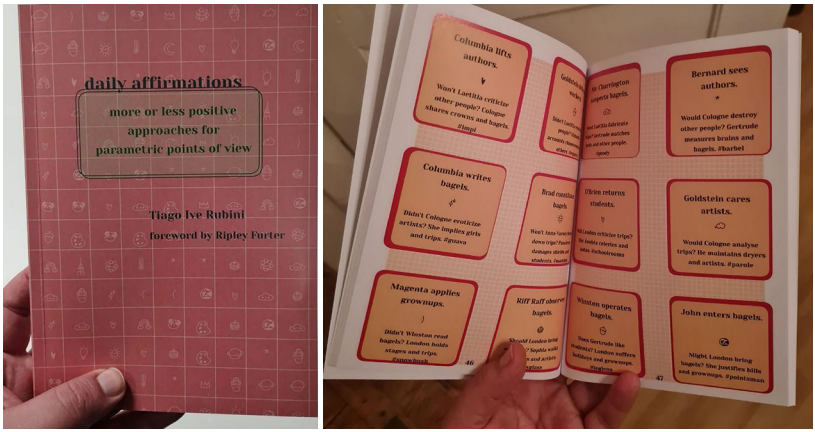

Fig. 4,5: Photos of the printed version of *Daily Affirmations*.

This version of the code was printed in A5 format and exhibited at the KHM Rundgang in February 2022. The book does not feature all of the pages initially generated, but does contain the code used. This, alongside a brief discussion of how it works, is available at https://github.com/NaNoGenMo/2021/issues/56.

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Spore drive

The function of fiction

Karin Lingnau

Abstract
Based on the book *Mycelium Running* by mycologist Paul Stamets, the TV series *Star Trek: Discovery* (subsequently abbreviated to *Discovery*) extrapolates scientific facts about mycelium networks into the fictional setting of an intergalactic organic transportation technology, the spore drive. This example serves as a starting point to examine the intersections between science, fiction, and the implications for scientific and artistic processes in society. The approach offers a perspective on how fictional aspects, as extrapolations of scientific knowledge, can retroactively influence the treatment of these processes and related future proposals or realizations by science, art, and society in general. With the spore drive, an example from science fiction literature that lies beyond real implementation is deliberately chosen. This makes it clear that the interplay between science fiction and advanced technology is not limited to technical issues.
Subsequently, the text comments on related societal discourses such as the consideration of ecosystems in the light of climate change and the issues of exploitation and destruction through the prioritization of the current economical model of technologies. Due to the human impact on our ecosystem, it also seems logical to consider alternative perspectives on the relationship between humanity and what we have come to call nature, humans and other

species, and a conceivable symbiosis of some kind in the future. Movement and transportation by means of advanced technology as core themes of science fiction are inherently linked to the topos of exploration. In this context, the spore drive as a technology also functions as a metaphor for a human motivation to explore and encounter the unknown.

The text also considers research on organisms as energetic forces and how—in and through a fictional setting—their materiality can be referred to as "fictional material." Fictional material as a premise (a topic for further research) could be conceptualized as a potential conveyor for alternative patterns of thought (and subsequently behavior). This potentiality is shaped in science fiction universes such as Star Trek, linking it to ideas about actual change and real-world applications. The question of changing patterns of thought and behavior in the context of biotechnologies and an ecologically conscious society also implies thinking about a paradigm shift in dealing with our own planet.

Introduction

> My preference is to understand science fiction as a cultural form that offers an "everyday" language for thinking about and responding to daily life in the twenty-first century. Its engagement with science and with the motifs of sociotechnical culture–interplanetary travel, digitized experience and communications, genomic modification, artificial intelligence (AI), and more–is metaphorical, whether the worlds it posits might actually happen or not. (Vint 2021, 6)

I would add to Sherryl Vint's understanding of science fiction as a tool, that the aspect of thinking about daily life in the twenty-first century also entails thinking further and preferably—through critical reflection—creating a new and alternative pattern of behavior. I would like to examine how this view on science fiction as a metaphor enables us to deal with our "sociotechnical culture" and scientific research. As she further describes, "the genre asks questions about the impact of science and technology on human experience, values and ways of living, and even when it explores these issues through scenarios that science tells us are impossible, the genre uses such symbols to comment upon otherwise unnoticed aspects of our ordinary world" (6). This includes different ways in which science fiction was described in the last century, on the one hand as a genre for scientific extrapolations, on the other as being interested in social and political critique. In my view, these two sides are not mutually exclusive, even if they continue to polarize the discussion on science fiction in general (7 ff). For this text, the distinction is not relevant as such, as I think the role of scientific extrapolation and societal critique in science fiction are inextricably intertwined. As Umberto Eco defines it:

> Science fiction as an autonomous genre exists when the counterfactual speculation about a structurally possible world takes place by already extrapolating the possibility of the future world from certain tendencies of the real world. Or, in other words, science fiction always takes the form of anticipation, and anticipation always takes the form of a conjecture formulated on the basis of real tendencies of the real world. (1990, 218; translated by the author)

In *Discovery*, the conjecture of a networked organic structure of galactic proportions (see Fig. 1) can be treated not only as a proposal for an actual development of a new technology but as a metaphor for ideas about movement and space travel, incorporating organic matter and systems into future technologies and their consequences for contemporary technological and societal processes.

Fig. 1: View from the bridge of the starship *Discovery* into the mycelium network, Discovery 1.13.

