THE CREATIVE PROCESS IN GRAPHIC DESIGN

BREAKING OUT OF ESTABLISHED WORK MODES THROUGH MODULARITY

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ABSTRACT

The field of graphic design is influenced by rapid technological and social changes, challenging us to redefine how we think about the creative design process. In this thesis, the well-known concept of modularity will be investigated from a contemporary perspective as a way to break out of established work modes which rely on a linear design process. Six types of modularity, as defined for use in product design, create the framework for a series of visual explorations. The underlying method is an iterative design process of graphic prototyping and modeling, followed by a critical review of the visual outcome. These explorations demonstrate how modularity can encourage creativity in the graphic design process. The benefit of a modular approach to the creative process is supported by research from the fields of psychology and design.

ACKNOWLEDGEMENTS

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INTRODUCTION

Personal Background

The beginning of the following investigation is grounded in my personal background as a graphic designer with a very systematic approach to work. The core of my present investigation is an attempt to open-up and broaden my own design process. Hence, I will give some background information about myself to make it easier to understand the following explorations and thoughts. I studied graphic design for seven years in Germany during which time I was mainly instructed to follow a linear creative problem-solving approach consisting of four stages: preparation, incubation, illumination and verification.

This process, still accepted as valid today (Nigel Cross, 2006), is employed to make the creative process more effective in a professional context, where everything must advance very quickly in order to be economically viable for studios, agencies and clients. However, according to more recent research (Gerd Fricke, 1993; Cross, 2006, 2011) this process has been the subject of criticism in the field of design because it seems to be counter-productive to the intuitive way of thinking and reasoning of a designer.
Having practiced this process in a professional field for some time, I felt trapped in my own thoughts and very unsatisfied with everything that I designed. I was incapable of breaking out of my established patterns and going beyond what I had learned and experienced. This situation led me to graduate education in design, where I could immerse myself in developing my own work. At the time I did not know what I was searching for, but one of my earlier pieces (see Fig. 1), which I created in a studio course, provided me with my current research topic and present investigation.

For this studio work I applied modular principles to a formal exploration of shape combinations. The visual variety presented by only a few shapes combined with only a few rules surprised me enormously, especially considering that I suspended further work after completing only a fraction of the possibly infinite variations. At the time I called the process of making this piece 'structured freedom'. The inspiring and experimental process provided a structure that was dynamic instead of limited and tedious.

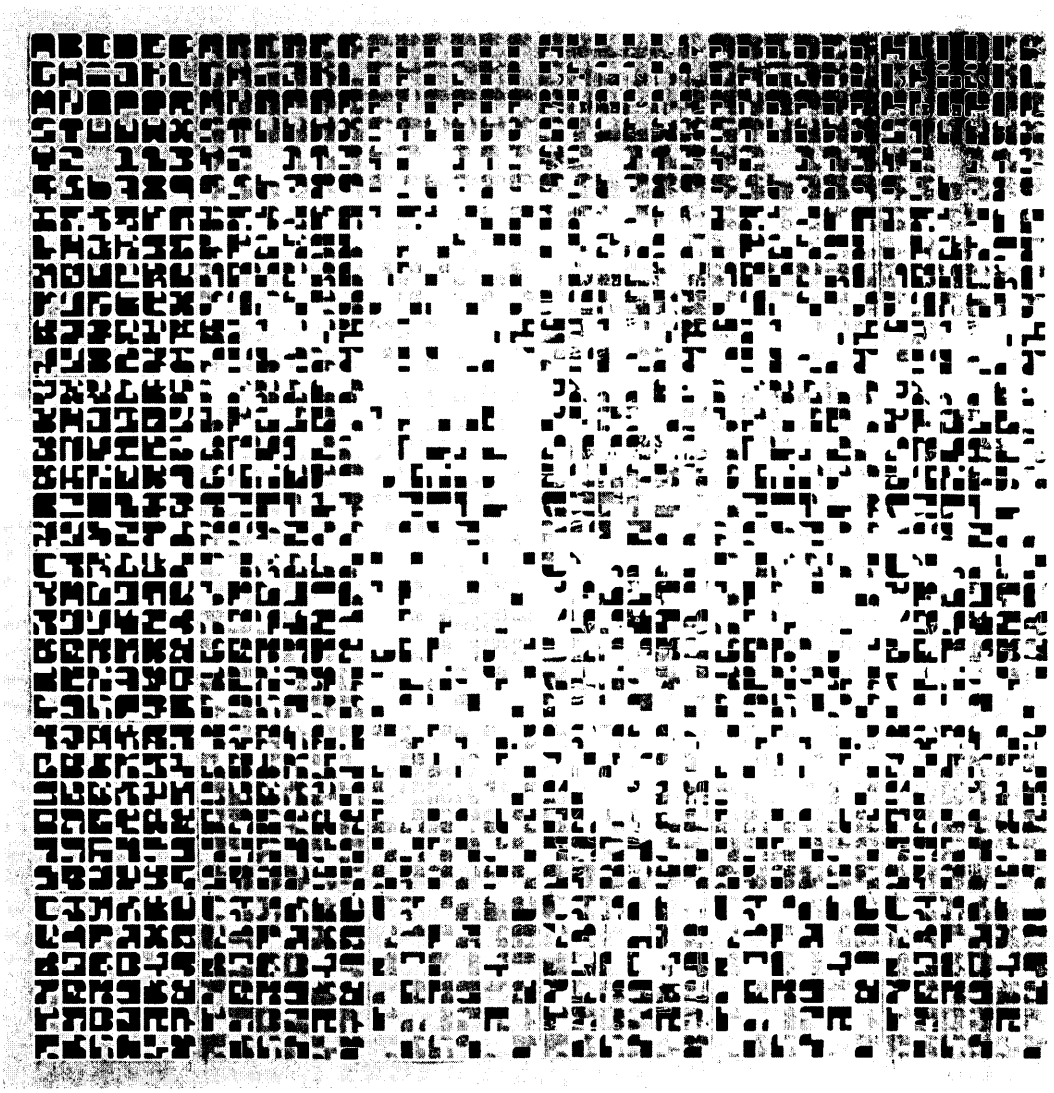


Figure 1. Franziska Erlebach, *Formal Exploration of Modularity*, 2011. 102" x 102" laser print.

