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### A Search for Unpredictable Relationships

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# A Search for Unpredictable Relationships

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## Abstract

This paper explores how design research that includes experimental design practice, can utilize the researcher's background as a practitioner, and make the practice central to the research. The aim of this paper is to make a case that practical experiment in a research context is a fruitful way to produce knowledge that supports the interplay between designer, material and technique in design practice. The research reported in the paper experimentally explores how a ceramist can utilize his approach to designing in the use of 3d digital media as a design tool, and what that use of digital media can add in a qualitative sense in interplay with the ceramic material. The investigation explores themes such as movements and metamorphosis. The paper suggests a method of research that the author has named *Method of Branching Experiments*. Subsequently, the method is exemplified by the author's experiments. The method is characterized by an explorative approach based on own design practice in interplay with techniques and materials, and by relying on a cluster of parallel and interdependent experiments within a defined frame rather than single experiments. The method has shown how new questions derived from an introductory experiment have influenced the process of exploration, by suggesting new parallel experiments. The new questions do not change the direction of the original experiment, but rather clarify and specify it, allowing the process to branch off in a variety of directions, and to be fuelled by spontaneous curiosity. Furthermore the method has shown how the parallel experiments have contributed unpredictable solutions to other experiments. Thus the notion of parallel interdependent experiments can be seen as a dynamic system in which a number of unpredictable and surprising relationships can emerge and be exemplary for what can be done and how, within the context of the original research question.

## Keywords

Research method; design practice; experiments; ceramics; 3d digital media.

## 1. Introduction

As a PhD. student with a background in design practice I have been exploring how design research that includes my own experimental design practice, can utilize the researcher's background as a practitioner and make the practice central to the research. This paper is about how my approach to designing can contribute to my method of research and under what circumstances design practice can be seen as an integral part of design research; a whole rather than two parallel tracks.

The paper reflects an ongoing Ph.D. project about experimental use of 3d digital graphics in the field of ceramics.

### **1.1. Research question and Design Practice as a Tool for Design Research**

My research question is about how as a ceramicist I can utilize my approach to designing in the use of 3d digital media as a design tool; and what, more generally, such a use of digital media can add in a qualitative sense in interplay with the ceramic material. The research question is investigated through practical design experiments with digital media and ceramic material that are

part of the design research and contribute empirical data. The experiments explore how the designer can use themes such as movements and metamorphosis in his work. Arguably, for this purpose the design process can be divided into three sections: problem identification, design practice and production (see figure 1). Problem identification is about identifying what to design e.g. by a participatory design process (Sanders 2000); design practice is about how to design an artefact or prototype in interplay with techniques and materials; and finally production is about how to distribute the design to the user. Thus my research question is neither about the design process as a whole nor about identification of a user problem or the context of an artefact, but is focussing on the explorative and experimental part of design practice. In this context the design practice is the shaping process; that is, the process by which the artefact emerges as physical form in interplay between designer, techniques and material. Thus I disengage design practice from the design process as a whole (see figure 2), focussing solely on the interplay between designer, material and technique (see figure 3).

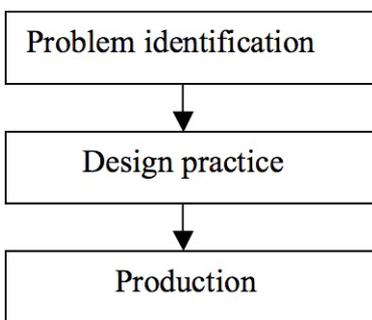


Figure 1

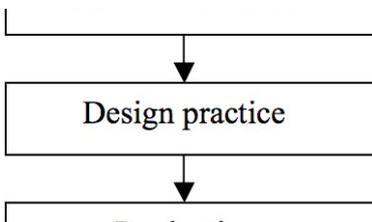


Figure 2

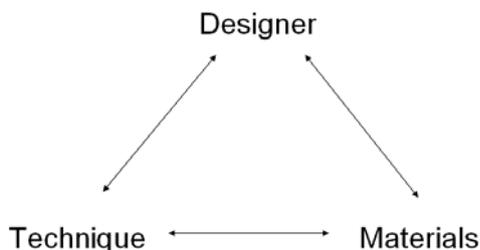


Figure 3

Michael Biggs (2004) has advocated a combined linguistic and non-linguistic research approach, in contrast to an entirely non-linguistic thesis, in so-called practice based design research. Following

his combined approach, the experiments and artefacts to be described do not stand alone in the context of design research, but will always be accompanied with a verbal reflection and discussion. This supports the notion of design practice disengaged from the design process as a whole. The linguistic element will explain the background and provide a basis for communicating the experiment and artefact, as well as the findings about what is possible and how, regarding the research question. This is how, in the present project, design practice is turned into a tool for design research.