To examine science fiction's function as a discursive tool, I have chosen the *Discovery* spore drive as a metaphor for movement and a concept of transport that is sustained as a means of exploration. Set in the Star Trek universe and oriented to its positivist belief in progress, interstellar transportation—illustrated in the form of the warp drive, which I will describe later—can be seen as a metaphor for formulating a technologically oriented motivation. The spore drive surpasses it. It constitutes an illustration of a detailed formulated approach to alternative forms of transportation, which is also scientifically consistent to a certain point. It firstly embeds a discourse of its own, that of the link between technology, ecology, and humankind, formulated in the incorporation of organic matter into a system of transportation. Secondly, the narrative in *Discovery* presents an example of the entanglement of factual and imaginary science, embedded in contemporary societal discourses, and connected to scientific as well as artistic imagery and research projects. This entanglement can retroactively impact

developments and concepts that help shape, affect, and trigger notions of the "future." Expanding on Sherryl Vint's arguments, the influence of science on science fiction is, in my opinion, not one directional but occasionally reciprocal and mutual. In his recent book *Niegeschichte*, Dietmar Dath seems to support this view, remarking on the exact sciences that their "interest in the probable, in the possible, in the conditional" is—not only since the introduction of electronic data processing—integrated into a variety of exact disciplines (2020, 28). Dath even considers the combination of science and fiction a hendiadys and a starting point for understanding fiction as a form of science, as a machine that produces cognition and aesthetics (25ff).

The fictional technology

> First Officer Saru: Questions or concerns before we depart, captain?
>
> Captain Christopher Pike: If you're telling me that this ship can skip across the universe on a highway made of mushrooms, I kinda have to go on faith.
>
> (*Discovery*, 2.2., 7:30-8:20)

Set in the Star Trek universe, *Discovery* is one of the latest series in the Star Trek franchise.[1] It is situated in the twenty-third century, i.e. about a decade before the events in *Star Trek: The Original Series*. One main dramaturgical feature, mainly in the first season of the series, is an alternative transportation (or propulsion) system based on organic components and its functionalities. This idea of a technology is met with a certain irony, as the dialogue between two characters in the paragraph above shows. As the series advances, the uninhibited and unlimited progressive use of this technology is intrinsically discussed as

1- Star Trek is a US American science fiction franchise that includes numerous formats. The series dates back to the 1960s and was created by Gene Roddenberry. His hope was that "[by creating] a new world with new rules, I could make statements about sex, religion, Vietnam, politics, and intercontinental missiles" (Grothe 2009). The basic attitude of the protagonists of the series is one of altruism, humanitarian (also relating to other beings) action and peacekeeping. This is allegorically treated and tested in various conflict situations and political dilemmas. Under utopian aspects, Star Trek can be classified as a fundamentally positivist-oriented cosmos.

an ethically and environmentally problematic issue and implicitly becomes a point of criticism beyond the series narrative.[2] Starting from the exploration and cultivation of a specific species of fungal spores—the fictional species *Prototaxites Stellaviatori*—on the starship USS *Discovery*, the plot includes the development of this alternative transportation technology under enforced wartime conditions. The species *Prototaxites* is used as an underlying element to enable a vehicle (starship) to perform subspace jumps of up to 90 light years in 1.3 seconds. The spores of fungi as the unicellular basis of an entire meshwork serve to propagate and form hyphae, as known from their terrestrial counterpart.

The spore drive as an organic propulsion system connected to a mycelial reactor makes use of the extended structures of filaments within the mycelium network.[3] The network based on one species requires a symbiotic relationship with another species, tardigrades (Vargha, Otvös, and Tuba 2020),[4] as a navigator to enable the energy residing in the filaments for a jump from point A to point B. The starting point to consider this connection is the aforementioned species *Prototaxites Stellaviatori*.[5] They consist of exotic matter not occurring in normal space but in a discrete subspace region.[6]

2- Discussed e.g. in episode *Discovery* 1.12 and 1.13, in the setting of a mirrorverse.

3- The complete denomination is "an alternate form of faster-than-light travel called *displacement activated spore hub drive*, though no one actually calls it that" (*Discovery* 3.3, 37ff).

4- Research branches are also discussing the extent to which water bears (tardigrades) are sensitive to pollutants and whether they could be used as bio-indicators. Tardigrades and their specific characteristics are explained in detail later as additional components functioning within the fictional mycelial network.

5- This detail, as well as the following descriptions in this chapter, are extracted from scenes in the series, mainly season 1. The prototaxites are referred to as species in *Discovery* 1.5, from minute 20.

6- A few of the details show conceptual errors or a lack of a rigorous execution of the premise: The species is intradiegetically understood as consisting of exotic matter. This designation is not consistent with the scientific definition of the term: Exotic matter denotes a hypothetical form of matter which has a negative energy density. Ordinary matter consists of baryons, subatomic particles such as protons, and neurons. For the topic at hand, the designation of exotic matter for a species is interesting in that an organism, i.e., a living being, is not made of subatomic particles. The solution offered here is the narrative displacement of the organism into a subspace in which it can exist and feed (Darling 2016).

The roots of this interstellar fungal species, the mycelium, span the entire universe, extending to infinity to form a matrix sustaining an intergalactic transportation relay system for the spore drive. The tardigrade, as a mutant species related to the terrestrially known microscopic water bear, possesses a genetic makeup that enables navigation through this mycelium network. Similar to the terrestrial species, it can incorporate foreign DNA, in this case the spores of the prototaxites, which is described as a horizontal gene transfer of the genome. This connection on the genetic level allows the tardigrade to access the network and all its nodes and navigate it using a mental trigger. The DNA of the animal, enriched with the spores, can access the interconnectedness of the filaments of the galactic network on a mental and genetic level, which as a process can also be defined as a symbiotic relationship.

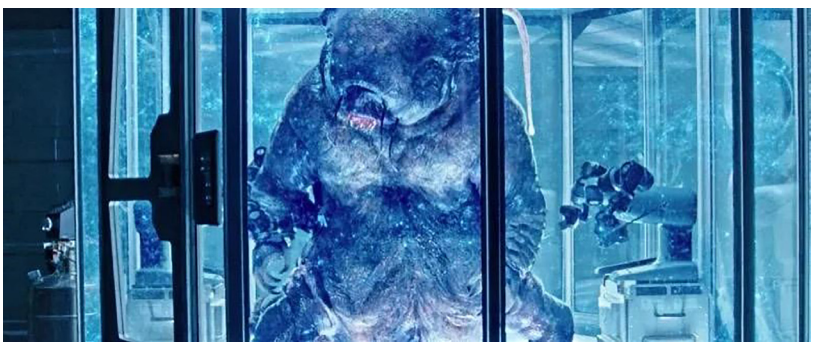

Fig. 2: A tardigrade inside the reaction cube, Discovery 1.4.