I felt I was discovering new possibilities while recombining the shapes over and over again, possibilities which never would have arisen without going through this process. In this case modularity created a playground with elements and rules for me, and these became a framework within which I could play. Based on the experience, gained during the process of making, I started to examine the concept of modularity and its potential to contribute to the creative process.

Historical Background of Modularity

Modularity, as a design concept based on repetition and reduction, became popular towards the end of the 20th century; today, with the ubiquity of computers and programming languages, it is experiencing a rebirth and enabling unlimited diversity (Lev Manovich, 2002). Manovich, a researcher and educator of new media theory and digital humanities, encourages us to rethink the 'old concept' of modularity, to consider technological changes and to apply more recent notions of modularity to discover a new perspective of this concept. Modularity, as a general concept, had historical importance as early as the 15th century with the development of moveable type in the printing process (see Fig. 2) and emerged naturally and artificially in a wide range of fields: biology, technology, engineering, psychology, management, and in the natural world. The field of art and design makes use of modularity particularly in industrial design, architecture, interior design, fashion design, contemporary art, programming and software design.
Le Corbusier's book *The Modulor* from the 1950s is an important example of a modular approach in the architectural field (see Fig. 3 – 4). In his book Le Corbusier presented a system of architectural proportions,

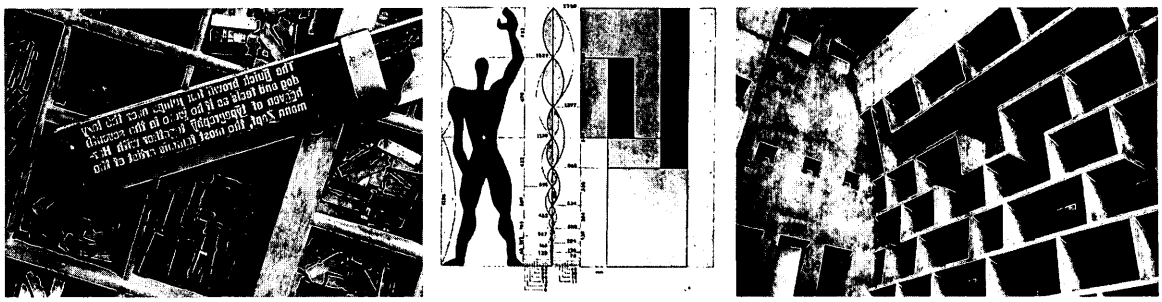


Figure 2. Johannes Gutenberg, *Moveable Type* from the 15th century
Figure 3. Le Corbusier, *The Modulor*, 1942 – 55.
Figure 4. Le Corbusier, *Punjab High Court Building*, 1966. Application of *The Modulor*.

'the Modulor', that made a major contribution to modern architecture and became the foundation of most design systems and modern grids. Graphic design has also been using the concept of modularity for a long time, as demonstrated by the typographical work (see Fig. 5 – 6) which the German artist and educator Joseph Albers produced during his time at the Bauhaus, and that of the Dutch artist Theo von Doesburg, the leader of the De Stijl movement. Further examples are provided by two Swiss graphic designers/contributors to the International Style movement, Josef Müller-Brockmann, who is known for his investigations in grid systems (see Fig. 7); and Karl Gerstner, who published the book *Designing Programs* where he proposed an approach of graphic design based on modular principles (see Fig. 8).

Figure 5. Theo Van Doesburg, *Architype*, 1919.
Figure 6. Josef Albers, *Architype*, 1926 – 1931.
Figure 7. Josef Müller-Brockmann. *Beethoven 07*. 1955. Concert poster.
Figure 8. Karl Gerstner, *Holzäpfel*, 1961. Proportion of a system & applications.

Today modularity in graphic design occurs in corporate design, type design, grids, editorial design, customizable book covers, collective work processes and many others instances. However, my research has revealed that neither a theoretical nor a visual investigation of the concept of modularity has taken place in the field of graphic design as it has in product design and the computer industry. I want to examine whether the potential of modularity in the field of graphic design offers more than its present application, particularly in terms of how it can promote flexibility and individuality of the design process.

A selection of different applications of modularity from the past and contemporary examples can be seen in the visual audit *Modularity in Various Fields* (see Fig. 9). The visual audit illustrates an overview of different applications of modularity from numerous disciplines. We can see from its range of use that modularity is a flexible concept able to provide structure and creativity simultaneously. A brief look into other fields which use modularity reveals that they deal with the concept in a much more structured way. For example, product/industrial design defines six types of modularity, each of which has different applications. The graphic design field may be able to learn from these examples or discover new possibilities. Consequently, I examined modularity in a graphic design context through an exploratory approach. *My thesis is focused on how modularity encourages creativity in the graphic design process.*