## 1.2. Contextualisation in relation to Design Research

Design research involving the researcher’s own experimental design practice can be labelled in many ways; e.g. as practice-based research, design-based research, practice-led research etc. Niedderer and Roworth-Stokes (2007) provide a critical discussion of the existing terminology concerning different roles of practice. They find a way to classify these terms in three categories but state: “Within these categories, terms are often synonymous or denote overlapping phenomena, and some terms span two categories which highlights the difficulty of interpretation and utilisation of such terms in a consistent and rigorous manner.” (Niedderer and Roworth-Stokes 2007) However their category “research involving practice” is relevant regarding the research presented in the present paper.

Category (with reference to terms identified)	Context	Purpose
<b>Research involving practice</b> (practice-based research, studio-based research, practice-centred research, practice-led research, arts-based research, design-based research)	Research process based on or rooted in practice, or where practice plays a lead role in the investigative process  Interventions/experiments are ‘framed’ investigate how practice can be enhanced or improved	Research outcomes make a direct contribution to, or are of direct relevance for, the advancement of practice  Practice informs theory building within research to gain new insights, knowledge or understanding

Table 1, Excerpt from a model presented by Niedderer and Roworth (2007).

Marchand and Walker (2009) draw on the contribution by Niedderer and Roworth’s category “Research involving practice”, which they further develop and subdivide into two main approaches. One being more oriented towards the tradition of “applied research” while the other is a counterpart of “fundamental research”.

Research Components	Practice in research oriented towards applied research	Practice in research oriented towards fundamental research
<b>Role of artefact</b>	Regarded as, and represents, an “end”	Regarded as a “means” and a design approach to fundamental knowledge development.

Table 2, Excerpt from a model presented by Marchand and Walker (2009).

Of particular relevance for the present project is their research component “role of the artefact” (see table 2) “regarded as a ‘means’ and a design approach to fundamental knowledge development”. My field of interest is what I will call an *exploration oriented design process* included in design research; a process focussing on the interplay between designer, techniques and materials. The role of the artefact is to act as a reflecting and responding means for pushing the research process forward to clarify what is possible and how, regarding the research question. A related example of such an approach to research is found at the research cluster *Autonomic* <http://www.autonomic.org.uk/> at Falmouth College University, which do research that explores the use of digital manufacturing technologies in the creative process of designing and making three dimensional objects. This approach is based on the PhD work of Katie Bunnell (1998) who proposed an open and emergent practice-based methodology for exploring the integration of digital technologies into her practice as a ceramic designer-maker.

As a contrast, consider a *problem oriented design process* included in design research. That is, designing which, although research embedded, nevertheless aims at developing working prototypes or appearance models, just as ordinary professional design. An example is the Ph.D. project by Jonathan Allen discussed by Pedgley and Wormald (2007). The aim of the Jonathan Allen’s research was to advance the design of, and champion new approaches to designing, products for people with severe communication disabilities and physical impairment. During his project, he developed a fully working prototype communication device.

However, in the present paper I shall demonstrate that *exploration oriented design* can be fruitful as a design research method, because it is relieved from the usual obligation to fulfil a purpose of everyday use, solve problems or fulfil certain needs. As we shall see, the exploration oriented design process does not proceed as a series of isolated experiments, but rather as a cluster of parallel and interdependent experiments, which as a whole reflect the potential of the research question. I will argue that this approach turns design practice in which the design researcher is trained into an effective tool for design research.

In the following sections I will explain more thoroughly my method of research *The Method of Branching Experiments* and exemplify the method by a series of parallel and interdependent experiments. Finally I will discuss the method.