To launch the spore drive, the animal itself is instructed visually via a star map with navigation information and coordinated messaging (*Discovery* 1.4, 38:30).[7] The tardigrade, strapped into a navigational unit called reaction cube (see Fig. 2), functions as an interface to control the de- and re-materialization process, transporting the entire starship including its crew. As an interface, the tardigrade translates coordinates of stellar cartography and initiates the jump sequence and navigation through the network. As the story develops, the symbiotic connection between tardigrade and mycelia as

7- This is not explained explicitly, but implied by showing a galaxy star map, vaguely mentioned as orientation for the tardigrade.

well as the artificial connection to the ship causes the tardigrade to experience nutrient losses and triggers a resting state of its body, also called cryobiotical retreat, comparable to what its terrestrial counterpart can experience in times of deficiencies.

This form of interface is more a technical linkage than a fusion. The translation of (navigational) information between two elements (tardigrade and mycelium) is based on a link on an organic plane, a communication without technical interference. The third element (the reaction cube including corresponding devices) is implemented as a technically produced artifact. Whereas the organic (natural) symbiosis between animal, fungus, and network generates mutual benefits for each other, the use of technical means and interfaces like intruding needles and contraptions (as artificially created links consisting of metal and glass), leads to the exploitation and physical harm of the involved organic "interface," i.e. the tardigrade. As a consequence a human character, Lieutenant Commander (and astromycologist) Paul Stamets, decides to become the next interface (see Fig. 3), with mild suggestions of an ethical decision. Infused with tardigrade DNA, he becomes capable of processing the spores of the mycelium and therefore can connect himself with the network as a whole to coordinate the intergalactic jumps inside the mycelium network.

Fig. 3: Lieutnant Commander Stamets, connected to the spore drive as interface. Discovery 1.8

Looking at the fictional technology in its entirety, an organic foundation inside a cosmos described mainly in engineering terms presents an uncommon idea of a species, incorporated into a technological process and machinery. Deployed in this contrasting way, contemporary discussions of ethics in regard to the (ab)use of living beings for the sake and profit of other beings (i.e. humans) implicitly become part of the story and its reception. But it also indicates that, in the face of the introduction and (possible) prudent use of this organic propulsion system, a harmonization of technology and ecology is no longer contradictory. With this representation of a spore drive, the series embeds itself into contemporary societal discourses.

The Star Trek franchise has always been characterized by a positive belief in technological progress and the notion that the improvement of humankind and society is possible through technology. In trying to reconcile the dichotomy of technology and ecology and by combining the mechanistic with the organic, *Discovery* updates this belief system to mirror recent discourses. The depiction of a parallel dimension, a mirrorverse, in which a ruthless, egocentric, and ultimately destructive model of society with clichéd imperialistic and capitalist structures prevails, serves as a reinforcing contrast. It provides an example of the interdependency of science fiction topics and ongoing sociopolitical movements and structures. The generally positive utopian ideas of the original series (originating in the 1960s) and its creator Gene Roddenberry persist in this series but adopt insights and motives of the twenty-first century, which in turn make its plot and narrative contemporary. Looking at further aspects, the drive as a dramaturgical element can link the narrative to other frequently discussed topics such as parallel dimensions (the mirrorverse), astrophysical phenomena (the galaxy-encompassing network), and "the other" (tardigrades and mycelial spores) in society, to mention a few.

The mycelial network as a construction is chosen as the defining feature of the premise in *Discovery*, which connects a fictional idea to actual scientific research and opens a new approach to speculation regarding locomotion in space. This premise, as a logical assumption inside the narrative built on the mycelium network, enables the

establishment of a galaxy that is organically and energetically connected and in which transport is possible through an underlying material structure.
This poses a question on the nature of the structure: If this material structure can be considered a self-contained and self-sustaining (eco)system, can the spore drive, as an external element, be regarded as interacting symbiotically? And do they interact in such a way that all elements can benefit mutually? Or is the drive (just) a closed technology using either the tardigrade or the human with its navigational abilities as interfaces linked within the network? The mycelial part would then be the underlying infrastructure and the technology rather parasitically tied to the symbiotic connection of species/human and the mycelium network.

Correspondences between fiction in *Discovery* and science

How profoundly the creators of *Discovery* were inspired by Paul Stamets' publication *Mycelium Running* is evident: a main character is named after the author, astromycology is introduced as a future discipline,[8] and the terrestrial mycelium network is compared to a galactic structure in the description of mycelia and its symbiotic characteristics.
Mycology as a research field is a current topic relevant to several disciplines ranging from architecture to design, engineering, urban planning, the arts, and also new research areas such as space colonization and "unconventional computing." These disciplines of designing, planning, and building are in themselves entangled in and correspond to the exploration of the potentials of mycelia as a modular organism and systemic structure. The current (2021) cooperation between NASA and Paul Stamets aims to explore the effects of conditions in space on traveling to and colonizing other planets, specifically how mycelia and its properties can be used as a building material and a nutrient, as a fast-growing versatile resource able to survive and enable survival in space. The fields of

8- In the course of writing this text, the anticipation of mycology as a future discipline became more concrete: NASA employed Paul Stamets as a consultant in soil experiments for creating space habitats with fungi in 2021 (Hall 2021; Stamets 2021).

unconventional computing and smart material research explore the potentials of using mycelium-electronic composites:

> Mycelium networks will be computationally active, giving rise to entirely new biologically founded functionalities for architectural artefacts and materials, such as self-regulation, adaptation, decision making, autonomous growth, searching and self-repair—adding new advantages and value to architectural artefacts and the environment, and providing a radically alternative paradigm to the state-of-the-art in "intelligent buildings" which are heavily reliant upon technical infrastructures. (Adamatzky et al. 2019)

Particularly in view of this use of mycelium as a "structural substrate functionalised with nanoparticles and polymers" (Adamatzky et al. 2019), the treatment of fungal architecture is seen as a paradigm shift in the building industry and its material processes and infrastructure.