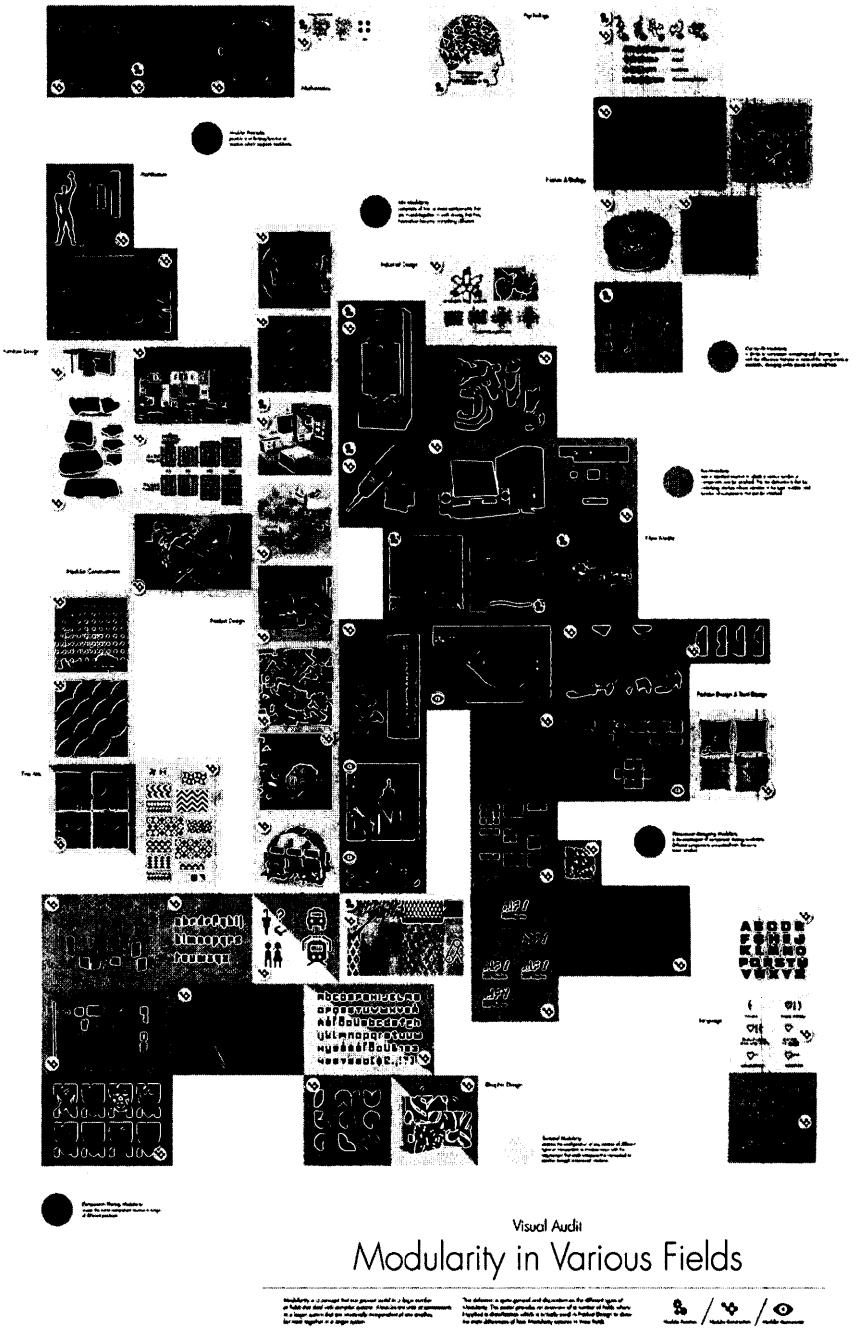


Figure 9. Franziska Erlebach, *Visual Audit Modularity in various Fields*, 2012. Poster 32" x 48". Colour code distinguishes the different types of modularity (see p. 7).

THE CONCEPT OF MODULARITY

Definition & Types of Modularity

In the literature on modularity Baldwin & Clark (2000), both Professors of Administration at the Harvard Business School, deal with the topic of modularity in the greatest detail, so much so that even graphic design-related books (e.g. Armstrong & Zvezdana, 2011) refer to Baldwin & Clark's research. Although Baldwin & Clark deal with modularity in a context of computer design, the definition is easily adaptable and similar definitions appear throughout much of the literature. According to Baldwin & Clark the core concept of modularity has proven useful in a large number of fields that deal with complex systems. Modularity is defined as a particular design structure which consists of modules in a larger system. Modules are structurally independent of one another, but work together. The structure is provided by design parameters partitioned into those which are visible and those which are hidden. Visible design rules must be established before the task begins. Hidden parameters are allowed to vary and are relatively easy to change throughout the process according to the discretion of the designer. For example, if the visible design rules in a graphic design context form a grid, the composition of the elements within the grid depends on the hidden parameters in the form of rules created by the designer. In the graphic design realm the terms 'visible' and 'hidden' may not be applicable because hidden rules will, in all likelihood, be visible. Thus I will refer to the 'visible' as primary design rules and to the 'hidden' as secondary design rules. Both provide the main structure of my exploratory practice (see Fig. 14). Baldwin & Clark state that secondary design rules allow for uncertainty. I interpret this to mean that when set (primary) and flexible (secondary) design rules are combined, the output will be flexible in any case. If new knowledge gained in the process subsequently yields a better solution for one of the secondary design rules, then the improved solution can be seamlessly substituted. This point will be crucial for the structure and process of the practical part of my thesis. For my further investigation I will use the term 'elements' for modules alike and clarify if applicable if it is about a unit of elements or a single element.

Baldwin & Clark note that perfectly modular design does not arise fully formed from the mind of the designer, which means that the design rules need to be defined throughout the process. Therefore what is required is an iterative approach of prototyping, critical review, and refining the design rules and output during the entire process. The basis of my experimental practice is the six types of modularity

defined by the American Joseph Pine (1993 Pine, a management and strategy adviser formerly of IBM, describes six different kinds of modularity for the mass customization of products and services, a selection of examples is presented within the visual audit *Modularity in Various Fields* (see Fig. 9), The variety of the modular types stretches from simple forms that allow great diversity without significantly changing the nature of the product to those which allow individual and fundamental change within the structure of the product or service. In employing Pine's definitions, which come from the business perspective of mass-customization, I disregarded the connection to products and customers, focusing instead on the core idea of each concept to assign them to a graphic design context to make them more easily accessible for use in my experimental practice.

1. *Sectional Modularity* combines different types and quantities of interrelated elements through a standard interface (see Fig. 9, yellow).
2. *Bus Modularity* uses the same standard structure to which a various number of elements can be attached. The underlying structure allows variation in the type, number, and location of these elements (see Fig. 9, gray).
3. *Mix Modularity* is the combination of two or more different elements in differing quantities in order to create something new. The elements are part of a set (see Fig. 9, green).
4. *Component-sharing Modularity* reuses the same element across different bases[1] (see Fig. 9, turquoise).
5. *Component-swapping Modularity* uses the same base with different elements in order to create different varieties of the same thing (see Fig. 9, blue).
6. *Cut-to-fit Modularity* combines elements, one or more of which are constantly variable in size or proportion to create dimensional variations of the same thing (see Fig. 9, orange).

An initial visualization (see Fig. 10) shows how these definitions can be applied to the field of graphic design. First, the definition of each type clearly shows that the concept of modularity mainly concerns reorganizing and recombining elements and the relationship of elements to each other.