## 2. Method of Research: Branching Experiments

As briefly mentioned in the introduction, my approach to design research is explorative, using experiments based on my own design practice in interplay with relevant techniques and materials. The role of the experiments is to contribute empirical data. This overall approach can be seen as “reflection-in-action” (Schön 1983), and is inspired by *action research* which Bruce Archer (1995) has described as:

Systematic investigation through practical action calculated to devise or test new information, ideas, forms or procedures and to produce communicable knowledge. ... the investigator is explicitly taking action in and on the real world in order to devise or test or shed light upon something. ... Action Research is pursued through action in and on the real world, in all its complexity, its findings only reliably apply to the place, time, persons and circumstances in which that action took place (Archer 1995).

An experiment executed in the context of design research is rarely seen as a stand alone, but is communicated visually and accompanied verbally by a discussion and reflection. According to Bruce Archer, research is ‘systematic enquiry whose goal is communicable knowledge: Communicable because the findings must be intelligible to, and located within some framework of understanding for, an appropriate audience’ (Archer 1995). Recently, Per Galle defined research as ‘disciplined acquisition of new non-trivial knowledge and documentation of it by means of theory (Galle 2009). Arguably the purpose of an experiment in the context of design research is to

produce knowledge expressed in terms of theory, which is communicable. Thus it is the researcher's responsibility to target and make the theory intelligible to an appropriate audience. Since my research question is about design practice, so as to support it in the best possible way, the primary audience will be colleagues in design research or design practice. Thus it is not the artefact produced in the experiment that is of interest, but rather how it appeared in interplay between designer, material and technique. This relieves the artefact from its usual obligation to fulfil a purpose of everyday use. Hence it is possible to focus solely on the explorative and experimental part of the design practice to explore what is possible, and how. This encourages a mode of research, which offers unpredictable and surprising results. I have explored this by a cluster of parallel and interdependent experiments, as I shall now try to demonstrate.

The method is defined by a frame for carrying out experiments inspired by *Exemplary design research* in the sense of Binder and Redström:

With the notion of “exemplary design research driven by programs, experiments and interventions”, we refer to research based on the explicit formulation of design programs that act as a frame and foundation for carrying out series of design experiments and interventions. It is ‘exemplary’ in the sense that it enables critical dissemination primarily by creating examples of what could be done and how, i.e. examples that both express the possibilities of the design program as well as more general suggestions about a (change to) design practice (Binder and Redström 2006).

The frame is defined by my research question (section 1.1). One experiment has formed the starting point in the research, which has given rise to new questions and experiments. Subsequently the research has comprised parallel experiments, which influence one another through verbal discussion and reflection. The frame and cluster of parallel and interdependent experiments can be illustrated as in figure 2.

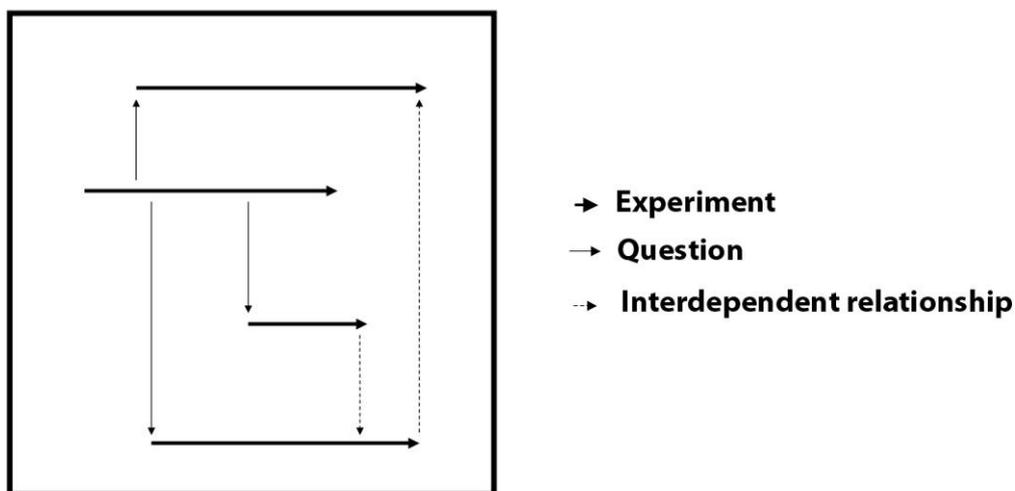


Figure 2, Cluster of parallel and interdependent experiments

It is by this approach, which I have named *The Method of Branching Experiments*, that I have investigated my research question. In the following section I will exemplify the method by describing the particular parallel and interdependent experiments that were undertaken.