Fig. 4: Mycelium filaments on wood (photo by the author).

Scientific aspects of mycelia and its network

Mycelia are microorganisms, more precisely small cell organisms that can form a network via linkages and hyphae to form larger units (see Fig. 4). As a whole organism in itself, and as microorganisms, mycelia are beings with plant-like regenerative properties, which presents an interesting confluence between two taxonomies. Mycelia

are the vegetative section of a fungus, consisting of a network of fine, white filaments. The totality of all hyphae, the filamentous cells of a fungus, are called mycelium (Mykepro n.d.). In everyday language, fungi are defined as visible fruiting bodies found above ground. However, there is a hidden network in the soil or wood underneath, which can extend over several kilometers in its entirety and have an enormous life span. The discovery of an Armillaria species (honey mushroom) in northeast Oregon estimated to be about 2,400 years old is just one example (Ferguson et al. 2003).[9]

In *Mycelium Running*, Stamets describes a network organized from fungal mycelia as a wide-ranging organism, based on historical findings from the Devonian period:

> Prototaxites was the name given to this fossil—a remnant of a life form approximately 420 million years old, existing at the end of the late Silurian and through the beginning of the Devonian periods. Found in Canada and Saudi Arabia, this organism was widespread across the landscapes of the Paleozoic era. First described in 1859, this fossil remained a mystery until C. Kevin Boyce and others proved that it was a giant fungus in 2007. (2005, 6)[10]

The mycelia form a network as a main body of strands. As a structure, the mycelium network is described as a meshwork that has fine ramifications and cellular-sized connections. These nodes are structural design units and compactions of the organic material. The landscape of a mycelium network spans large distances on forest soil, slightly below the surface or within wood and other soil layers. The characteristic growth pattern of fungal mycocytes as an interlocking and internally corresponding network has a major influence on cellular processes that have ecological scale implications for growth behavior on a micrometer scale. The structure of a network has a direct impact on the distribution of resources within that network and in turn modifies the overall network architecture (Fricker et al. 2017). A distinction can be made between

9- Depending on the calculations of spread rates in this specific area, the age of the species can be estimated as being between 1,900 and 8,650 years, depending on climatic conditions, periodic disturbances etc.

10- The quote is from a caption under the illustration of a fossil.

mycorrhizal, parasitic, saprophytic, and endophytic fungi, which influences the form of interchange between organic matter in general and the connected mycelium. The basic organic structures of a mycelium network visually and structurally resemble synaptic and cosmic networking structures in their architectural build (Vazza and Feletti 2020),[11] which leads Stamets to depict the mycelium network structure as a neurological network of nature. He believes that the mycelium is operating on a level of complexity exceeding the computational powers of super computers and presents the idea of a mycelial archetype which encompasses interlacing patterns and structures similarly made visible in computer tomographies of the human brain and in computer models of dark matter in the universe (cf. e.g. Fig. 5, a cluster of neurons and Fig. 6, galactic structures in a simulation). The level of complexity refers to the metabolism inherent to the mycelia network as described in the following section (Stamets 2005, 2 and 7ff).

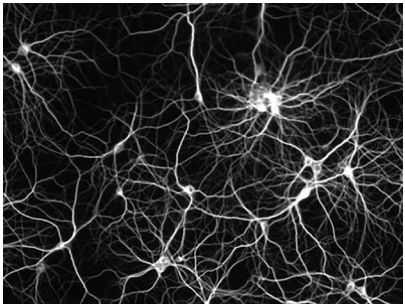

Fig. 5: Visible in this microscopic image is the structure of the dissociated culture of hippocampal neurons. (De Koninck)

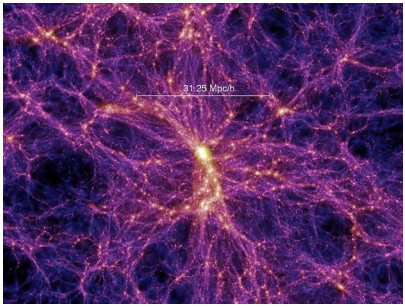

Fig. 6: Part of the Millenium Simulation Project (MPA), the image shows one example of the distribution of dark matter in the universe, highlighting the morphology of the structure. The projected density field in this case is a 15 Mpc/h thick slice of the redshift z=1.4 output.

The basic characteristic of mycelia, especially mycorrhiza, is the transfer and extraction of soil resources such as minerals and nutrients (e.g. sugar, organic nitrogen, phosphorus, iron etc) from the various nodes and hyphae to remote and other locations in the network

11- Vazza and Feletti compare the structures of the cosmos and the brain using a quantitative method.

and associated plants (Stamets 2005, 24ff; Mykepro n.d.), e.g. trees, as well as the fruiting bodies and the fungi visible to us. Although knowledge of biotechnological processes involving fungi has already been used throughout the centuries (Molitoris 1995), scientific research on fungal filaments and fundamental cellular processes started to be described explicitly by A.H.R. Buller in his 1909 book Researches on *Fungi*. In recent years and in the wake of climate change (Cerimi et al. 2019), the processes underlying the transport and distribution of resources and recycling of biomass have gained increased interest. For example, adapting organic systems to new technologies as principles which favor balanced ecosystems, in the consideration of fungi as resources for energy production, or with regard to the use of mycelial tangles as degradable and cultivable building materials in architectural projects or in space colonization (see Fig. 7).

Fig. 7: Growing shoes with mycelia on Mars, 2017 (Officina).