[1] A base can be a main object/element or a stable group of elements that remains the same in appearance and position throughout.

Second, the result of this process is the creation of numerous variations. These two facts will be crucial in the later stages of my investigation.

For my exploratory investigation I applied these different modular types to the field of graphic design in order to explore their influences and possibilities in the design process. This differs from the role of the modular concept in product design, where focus is on the actual final product rather than the design process. The aim of my exploratory projects was not to create visual results with practical application; rather I developed a methodology that can be applied to a range of projects.

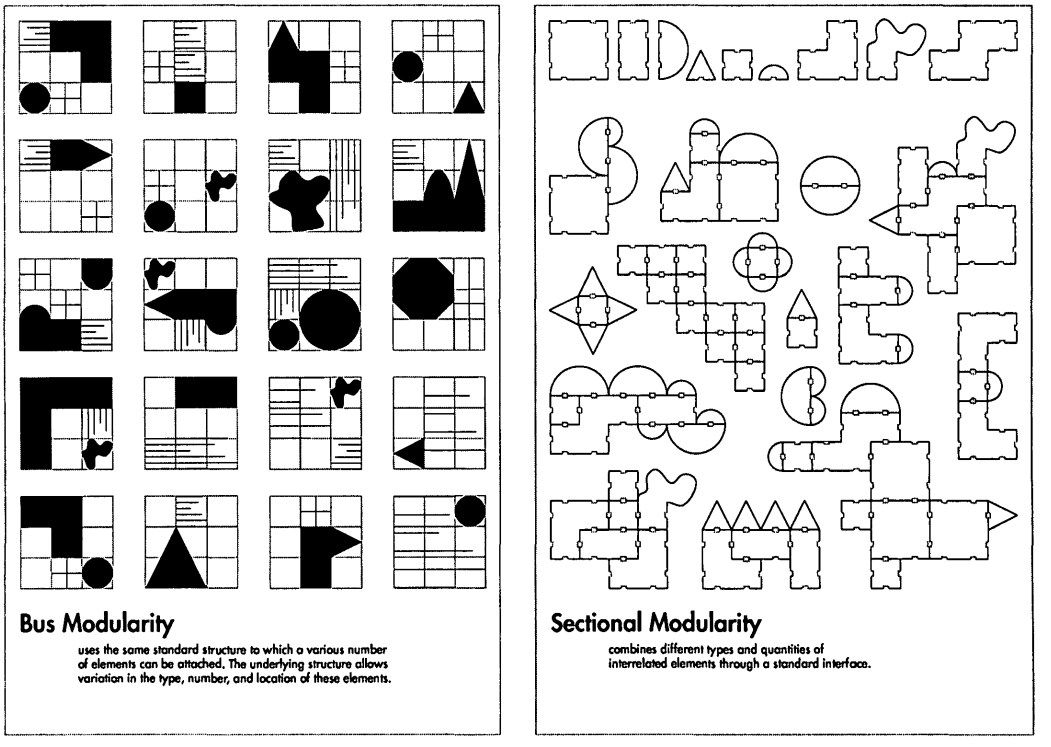


Figure 10. Franziska Erlebach, *Initial Visualization of the six Modular Types*, 2012. 6 Posters 17" x 25".