### 3. Exemplification

Recall that the research question was about how as a ceramist I can utilize my approach to designing in the use of 3d digital media as a design tool and what such use of digital media can add in a qualitative sense in interplay with the ceramic material. The research question is investigated by experimenting with digital media and ceramic material. The pivotal point for these experiments is as the theme of *movement* and *metamorphosis*. To be able to explain the research method, I shall first consider the traditional approach of a ceramist and then briefly review state-of-the-art use of 3d digital media within the field of ceramics and related fields. After that I shall go into more details about my experiments, to exemplify *Method of Branching Experiments*.

#### 3.1. The ceramicist's approach to form

In the field of ceramics, many approaches are taken to form-finding. The one of interest in this research is to rely on the material as a major source of design ideas. This means the material itself generates form in interplay with the designer. An example of such an approach is the design by the Danish ceramist Anne Tophøj (figure 3).



Figure 3

The pattern of the edges of the plates appeared by centrifuging fluid porcelain from the base. This pattern could never have been realized without the potential of the material to flow and be captured in this way. The material determined the spread of the pattern, and Anne Tophøj exerted her influence by controlling speed and acceleration of the centrifuging process. The pattern of the edges was determined by the interplay between the liquid porcelain, the idea of centrifuging and the intervention by Anne Tophøj (2009). This intervention relies on an explorative and playful approach to design practice regarding material. I have named this approach *material-driven form-finding*.

As a contrast, I can refer to an example of my own, which can be seen in Figure 4.



Figure 4

These plates were realized by three profiles that were initially drawn, then modelled in plaster, and finally executed in ceramic material. The ceramic material did not contribute anything to the form

itself, as opposed to the example by Anne Tophøj. The design was simply determined before being executed in ceramic material. I call such an approach *constructional form-finding*. However, it is by an approach such as *material-driven form-finding* that I have chosen to explore the digital media.

### **3.2. State-of-the-art use of 3d digital media**

There are several of examples of explorative and experimental use of digital media operating with themes such as movement and metamorphosis within the field of ceramics. An example is the work by Tavs Jørgensen, who is part of the research cluster at Falmouth College University “Autonomic” (<http://www.autonomic.org.uk/>). Tavs Jørgensen has been experimenting with a Microscribe® G2L – a digitizing arm to record a 3d gesture movement by the hand in a 3d virtual space. These data constitute the basis for a 3d digital form, which can be transformed into a physical model by Rapid Prototyping (RP). RP is a range of techniques for transforming 3d digital form into 3d physical form. Figure 5 shows the recorded gesture movement and the 3d digital form, respectively.

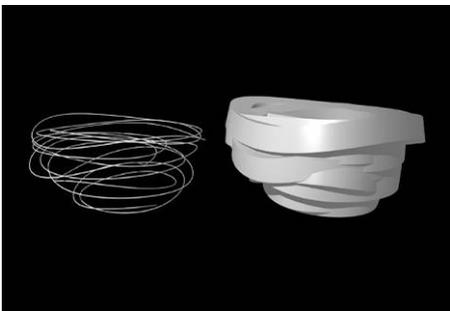


Figure 5

Another example is provided by Geoffey Mann (<http://www.mrmann.co.uk>), who has been experimenting with the use of 3d digital software to generate and simulate naturalistic phenomena such as waves on water surfaces. This was then utilized in the design of a coffee cup. The coffee cup was initially designed as a 3d digital form and was subsequently transformed into a physical model by RP and finally executed in ceramic material (figure 6).