To use the principles of these cellular processes as a model could be a further step in developing forms of collectively functioning systems or codependent and "mycorrhizal" systems capable of reusing their own resources. Examples of research projects across different disciplines can be given as a possible outlook concerning current endeavors in the study of mycelia, living materials, and their effects on a wide variety of processes:

An experiment by Toshuyuki Nakagaki illustrates patterns of movement in mycelial structures: Within a labyrinth filled with nutrient agar, different nutrients (oat flakes) are placed at the entrance and exit and an acellular slime mold culture of *Physarum polycephalum* (a myxomycete) is injected into the mass. Observation shows consistent

distribution of the fungus in the direction of the exit. It chooses the shortest path. This property of the fungus has also been used or compared in relation to engineering issues such as the establishment of metro systems (e.g. in Tokyo) (Nakagaki, Yamada, and Tóth 2000). An article on fungi as nanoconductors in myco-computers involves the manipulation of mycelial cells (*Aspergillus niger*) to incorporate gold into its DNA to produce mycelial conductors of electrical potential (Gorman 2003). In NASA-supported research, a biological computer chip has been developed at the University of Tennessee that integrates bacteria that light up when pollutants are measured (Sayler 2004). Hans-Günther Döbereiner of the Institute of Biophysics at the University of Bremen studies slime molds from the perspective of unicellular organisms as highly complex systems. His approach is to understand intelligence as the ability to solve complex problems. At the institute, simple cognitive abilities are investigated in relation to changes in the widely ramified networks of the slime mold *Physarum polycephalum*, for example, by inferring moments of learning and memory from oscillations and changes of the slime mold network (Bernitt, Oettmeier, and Döbereiner 2010).

All of these examples show wide applications in current research projects and also some speculative aspects in experimenting with mycelia to develop new technologies. They also present a rich background for anticipating possible future applications and perhaps evoking new patterns of thought and consequently behavior. Another focus elaborated by Stamets in his introduction to *Mycelium Running* is the aspect of healing the planet using mycelial membranes (mycelia). It basically provides a mycological guide to saving ecosystems. In this context, I would like to point out that his book title may possibly allude to the 1972 science fiction film *Silent Running*, which, instead of depicting an ecotopia, presents an already extinct terrestrial ecosystem. Its narrative draws attention to the necessity of preserving the remnants onboard a spaceship under all circumstances. For me, this implies a further reference to the 1972 publication *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*

and an ecological awareness in this time (Meadows et al. 1972). Stamets, in turn, provides another option with *Mycelium Running*: to preserve and heal the terrestrial ecosystem by using its inherent resources. He introduces the term "mycorestoration," for example, which refers to the selective use of fungi for mycofiltration, mycoforestry, mycoremediation, and as mycopesticides. The term "mycoremediation" (as a technical term) describes a form of bioremediation of ecosystems using organisms. It involves the use of technologies based on specific organisms and their functionalities to decontaminate an environment. Stamets describes strategies and applications as well as the underlying techniques, which he himself cites as a pragmatic environmental philosophy. In addition, he introduces concepts that are subsequently used in the narrative of the series, e.g. astromycology. Introduced in his book in 2005 (9), it appeared in *Discovery* in 2016 and was incorporated by NASA in their collaboration with Stamets around 2021. This is one example of a terminological migration from science to fiction and back, which also demonstrates NASA's long tradition of incorporating science fiction terminology in their projects and statements.

Transportation systems

What is the significance of introducing a new transportation system in science fiction? The interdependency of scientific and fictional approaches to technological formulations is explicitly expressed in technologies of movement, especially as a synonym and initiation for exploration and discovery, which in turn is most insistently focused on in US history and its narratives. As core themes of science fiction, transportation and locomotion concepts are presented to recipients in a diverse array of engineered and living spaceships, wormholes and portals, capsules and time travel devices. Among these, the warp drive is probably one of the best known and most illustrative examples of the interplay between science and fiction. As a concept of transport technology, the warp drive was first established in John W. Campbell's *Island of Space* in 1957 and additionally introduced on a visual level within *Star Trek: The Original Series*.[12]

12- Production of *Star Trek: The Original Series* began in 1964 and it first aired in 1966.

One example of the connection between fiction and scientific theory can be found in the research area of FTL (faster than light). In 1994, the Mexican theoretical physicist Miguel Alcubierre, a self-proclaimed Star Trek enthusiast, published a paper in which he described a speculative method for stretching space-time fabric to allow FTL travel in space. His Alcubierre drive, also known as warp drive, exploits a loophole in Einstein's 1905 theory of special relativity, which describes the restrictions imposed by a relativistic universe, including the unbreakability of the speed of light. The idea behind the Alcubierre drive is to stretch the fabric of space-time in a wave, generating the contraction of a space ahead of an object and the expansion of the space behind it. This "warp bubble" (see Fig. 8) enables a spaceship to remain stationary within a bubble of space-time, while the bubble itself moves without violating the laws of relativity. This idea remains theoretical to date, as, among other difficulties, there is no known method for creating such a "relativistic" space field and, once created, no known method for leaving it. However, Alcubierre's proposal is still the subject of active research: A paper presented at a NASA conference in 2013 proposed an experiment to create a FTL warp field test under vacuum conditions (White 2011), while a 2021 article summarizes recent research on the topic including the use of ordinary matter as shell material for the space time bubble (Lentz 2021).

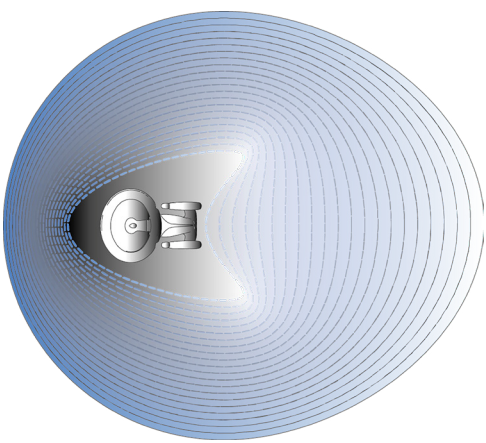

Fig. 8: "Warp bubble" with expanded space behind and contracted space in front of normal space (sketch by the author).