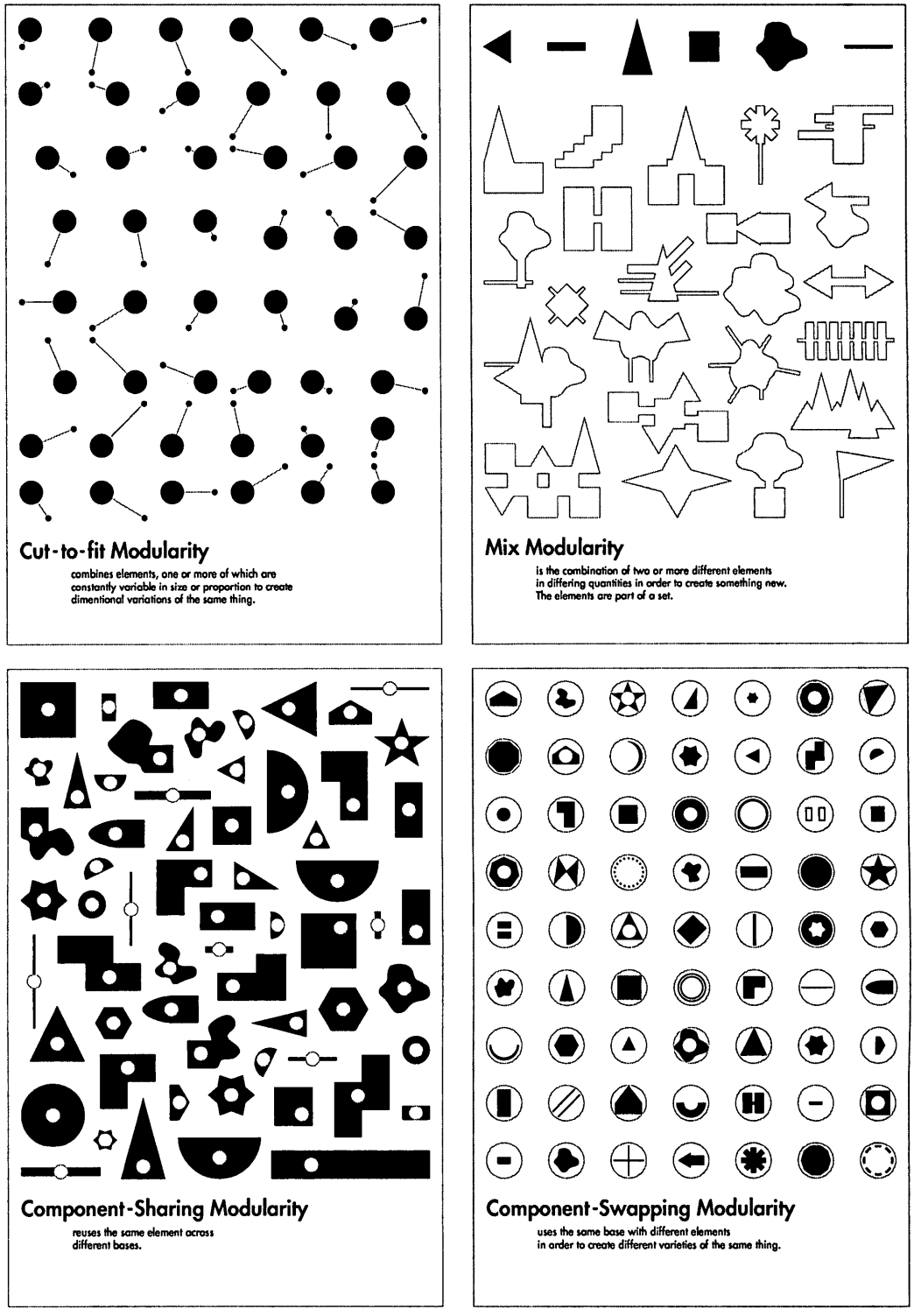


Figure 10. (continued)

Modularity in the current Design Practice

In the present discourse on modularity, Armstrong & Stojmirovic (2011), both designers and educators, contribute to the discourse of modularity from a graphic design perspective. Their book, *Participate: designing with user-generated content*, covers modularity in two ways. First, they consider modularity as a design concept with multiple design units to which a user can contribute content. Second, they examine modularity as a collaborative way to work on a specific design issue among design professionals. Armstrong & Stojmirovic focus on the application of modularity in the design process and the advantages and possibilities of the concept of letting the user drive the content of design, and they introduce several corresponding projects, but they do not examine modularity as a concept itself. Instead, they shift the focus from the finished product to the process of creating by using modularity as a way of collaboration. Though awareness of the opportunities of flexibility, independence and customization, as well as the present-day demand for such concepts are still relevant for my area of investigation; my current research is limited to the exploration of modularity as a personal design process. Nevertheless, in further research, collaboration as described by Armstrong & Stojmirovic (2011) can be easily applied and examined in a similar way.

Reas & Fry (2010) consider modularity from the viewpoint of a programming language called Processing. In this context the use of functions implies modularity. Functions are the basic building blocks for processing programs, independent software modules that are used to build more complex programs. Since programming languages work in a modular manner and motion graphics and animation are an important part of graphic design practice today, I have incorporated the use of Processing to experience this modular way to work and to broaden my own work in motion graphics and animation, which were formerly not a part of my personal practice.

A brief look at a selection of influential graphic designers in practice and their work (e.g. Michael Beirut, partner of Pentagram; Stefan Sagmeister, founder of Sagmeister Inc.; and Jonathan Puckey, a collaborator in an informal group called Conditional Design) clearly shows a modular approach in some of their work. Beirut (see Fig. 11.1 – 11.3) and Sagmeister (see Fig. 12.1 – 12.2) provide a modular approach for the design of some of their identity work through flexibility in the appearance of their design. The process in some of Puckey's work also seems to include a modular approach in addition to the flexibility of the visual results (see Fig. 13.1 – 13.3). However, none of the three designers identifies his

approach as modular, instead they use terms like flexible, transformative and adaptable to describe their work. These tendencies in their work show that modularity has its place in the field of graphic design, but mainly with reference to the flexibility of the visual result rather than in connection to the process itself.

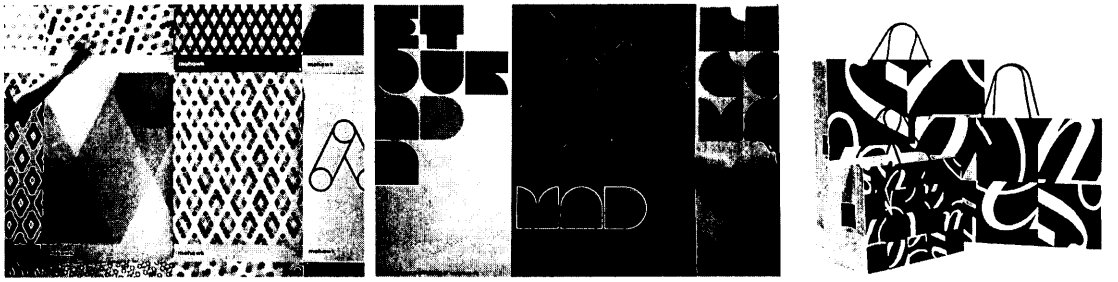


Figure 11.1. Michael Beirut, *Mohawk*, Identity redesign for the well-known paper company.
Figure 11.2. "_____",*Museum of Arts and Design*. Identity for the art & design museum.
Figure 11.3. "_____",*Saks Fifth Avenue*, Identity & packaging for the iconic New York retailer.

Figure 12.1. Stefan Sagmeister, *Things I have learned in my life so far*, Book. 2008.
Figure 12.2. Sagmeister Inc., *Casa da Musica*, flexible Identity System. 2007.

Figure 13.1. Conditional Design. *Birthday Poster* e.g. Jesus: 24.12.0 & Jesse Paulus: 9.4.1974.
Figure 13.2. Jonathan Puckey, *The Beach*. adaptable Identity System, 2007.
Figure 13.3. "_____". Typography for record label called *Special Box*, created with Tile Tool, 2007.

EXPLORATORY PRACTICE

The objective of my exploratory practice was to examine modularity from a process-based perspective, without a client in mind or any intention of creating and presenting a final, stand-alone piece; my aim was to produce a body of work lying beyond the definition of modularity with which we are acquainted already. I regarded the visual output of my explorations as works in progress, capable of further development in various directions. The content of my experiments was self initiated and based on either influences from my environment, my experiences from living in a new culture or issues on which I had wanted to work for some time already.