Figure 6

In the course of my project, a survey of experimental use and research in the field of 3d digital media was made. It has continuously influenced the exploration of the research question. Examples of such media range from the use of Generative Components by Bentley and primarily used in field of architecture, Interaction design by the use of the programming language Processing to animation based software developed for the film and game industry; e.g. Real Flow. The significance of these influences will be explained while presenting the experiments in the following section.

### 3.3. Experiments

I will now give a brief chronological presentation of the series of experiments that I have undertaken. Firstly I will present an introductory experiment, which raised new questions, and thus gave rise to new experiments. It had the important role to keep my exploration of the research question on the track. After that, further experiments will be presented and the interdependence among the multiplying experiments will be explained.

The system of experiments, questions and interdependency relationships are visualized in figure 7. The meanings of the labels are given in Table 3.

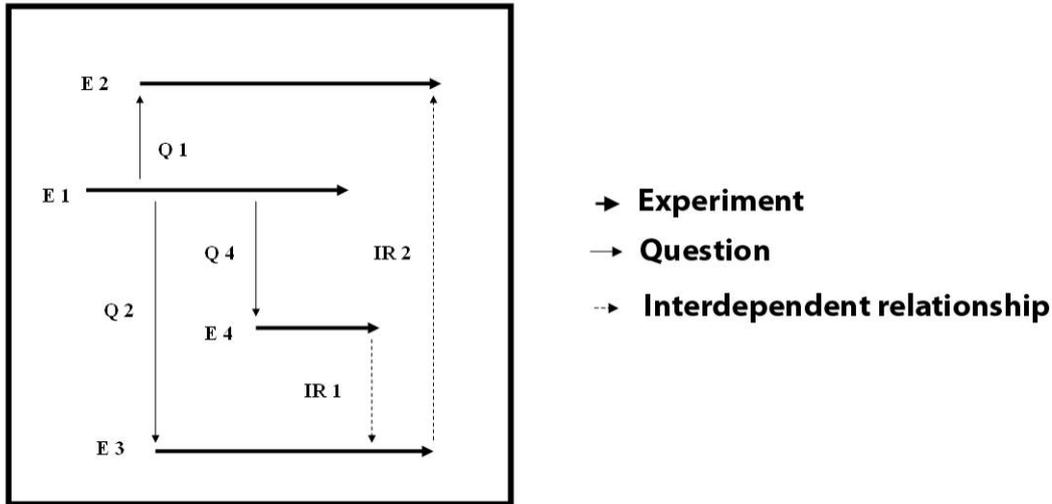


Figure 7

Table 3. Key to figure 7.

E1	Dynamics
E2	Interactive Dynamic Design Tool
E3	Silicone moulds and clay plaster mixture
E4	Capturing flowing form
Q1	Is it possible to achieve a higher degree of interaction regarding generative software? This question initiated the experiment: Interactive Dynamic Design Tool. E2. See section 3.3.2
Q2	Is it possible to improve the degree of complexity in the Rapid Prototyped produced model, when used within traditional techniques? This question initiated the experiment: Silicone moulds and clay plaster mixture. E4. See section 3.3.4
Q3	How can the digitally produced model contribute in interplay with the ceramic material? This question rather targets the present experiment than initiates a new one. E1. See section 3.3.1
Q4	Is it possible to capture transient phenomena and achieve similar effects as in reality by the use of e.g. plaster and what is gained by the use of digital media? This question initiated the experiment: Capturing flowing form. E3. See section 3.3.3

IR1	The mixture of plaster and liquid porcelain used in E4 was found suitable for improving the degree of complexity, when transforming the digitally produced form to the ceramic material, used in traditional techniques with moulds of silicone E3, Q2.
IR2	Complex digitally produced forms carried out by the Interactive Dynamic Design Tool in E2, can be transformed into the ceramic material by moulds of silicone and the mixture of plaster and liquid porcelain (developed in E3, Q2). The mixed material shows potentials as a material for solid models and strong textural qualities gained by firing.