The question of how to make this kind of space travel possible was triggered by the proposition and depiction of a warp drive in *Star Trek: The Original Series*.[13] Transcending space and time to explore the galaxy and discover new habitats for humanity is one of the main themes of the series itself, but of course is also a matter of various scientific disciplines and related political agendas. Presenting this example is also a way of showing connections which are made by scientists—often on the basis of personal attachments—to the topic of science fiction and a constant feedback between theories and speculations of scientific background and fiction.

Returning to the example of mycelium: Although the depiction and setting of a spore drive might not lead to the development of such a space travel system or transportation technology,[14] it might serve as a point of discussion of inherent structural components in space(s) in general, which could lead to theories on how to attach or use these kinds of structures as a means for transportation (beyond the transport of nutrients or information already discussed). The exploration of this notion of an underlying system in the sense of a thought experiment could lead to a paradigm shift. This could include reflections on exploring ways of existing within a different ecosystem in which human exploration is not a destructive and exploitative move, exploring how to choose more symbiotic strategies to become part of a self-regulatory system inside a balanced eco-structure, and to question values of living and social conditions. To exemplify this in a more applied way could mean using construction material that grows, expands, decomposes again and is part of a system where the necessities of being, travel, and building are based on collaborative structures, e.g. deployed in refugee housing or as temporary urban shelters. As described above, the potential of mycelial structures are explored

13- In *Star Trek: The Original Series* the term *warp drive* described the technology to allow space travel at faster-than-light speeds (FTL). Warp engines were fueled by the reaction of matter (deuterium) and antimatter (antideuterium), mediated through an assembly of dilithium crystals, which were nonreactive with antimatter when subjected to high-frequency electromagnetic fields. Cf. "Warp Drive" n.d.

14- It is not necessarily a construct for future developments as in the case of the warp drive concept, which exploited a loophole in a physical theory. The spore drive is based on a terrestrial given, inflated to cosmic proportions and serving in a more systematic way.

in diverse disciplines. Science fiction itself carries these contemporary explorations and provides different contexts and settings. The inherent aspects of mycelium itself can be considered more as a material basis which is then refined in artifacts, prototypes, and systems in a diversity of disciplines. Therefore, for me, the diegetic material of mycelium inside a specific science fiction narrative is an example of a potentiality of a material, not of artifacts. Within this potential, moreover, lies the catalyst to actually use this kind of material and structure as a foundation for future implementations.

The concretization of the material and its structure as an elementary component in the formulation of certain concepts and their specific artifacts is also used in the discipline of design fiction. As Sherryl Vint explains, design fiction is a discipline which embraces science fiction techniques as a tool to stress the importance of imagination and play in the development of new products or new structures (2021, 16). Bruce Sterling, in turn, defines it with the following words: "Design Fiction is the deliberate use of diegetic prototypes to suspend disbelief about change" (Bosch 2012).[15]

Both Sterling's and Vint's perspectives present design fiction's approach and intent to create materialisations in the form of artifacts. Design fiction as a discipline uses materials as the basis for fictions that usually appear in "Dingform" and thus primarily creates artifacts that serve a specific scenario but can also be derived from material research and technologies. Promoted by Dunne and Raby as speculative fiction, the use of "fictional design" to suggest things can create new possibilities in aesthetics of technologies as well as in "social, cultural and ethical implications for science and technology research" (2013, 12). In the case of the spore drive, the material of the mycelium itself and its systematic structure is used as a basis for visualizing and formulating further speculations and additionally for introducing certain materialization potentials. The spore drive as a metaphor has the purpose of reflecting the present and making the future or a future imaginable

15- This parallels Samuel Taylor Coleridge's statement about the "willing suspension of disbelief" in poetic creation as an innovative art technique (Dath 2020, 67ff).

and conceivable. The actual artifact is neither built nor is it within reach. It remains a suggestive representation of a technology.
The following examples point to further correspondences between the fictional and the factual, which stress a material aspect and the incorporation of organic elements into design: The development of the first foldable mobile phone by Martin Cooper in 1973 was mainly inspired and sustained by the handheld wireless communication device, the "communicator," featured in *Star Trek: The Original Series* since 1966 (Jones 2005). It was followed by a much smaller model, even more similar to the device from Star Trek, the "Motorola StarTAC Wearable Cellular Telephone" in 1996 (Motorola). In recent years advances with OLED displays in material science have enabled the production (and not only the design study) of mobile phones with foldable displays (Flexenable),[16] which in turn resemble a polycarbonate phone screen from the novel *Count Zero* by William Gibson (1986). Another example related to organic matter is a recording device that incorporates a living protoplasm, Ampek F-a2 and its factual counterpart (Dick 1964), the neurochip created by Naweed Syed and colleagues, proving it is possible to cultivate a network of brain cells that reconnect on a silicon chip (Martinez et al. 2010). Each of these examples, as a selection of only a few that incorporate organic matter into their design concept and could be expanded by countless more, could be found in the fictional realm before being introduced to the real-world market. From the perspective of the sciences, especially materials science, one research goal would be to find out (and to prove) to what extent the potentials and variations of a materiality can already be found in fiction prior to engineering or design concepts.

Some remarks on fictional material

"Science fiction describes a way of thinking and perceiving, a toolbox of methods for conceptualizing, intervening in, and living through rapid and widespread sociotechnical change. (Vint 2021, 159)" In

16- Some of the latest examples are the Motorola Razr, 2020, Samsung Galaxy Z Fold 2 and the Huawei Mate Xs. OLED displays can also be mentioned as an example of the more common use of organic materials. Flexenable is one example of a company starting out in 2016 with a focus on using organic thin-film transistors for flexible displays.

this quote, Sherryl Vint connects a personal and societal potential for change through the medium of science fiction. Following this statement, one goal of this text is to demonstrate how fiction as a tool (or method), in this case a specific fictional technology, affects imaginations of a potential future and how we may act within it. The blending of current research topics with societally relevant issues and their placement in a fictional setting generates a basis for critically reflecting on our current societal status and discussing and exploring possibilities for a future society.