The *framework* for the execution of these explorations was created through the six modular types by Pine (1993) outlined earlier, *Sectional Modularity, Bus Modularity, Mix Modularity, Component-sharing Modularity, Component-swapping Modularity, Cut-to-fit Modularity.* The different types were explored by undertaking explorations based on each type and their design rules. In addition to this set of invariable primary design rules, the framework also included secondary design rules, which varied from piece to piece. The initial elements used to explore each type were chosen based on previous knowledge about the topic and/or knowledge based on my design practice or research. These elements, as well as the secondary design rules, were affected by adaptations throughout an iterative design process, a back and forth of early prototyping and modeling followed by a critical review (see Fig. 14). As a result initial

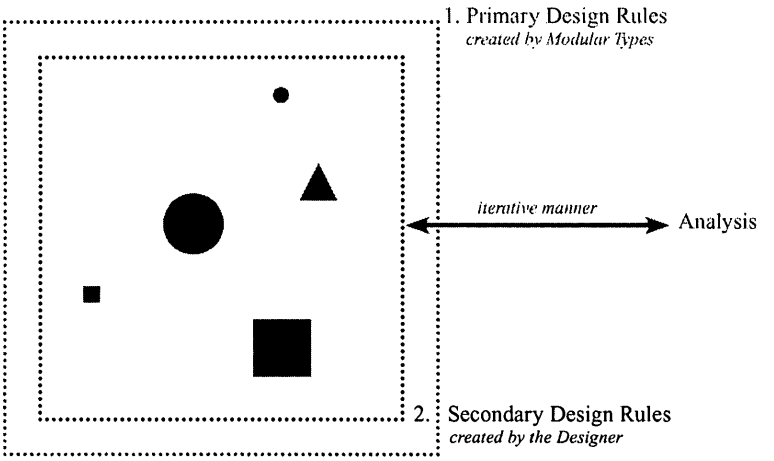
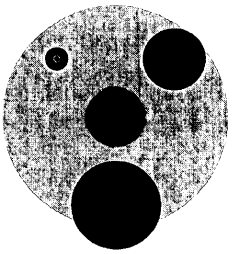


Figure 14. *Underlying Method* of my exploratory practice created through design rules & an iterative design process.

elements can be either partly or completely replaced, or altered throughout the process, the same holds true for the flexible (secondary) design rules.

Within the explorations I considered the three forms of how we receive information defined by Dondis (1973) for each type of modularity. In design practice the three forms build a foundation for the visualization of any visual information in the field (see Fig. 15.1 – 15.4):

1. *Representation* is a visual form with a specific reference to reality (our environment), for example, a realistic 3D-model or photography.
2. *Symbolism* is a visual form to which meaning is applied, for example, the nuclear symbol is an abstract sign which stands for radioactivity.
3. *Abstraction* has two stages, the first approaches Symbolism, sometimes with experienced meaning, sometimes with arbitrarily attached meaning; the second stage is pure abstraction, the reduction of the visual statement down to the basic elements bearing no connection to any representational information drawn from experience of the environment.



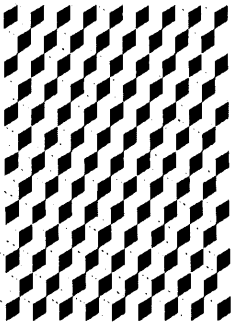


Figure 15.1. Franziska Erlebach, *Representation*, 2012
Figure 15.2. Franziska Erlebach, *Abstraction approaches Symbolism*, 2013
Figure 15.3. Franziska Erlebach, *Pure Abstraction*, 2013

Figure 15.4. Franziska Erlebach. *Symbolism*, 2012

The form of *representation* gave me an insight into the behavior of meaning within a modular framework. *Abstraction* provided me with a more general and all-encompassing view about the six modular types. Finally, I narrowed the *symbolism* down to typography, which provided me with the opportunity to apply the different types of modularity to a specific subject (Dondis,1973). An exploration was considered successful when two criteria had been met. First, when I mastered the requirements of the specific modular type (primary design rules) within the relevant form of information retrieval. Second, when the secondary design rules led to an aesthetically pleasing visual result for a trained designer eye. This can be measured by whether the exploration was driven by first design principles (Table 3). The result is an analysis of the types of modularity within the three forms of receiving visual information. My work process was a constant interplay between *manual design* and *computer-generated design.* For the present investigation *manual design* refers to working by hand and moving objects by mouse, design tablet, touch screen or other devices, which can control elements on the screen; *computer-generated design* is defined as the control through a programming language (Processing), which generates visual results. In *computer-generated design*, creative process was reduced to an act of writing a program and setting limitations without direct control over the visual outcome, the results of which were controlled by the program and its random decisions. Within both ways of working, modularity inspired the use of different materials as collage, tape/sticker, paint, photography, vinyl and Plexiglas.

Different materials could either reinforce or diminish features of each modular type, which encouraged investigation into the positive influence of materiality upon an idea (e.g. *Death Poster*, see App. 2.7) or even materiality's potential to drive an idea (e.g. *Half Circle Type*, see App. 3.5). This approach led to eighteen experimental explorations (6 modular types * 3 forms of receiving information) which included 2D as well as 3D explorations and motion graphics. Working across different mediums afforded me a closer picture of the framework as well as of advantages and disadvantages of each of the six types. The benefits of such an approach have already been noted by Marshall McLuhan, who observed that *"understanding always requires a multidimensional approach"* (Gordon, 1997).

In order to be able to compare each type of modularity, I decided upon a three-stage process where in I worked on six explorations simultaneously. I choose to work on the six different types within one of the three forms of receiving visual information to impose a permanent comparison between each of

the modular types. I began with the representational form because it seemed the form least associated with a modular context, the abstract and symbolic followed respectively. The entire process of making contributed to my research in the same intensive way as the literature did. The design process even led to specific points of my theoretical research.

MODULARITY & THE CREATIVE PROCESS

Before I move on to deliberations about the creative process, I would like to provide a brief explanation of what creative design actually means from both a psychological and a design point of view because these two fields create the foundation of my theoretical investigation. Nigel Cross (2006) and Bryan Lawson (2006), both Professors with academic and practical backgrounds in architecture, describe creative design as design that can occur by combining features from existing designs into a new combination or configuration. Psychological studies use a similar definition; according to Sandra W. Russ (1993), something counts as creative if old facts are integrated in new ways, new relationships emerge from old ideas, or there is a new configuration. These two definitions already include one point of my essential findings, but before I describe my results in more detail I want to talk about more general findings important for a creative process.