### 3.3.1. Dynamics (E1)

At a very early stage I developed an interest in using digital media as generative software, as in the work of Geoffrey Mann (figure 6). It seemed quite obvious to investigate such software regarding a material-driven form-finding approach of the kind taken by Anne Tophøj (figure 3). The first experiment, which formed the starting point, is about the use of “Dynamics” in the 3d animations based software program Real Flow. Dynamics cover a range of tools in 3d digital graphic software to simulate effects related to reality such as wind, gravity, liquids etc. Dynamics allows you to simulate these transient phenomena, making it possible to work with physical representations of these. Through the use of Real Flow, I am not bound by the laws of physics and can even freeze a moment in the film sequence at any time. The generative software is very useful as a means to explore the interaction between forces and the physical representation. For example, it is possible to set up an event such as a collided water surface, which delivers a water splash (figure 8).

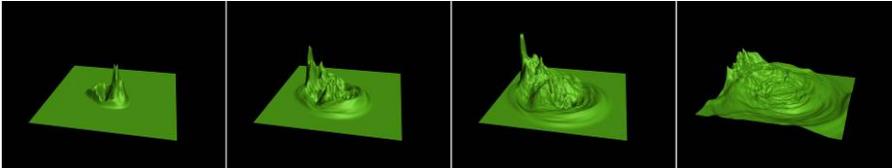


Figure 8

The event simulation in Real Flow is defined in advance with the possibility to change parameters and orientation. However, there is no possibility for the user to interfere while the simulation is executed. This differed from the material-driven form-finding approach and raised my first question (Q1): Is it possible to achieve a higher degree of interaction regarding generative software? This question initiated the experiment: Interactive Dynamic Design Tool; see section 3.3.2. Thus at this stage a new experiment was initiated about a higher degree of interaction regarding generative software, and at the same time a consciousness about a lack of interactivity became evident.

An attractive point using Real Flow is the possibility to have these naturalistic effects – in this case collided water – produced as a 3D physical model by the use of RP (figure 9).

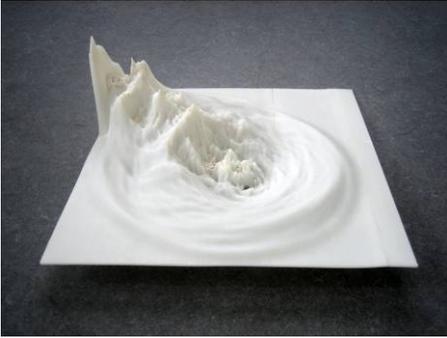


Figure 9

The digitally produced form in Real Flow can become very complex. The technique of RP is not developed to a satisfactory degree to transform the digitally produced form into the ceramic material. Thus this project focuses on the RP-produced models used in combination with traditional techniques. This sets some limitations regarding the degree of complexity allowed in the 3d model. However, this is not a problem in our example in figure 9, but necessitates some considerations and concerns regarding the overall research question. Thus a second question (Q2) was raised: Is it possible to improve the degree of complexity in the RP-produced model, when used within traditional techniques? This question initiated the experiment: Silicone moulds and clay plaster mixture; see section 3.3.4.

Meanwhile, the RP model raises a third question (Q3): How can the digitally produced model contribute in interplay with the ceramic material? This question targets the present experiment, rather than initiating a new one.



Figure 10

An artefact was produced by pouring liquid porcelain onto a plaster mould, which had been made on the basis of the RP model (figure 10). As the liquid material flows across the plaster, the water is drained out of the porcelain, whereby it slowly stiffens in its action and dries. The dry porcelain can subsequently be dismantled from the plaster mould, which now has made an imprint in the porcelain. At this stage of mould making by plaster a fourth question (Q4) emerged: Is it possible to capture transient phenomena and achieve similar effects as in reality by the use of e.g. plaster, and what is gained by the use of digital media? This question initiated the experiment: Capturing flowing form. See chapter 3.3.3.

The resulting artefact can be seen in figure 11. It has an organically growing and detailed formation in the middle (stemming from the 3d print), and a soft curved edge determined by the liquid material, in which it is produced.



Figure 11

The following observation relates to the third question (Q3). (How can the digitally produced model contribute in interplay with the ceramic material by a material-driven form-finding approach?) The formation describes and pictures a phenomenon about liquid. It is naturalistic but fictitious. It has never been a floating liquid itself and refers to a phenomenon that differs from its own creation, similar to the notion of a figure, model etc. On the other hand, the contour of the artefact rather refers to itself and its creation. It simply looks like what it is. It has never been the intention for it to be anything but the flowing porcelain, which has stiffened. Thus the two expressions differ and integrate at the same time. The two expression and thus the two media are interdependent to fulfil such an expression. When contemplating the artefact, we will alternate between fiction and reality and a fluid boundary emerges presented in one and the same thing.