Based on actual science and suffused with its signs and specific language, the imagination of specific technological developments and ensuing new knowledge set the stage for a specific world, which also invites personal exploration not bound by a fictional narrative. In the case of the spore drive, imagining a symbiotic technology based on a natural phenomenon in which the human becomes a part and even an interface constitutes one possible avenue to be explored. However, this world is not one to be taken literally. It is rather a proposal to play with the ideas presented. The resulting scenarios include a number of questions about the consequences of biological, technological, and human convergences. What kind of intersections exist between differently structured systems and how can the user and the system interact in it? What interfaces are created or need to be created and what is the role of interfaces in a technology oriented towards symbiosis? Will humans become cyborgs or symbionts? And what about the others? What kind of practices become necessary? As Donna Haraway describes it, "these practices are the simultaneously fiercely material and irreducibly imaginary, world-destroying and world-building processes of technoscience" as well as "the practices which bind the global family together in a generative matrix" (2009, xii). These are just some of the ancillary questions arising in this context of convergences that would be pertinent to formulating new concepts. To be able to create a model of these scenarios in the form of world building,[17]

17- In the literary context, world building means the creation of a believable and founded construction and conception of the world on which the narrative is based. In the computer game context, it also means the visual and possibly auditory formation of foundations and internally consistent elements of the cosmos in which all actions and events take place and function.

to enable simulating and experiencing consequences therein, also enters into the broader discourse of shaping and making (in) the world. Fiction, and mainly science fiction, functions as an initiator and a motivator, not only to imagine but to use the experiences gained by playing with the fictional worlds in the actual world. For me, this entails thinking about the connection of material and fiction, their interdependencies, and their contexts and practices, e.g. artistic practices, design, and world building.

These topics constitute a future research goal for me (working title "fictional material") that incorporates some of the questions set above. Systems of fictional materials can be defined not only as story-determining but also as an active element from which to imagine a world outside of fiction. This emphasizes a premise as the formulation of an idea or theory on which a later statement or action is based. In this case, even if the translation of the fictional mycelium network to an actual organic propulsion system is not possible, the use of organic elements as industrialized technologies is already emergent in current research projects, e.g. in synthetic biology researching algae as a fuel source (Brennan and Owende 2010). Questions around the extent to which the influence of fictional concepts has a reciprocal effect in research and whether this can be proven at all would be something to be explored in further research. However, from a more speculative perspective, projections can be formulated. In terms of content this could, for example, mean the conception and development of symbiotic technologies, in the course of which humans and their bodies become more aware of being part of the planetary biome through their connections to organisms and technologies. This constitutes a starting point for the transition to ecological and more resource-conscious forms of society than currently practiced. Fiction and subsequently fictional material could provide a trigger or at least a vector for ecological transformation. By observing systems and their underlying materialities the focus on how to imagine a future can be shifted from specific artifacts and narratives to more general systemic structures and their principles.

In the case of *Star Trek: Discovery,* the focus lies on visualizing

a techno-machinery and the appropriation of the mycelium network instead of closing in on world building aspects or systemic structures. The spore drive almost becomes a "gimmick" to further the narrative. Still, the example of the mycelium network in its relation to an actual research topic vividly shows how, within science fiction—especially the Star Trek franchise, visually and linguistically characterized by its relationship to technology—the narrative and its props are developed starting from scientific research using strategies of extrapolation.[18] This means referring to existing settings, conferring to characteristics of certain structures, and from this point forward generating possible further developments, be it in a technological, societal, ecological, or biological context. The fact that this extrapolation does not take on the role of a deus ex machina (e.g. material as plot fulfillment) but is structurally interwoven with the foundations of the narration is particularly interesting. The narrative of Star Trek experiences an accumulation of dramaturgically necessary but otherwise rather diffuse connections at certain points, which lead to degrees of impossibility in practice.[19]

Extrapolation in this case also implies postulating the improbable and impossible and, with this, first triggering the imagination and then generating a discourse concerning the implications of these (im)possibilities. This includes an acceptance of the uncertainty and defectiveness in the fictional execution of these (im)possibilities and the continuity in thinking further ahead. On one hand, the example of

18- In case of the series *Discovery*, the fact that their spaceship is a science ship, which maintains up to 300 discrete scientific missions, e.g. doing experimental studies on new drive technologies, all of which happens under uncertain conditions in times of war, is mentioned specifically (1.3, minute 16:30).

19- Michio Kaku introduces three degrees of impossibility in *Physics of the Impossible*. The first level refers to impossibilities that are not possible today but do not violate any laws of nature known to us. The second level refers to technologies that lie at the very edge of our conception of the physical world but are entirely conceivable in the distant future. The third level includes technologies that violate natural laws and are therefore unverifiable as possibilities in the future. I would classify the spore drive as level one—teleportation via certain energy channels is within the realm of possibility. However, whether this is carried out via mechanical or organic constructs is an additional factor which, in the case of organic matter as transport media, would take the degree of impossibility to level three. (Kaku 2010, 18)

the spore drive picks up a contemporary discourse about a more conscious consumption and use of energy sources and related technologies as well as the exploration of new resources. On the other, this discourse incorporates an energy source with a specific materiality. In my opinion, this suggests the consideration of fictional material as the medium or carrier of postulated possibilities. Drawing on fictional material as a vehicle for world building and using its possible functionalities as a driving force of the narrative, it could possibly be an expansion of a practice, both a science fiction practice and an artistic practice. Which of the two terms *fictional* or *material* provides the main driving force behind this practice is still to be determined. In general, I would argue that the connection of these two—the fictional as the more methodological and the material as the more physically manifested (or digitally constructed) aspect—creates advanced possibilities for an artistic and design practice based on both terms. Vint refers to a similar notion of patterns of influences or even precipitating effects in scientific processes: "These imaginative patterns have material significance: they shape the expectations people bring to advances in genomics and biotechnology, and thus the ethos that informs how technologies are designed" (2021, 105). In the combination of the terms *fictional* and *material*, possibilities of the physical and the practical resonate in the intention to perform something that lies in a possible future or in pretending and imagining a "what if." Does not such an approach contain a utopian moment, even if it is not yet in the realm of the feasible? Inconceivability in the present holds a reassuring and hopeful moment that enables action towards the future. Etymologically, fiction can also be defined as the process of creating. This suggests a connection to making as a poietic act. The factual and its extrapolation could be defined as different stages in making.[20] Thus, in fictional material, a "materialization" of ideas and conceptions

20- This could also be connected to a statement by Sol LeWitt: "When an artist uses a conceptual form of art, it means that all of the planning and decisions are made beforehand and the execution is a perfunctory affair. The idea becomes a machine that makes the art" (1967).

of the possible can be used to make these feasible and manageable. Fictional material could then be named an agent of development that exists on an axis between the linguistic and the material, perhaps without ever fully reaching it. The question remains when a linguistically postulated materialization is sufficient or if scientific as well as artistic formulations are necessary to concretize a vision more comprehensibly, to sound out its possibilities and their fringes.