My experimental practice for this project was unlike how my education had taught me to approach a design issue. The process of the eighteen explorations which I conducted was one of discovery rather than logical stages, a back and forth of making and analyzing; an interplay of the different projects that I was working on simultaneously. The projects informed each other instead of being treated separately. Modularity promoted this kind of process and even guided it along such a nonlinear approach. A cursory look at the visual outcome of my explorations has already revealed improvements to me in comparison to results based on my previous linear working practice. This implies that a nonlinear creative design process has relevance and even advantages for creativity. Cross and other scholars in design (Lawson, 2006) as well as those in the field of psychology have come to a similar conclusion. Cross (2011, page 27) asserts that critical opinions about nonlinear work methods with periods of uncertainty, with longer explorations and with reliance upon intuition led to attempts to provide design methods that encouraged designers to work more rationally. Such guidelines are generally outlined as a linear process of analysis-synthesis-evaluation that is based on the creative problem solving stages espoused by the psychologist Walles (1926). Many current day models of creative problem solving can be mapped from an adaption of this early model, which included 4 linear steps:

1. *Preparation Stage*: research, analyzing the problem
2. *Incubation Stage*: ideas evolve without regard to the problem's solution, a stage where uncertainty plays a role
3. *Illumination Stage*: recognizing a solution
4. *Verification Stage*: evaluating the solution

The linear creative process has also faced criticism from the psychological field. William Edgar Vinacke (1952) and Catharine Patrick (1955) have demonstrated through a series of experiments that creative problem solving does not occur in stages (not linear), but involves an interweaving process (nonlinear). The findings from both design and psychology validate the impression I gained from my experimental practice.

A more in depth look at my findings brings to light the close connections between modularity and my theoretical research about the creative process. In particular, four points occurring throughout my entire experimental practice were crucial for my creative process: 1) Structure & Flexibility in the Creative Process 2) The Generation of Blind Variations 3) The Recombination of Elements 4) Key Strategic Aspects of Design Thinking. Although these points will be discussed separately for reasons of clarity, it is important to note that the first three are interwoven and almost inseparable. The first three points will be described first in a subjective manner, resulting from my own notes, my process work and memories, followed by an objective description grounded in theoretical research in psychology and design.

1) Structure & Flexibility in the Creative Process

The modular framework in my experimental practice, created by the six types of modularity (primary design rules) as well as by the secondary design rules (depending on a designer's decision), played a crucial role in each of my eighteen explorations. It provided a structured and guided process, while simultaneously creating a playground for my exploratory practice with freedom for visual exploration and discovery of novel combinations on a nonlinear basis.

An example from my practice is the exploration *Image Grid* (see Fig. 16).

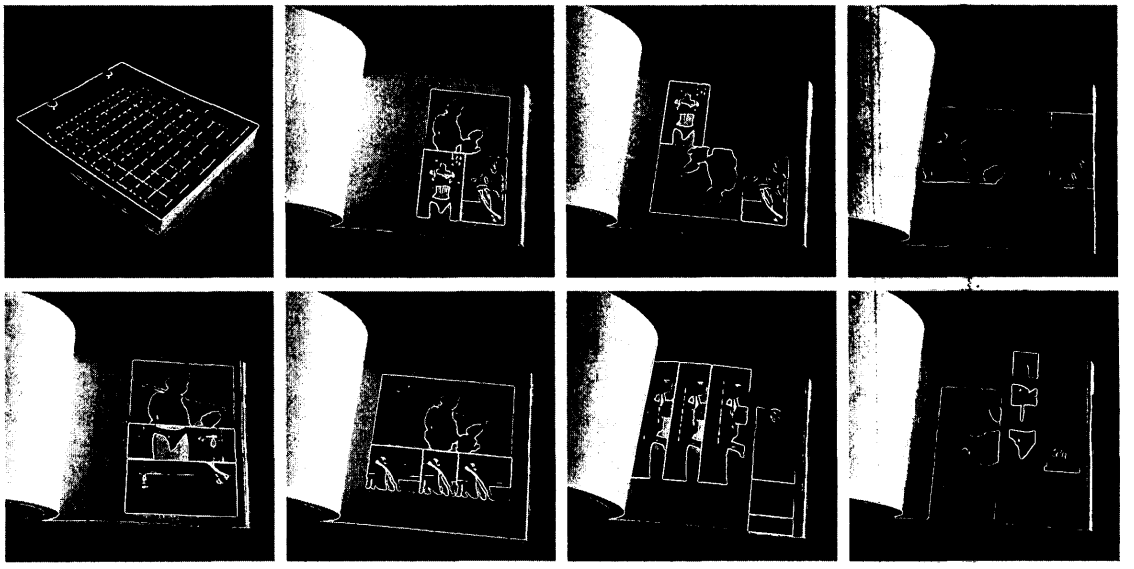


Figure 16. Franziska Erlebach. *Image Grid* (sequential selection), 2012. 153 Pages 6" x 6", inkjet print & animation (see CD).

The primary design rules were defined by a standard structure, which is in this instance represented in form of a grid, to which a varying number of elements can be attached. In the case of this experiment, the varying number of elements is limited to a selection of six images. These images were taken at different times, in separate contexts without any intention of combining them at any point. The secondary design rules served to aid the placement in the grid (e.g. bleeding over the edge, size and rotation of images, spacing between them, amount of images and the framing of motif). The adaptation of the secondary rules took place during the exploration. The process went back and forth between the adaptation of the secondary rules and the reorganization of images and approximately 150 different variations based on three different image combinations were produced.

The process of getting to know the elements from new perspectives seemed to offer me a form of structured play. Moreover, I found inspirational freedom within the limitations of the modular concept. This inspirational freedom should not be interpreted as total freedom, which can easily lead to a halt in progress because work on too many ideas may result in difficulty focusing. In *Image Grid*, the initial results were a variety of commonsense combinations, but in later stages new combinations emerged which I would not have tried without this underlying structure. The aforementioned interplay of limitations and flexibility played a crucial role in both this and my other explorations.

> *"Working with the constraints of a problem is part of the fun and challenge of design. Modularity is a special kind of constraint. A well defined constraint can free up the thought process by taking some decisions off the table." (Lupton & Phillips, 2008)*

There are several sources in the literature of design that suggest a balanced approach of a systematic or structured work process, which provides flexibility and space for exploration simultaneously in order to promote the creative process in design.