The next three sections follow up on the questions that emerged above.

### 3.3.2. Interactive Dynamic Design Tool (E2)

First question (Q1): Is it possible to achieve a higher degree of interaction regarding generative software?

The experiment with Real Flow showed that I needed interactive software. This led me to other artists and designers experimenting with motion and interactive systems. Such an example is *Untitled 5* by the American-based artist Camille Utterback (<http://www.camilleutterback.com>). She designed *Untitled 5* as an interactive system, which can be explored by the audience (figure 12).



Figure 12

What is interesting in Camilla Utterback's work is the dynamic, generative and interactive system, which responds fluidly and intriguingly to physical movement. Camille Utterback has, by her aesthetic system, created a framework for various possibilities to occur through the physical relationships between the audience and the projection. The idea of Camille Utterback's work is to be an eternal living system projected onto a two-dimensional surface; it is not a design tool.

Another example is the Swedish based design group *Front* (<http://www.frontdesign.se>) using Motion Capture (figure 13). *Front* tracks 3d motion by an infrared pen, whose movements are recorded by two cameras and thus generate 3d digital files. The idea is similar to the experiment by Tavs Jorgensen. *Front's* technique captures movements in 3 dimensions as a tool to define shape, but does not use a dynamic interactive system as in Camille Utterback's work.



Figure 13

I saw a combination of these two examples as a good basis for a 3d digital design approach, which led me to a cooperation with the programmer and designer *Marcin Ignac* (<http://www.vorg.pl/>). Together we have developed what I have called an *Interactive Dynamic Design Tool*. We made use of Marcin Ignac's skills for programming in the programming language *Processing* and the use of a *wii* remote as a device to capture the 3d motions. By the *wii* remote the movement of the hand is tracked in a 3d virtual space (figure 14).



Figure 14

A dynamic and generative system is defined by emerging 3d geometries, which respond to speed. The size of geometry and the distance between the geometries reflects the speed of the movement of the hand with the *wii* remote (figure 15).

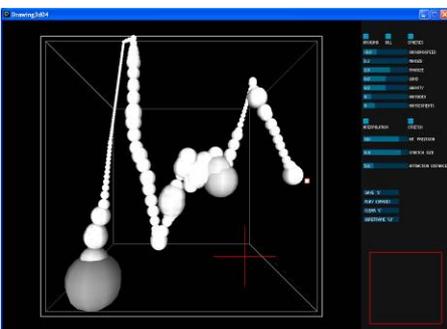


Figure 15

Furthermore the emerging geometries can either increase or decrease and be affected by the following movements of the hand by being repelled or attracted. The geometries provide a trace of the movement in the interactive dynamic system, which may be captured at any time. The captured movement forms the basis for a 3D physical model produced by the use of RP (figure 16), which express the captured movement in physical form.



Figure 16

The constellation of a programmer and designer has been constructive. The programmer is the specialist in the "material" of computer software, and I as the designer have had the notion of a digital design tool based on the idea of material-driven form-finding. It is obvious in this cooperation that creative thinking relies on the dynamic system, rather than the particular artefact.

The next step is to test the Interactive Dynamic Design Tool in cooperation with an artist from the field of ceramics and related fields for further development.

### 3.3.3. Capturing flowing form (E4)

Fourth question (Q4): Is it possible to capture transient phenomena and achieve similar effects as in reality by the use of e.g. plaster and what is gained by the use of digital media?

Plaster has the quality of a crystallizing process, which enables us to capture a movement of the material in a process from fluid to stable. This was explored in several ways; e.g. using gravity and blasts of compressed air, as shown in figures 17 and 18 respectively.