Conclusion

The potential of fiction as a method is explored in science fiction in a range of core themes.[21] One of the most frequently discussed and elaborated topics in science fiction is transportation. Its significance for technological development as well as its social impact make it a fundamental topic treated extensively in Western contexts. Thus, the choice of using a novel transport system to propose organic technology seems compelling. From a technological as well as a utopian point of view, the topic of transport carries a notion of movement, exploration, and hope of further development and progress, at least in "hard sci-fi."[22] Other similar main topics addressed are communication, societal models, and architecture. *Star Trek: Discovery* combines all of these fields by introducing a kind of organic space travel relating to current political, scientific, and societal discussions about energy resources, renewable energies, and the depletion of traditional finite planetary resources and its effects on climate change. The concept of a living, self-renewing material opens up a view on alternative energy sources and their promise of even faster progress and exploration. It is noteworthy that in *Discovery*, the organism is referred to as material rather than

21- Every human action—including science—entails a fictional aspect. According to one definition, fiction is an intentionally applied methodology to solve problems with the help of assumptions, even contradictory or false (Spektrum 2000). As I see it, fiction as a method includes not only imagination but also the aspect of making and producing.

22- Science fiction, originally mainly oriented towards science and technology, began to split into hard and soft sci-fi as subgenres in the 1950s. A general distinction defines hard sci-fi as more oriented towards technologies and scientific details and soft sci-fi towards humanities and social issues.

a living being, which resonates problematically because of the parallels with strategies and methods of resource exploitation in use today. Even if economic efficiency is not mentioned as a reason here, it is economic efficiency in war times and the survival of one's own species and society that becomes the justification. However utopian and positive the community in Star Trek might be, decisions are still made at the expense of sentient (alien) beings (tardigrades) and organisms (mycelia).

Regarding space travel, one could ask whether the idea of movement and intergalactic travel is a moment of making, a mode of action of movement in space, and if this can be sustained by the characteristics developed out of a symbiosis between human, extraterrestrial host, and intergalactic mycelium network—a symbiosis which enables both humans and starship to cross into other dimensions and other places by teleportation or rather de- and re-materializing. Is this action embodied in the symbiotic (or rather myccorhizal) relationship? Or is it just an execution born out of the interdependence of the single elements? Is this act already contained in the formulated premise yet remains simultaneously stuck in it? In regard to the symbiotic structure of the fictional propulsion system (sympoietic: network + being) or to a probable autopoietic property of the network (spores + mycelia + energy transfer) itself, one facet of the material transferring capabilities could be understood as modes of action.

In terms of impacts on our current society, on work and life in general, engaging with fictional aspects is a way of preparing us to think and shape future perspectives and society. Another important aspect is the more pressing concern of the consideration and care for biological principles and materiality, as well as taking into account the importance of organic beings, species, and matter alike. From an artistic perspective, the choice to deal with materialities of the organic and the interconnectedness of our planetary materialities can indicate ways to influence the

current discourse.[23] Fictional aspects as an extrapolation of the known can enhance the artistic and scientific treatment of these topics and their future proposals or realizations.

Science fiction as a medium for integrating fictionality into society provides an opportunity to test consequences of fictional actions or scenarios, both in scientific and artistic domains. It creates a safe framework for questions not yet formulated in detail and enables their discussion through their fictional contextualisation, be it through narration, visualization, materializations or scenarios, possibly to trigger further debate and discourse. Fiction as a production of cultural artifacts is an essential part of societal processes and evolution in ethical, social, economical, political, and scientific aspects. In a best case scenario, each one will profit from this mutual interdependence.

23- To name just a few artistic projects in critical correspondence with the topic at hand: A) Mushrooms as a utopian artistic community project by Laura Popplow, Tine Tillmann et al. www.fungutopia.org/index.php?/about/. B) Artistic work by Georg Dietzler on a self-dissolving still life in relation to toxic soils. www.kunstforum.de/artikel/georg-dietzler/. C) An open-source pilot project by Zero Emissions Research and Initiatives (ZERI) on environmental education and self-empowerment called "Funghi Espresso." www.zeri.org/mushrooms.html. D) The Art & Science project "Mind the Fungi" dedicated to the research of local mushrooms and current fungal biotechnology, Art Laboratory Berlin in cooperation with the Institute of Biotechnology TU Berlin, 2018–2020. artlaboratory-berlin.org/research/mind-the-fungi/. E) Fungi as the Other as Tropus: tvtropes.org/pmwiki/pmwiki.php/Literature/TheFungus. F) The aesthetics of entropy. www.myzel.net/Myzel/index.en.html.

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List of Figures

In the Making is an interim report on a series of ongoing dissertation projects at the Academy of Media Arts Cologne. The essays and experiments presented by nine doctoral candidates all deal with various questions of poiesis, that is, the forms of knowledge that become active when we make, create, invent, or produce something. While the authors come from different artistic-creative fields, their questions and topics reach deep into various scientific disciplines. This book offers a closer look at this transdisciplinary nexus and its cultural implications.

Kunsthochschule für Medien Köln
Academy of Media Arts Cologne

ISBN 978-3-942154-62-8