Figure 17



Figure 18

The transformation of a ceramic material, which can subsequently be fired, is of paramount importance to this research. Plaster is not such a material. But by accident I was introduced to Karen Harsbo, associate professor at the School of Architecture in Copenhagen, Fine Art department and head of the Ceramic Lab, and her collaboration with Neil Brownsword, PhD from

United Kingdom. As it turned out, they experiment with a mixture of plaster and liquid porcelain. This particular mixture constitutes a material with the quality of plaster as well the quality of a textural ceramic material meant for firing. This mixture was utilized in the experiment.

The mixture of plaster and liquid porcelain showed great potentials for capturing form in motion, which could be further developed, but most importantly regarding this research, the experiment put the use of dynamics into perspective. On one hand dynamics showed a potential to capture transient phenomena in a way which could be exactly controlled and even beyond the laws of physics, and furthermore a potential in an interplay with traditional techniques and materials. On the other hand, the experiment drew my attention to the lack of playfulness caused by the lack of interactivity found in the use of dynamics.

Another important and unpredictable outcome from this experiment was the idea of this mixture of plaster and liquid porcelain used in relation to the second question (Q2) in section 3.3.1, which the following section is about.

### 3.3.4. Silicone moulds and clay plaster mixture (E3)

Second question (Q2): Is it possible to improve the degree of complexity in the RP-produced model, when used within traditional techniques?

The mixture based on plaster and liquid porcelain mentioned in the previous section has shown a potential for improving the degree of complexity when transforming the RP-produced model into the ceramic material. An imprint of the RP-produced model by silicone can make the basis for the transformation. The mould of silicone is much more flexible than the traditional mould made from plaster. The mixture can be poured into the mould of silicone and can be fired after being disengaged from the mould. Complex digitally produced forms carried out by the Interactive Dynamic Design Tool, are now being explored for the potential to be transformed into the ceramic material. The mixed material has potential as a material for solid models and strong textural qualities gained by firing. Figure 14 shows such a test piece (left) and its silicone mould (right).



Figure 14

This experiment (E3) was based on the findings in the experiment: “Capturing flowing form” (E4) and thus an unpredictable interdependent relationship (IR1). The outcome from this experiment (E3) will subsequently support the experiment: Interactive Dynamic Design Tool (E2) transforming the RP produced model into ceramics and thus a second unpredictable interdependent relationship (IR2). These unpredictable relationships serve as examples for how interdependent parallel experiments are able to generate unpredictable and surprising results. Thus the *Method of Branching Experiments* is useful for the design researcher to generate new knowledge to support the designer in design practice.

## 4. Concluding Remarks

In this paper I have introduced my method of research, which I have named the *Method of Branching Experiments*. The method has shown a potential to produce knowledge that supports design practice regarding the interplay between designer, techniques and material. The method is characterized by an explorative and experimental approach based on the researcher's own design practice in interplay with techniques and materials relevant for the research, and by parallel interdependent experiments. The experiments have shown how new questions derived from an introductory experiment influenced the process of exploration, by suggesting further experiments. The new questions did not change the direction of the original experiment, but rather clarified and specified it, allowing the process to branch off in a variety of directions, and to be fuelled by spontaneous curiosity. Furthermore I have shown how the parallel experiments have contributed unpredictable solutions to other experiments. Thus the notion of parallel interdependent experiments within a defined frame can be seen as a dynamic system in which a number of unpredictable and surprising relationships can emerge and be exemplary for what can be done and how, within the context of the original research question.

As we have seen, the method utilizes design practice and the artefact as a means especially for design research. This is in a way that differs from the usual obligation of design to fulfil a purpose of everyday use, solve problems or fulfil certain needs. The strength of the method was found to lie in its capacity for producing unpredictable and explorative situations that stimulate the researcher's search for new knowledge. The main weakness and danger of the method is that it may render the experiment, artefact and discussion too abstract and thus incomprehensible, inaccessible or irrelevant for the intended audience, thereby making the knowledge it generates useless.

As a measure against this potential problem this research included collaboration with other designers. Selected designers are introduced to the research and invited to explore the obtained results in collaboration. Thus the relevance and usefulness of the results are evaluated currently, through the interaction with designers, traditional design practice and production of artefacts such as jewellery and tableware. Yet the process of research itself is secluded from such collaboration, and remains a practice in its own right, subject to its own criteria of quality.

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