In the1960s Karl Gerstner (2007) suggested developing programs for design problems rather than for single solutions. Gerstner asserted that programs were a means of developing a structure in which to be creative. While a structure can appear restrictive, this seeming limitation can establish parameters for a design problem, which can keep a designer focused. In his 1970 book, *Design Methods*, which is considered a major text in design, Christopher J. Jones (1970), a Welsh engineer and industrial designer, wrote about a two-sided *design process "... none of the design methods that have appeared so far is as complete as it looks and that some mixture of both rationality and intuition is needed in the solving of any design problem."* At the time there was insufficient research to explain the behavior of designers and their design process more closely. However, Jones was beginning a discussion about the combination of rational and intuitive design methods. Fricke (1993, as cited in Cross, 2006), a German engineering designer; Bryan Lawson (2006), Professor in Architecture with academic backgrounds in psychology; and Cross (2006, 2011) substantiate Jones' remarks with their more recent research. Fricke conducted a number of studies in systematic design processes. His results revealed that designers who followed a 'flexible-methodical procedure' tended to produce good design solutions. In comparison, designers with an excessively rigid compliance to a methodical procedure or an extremely un-systematic approach produced indifferent or poor design solutions. Cross (2006) came to a similar conclusion based on his observations, experiments, interviews and think-aloud protocols of designers in practice. He states that following a reasonably-structured process seems to lead to greater design success; however, rigid, over-structured approaches do not appear successful. He pointed out that flexibility seems to be the key of a successful approach.

Scholars in the field of psychology touch upon the notions of structure and flexibility in the creative process from a slightly different angle, but with the same conclusion.

> *"Play is recognized as a way of achieving innovation and creativity because it helps us see things differently or achieve unexpected results. A playful approach can be applied to even the most serious or difficult subjects because playfulness is a state of mind rather than an action " (Fullerton, Swain & Hoffman, 2004).*

The field of psychology examined "play" as a natural path of creativity that proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner (Huizinga, 1955). Mainemelis & Ronson (2006) and Haefele (1962) add to this that a creative person needs freedom. This freedom is necessary to reach a state of mind which allows unconscious activity and interplay of individual creative stages that require a nonlinear/playful working process. The "play" approach to the creative process also suggests a combination of fixed rules and freedom concurrently. The findings of these researchers and professionals from both fields confirm the observation of my experimental practice and show the importance of the combination of structured guidance and flexibility in the creative process.

2. The Generation of blind Variations

This section combines two major findings that must be seen as linked to each other. The first is the generation of a number of variations; the second is that uncertainty during this creation process results from the fact that the designer is not creating variations with a view to a particular solution, but rather in an illogical fashion.

Concerning the first point, the six types of modularity, according to their definition, allow either for a great diversity without significantly changing the nature of the work piece or for individual and fundamental changes within the structure of the work piece. In either case, numerous variations of an idea result. With regards to the uncertainty in the process, which is in the first place a phenomenon in the designer's mind, the flexible secondary design rules of modularity grant the designer space for discoveries in different directions within the bounds of the primary rules that keep the designer on track. In other words, the designer is encouraged to explore things more thoroughly, which increases the likelihood of discovering new combinations.

I will explain these points using two examples from my experimental practice. The first example is *Body Parts*, an instance of a great diversity without changing the nature of the piece (see Fig. 17).

Figure 17. Franziska Erlebach, *Body Parts* (sequential selection). 2012. Flip-book 6" x 6", inkjet print & animation (see CD).

The main idea was to collage a human form out of elements of the human body which originally did not belong to each other; each element was flexible in size. The result was different variations of a human form that could stretch from common to grotesque body proportions. I worked through a number of possibilities, only a fraction of which were used for the representative piece. While generating these different proportional variations, I did not know where the process would lead me. The actual idea for a flip-book and a related poster (see App. 1.3) did not emerge until after I made the connection that these diverse looking human forms could represent the diversity of people in my multicultural environment. In this case my exploration even led me to my topic. The second example from my experimental practice, *Remaining Eyes*, is a piece which changes its nature within different variations (see Fig. 18).

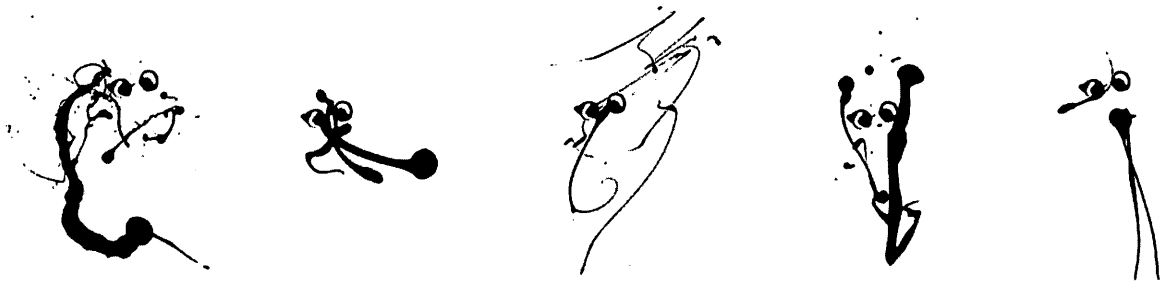


Figure 18. Franziska Erlebach, *Remaining Eyes*, 2013. Animation 6" x 6", acrylic paint (see CD).

The shared element, a pair of eyes painted with a chopstick, remains in a fixed position. This element persists as a top layer and is combined with a variety of different forms painted with the same materials. The result of these combinations, however, creates characters with different qualities based on how the paint was introduced to the paper (dripping/circling/tossing slowly or quickly) and generates a great number of various combinations which represent faces, animals or fantasy figures. The process of finding these combinations required the creation of a great number of forms which could be combined with the

eyes, as well as tests to discover whether the combinations reveal characters at all. Throughout the project, I could not anticipate whether the forms created would reveal characters; it was an uncertain process where a solution remained unclear until I had tried multiple possibilities which revealed some efficient combination.

In his 1960 paper, the American psychologist Donald Campbell proposed a model for creativity occurring via the process of *blind variation* and *selective retention* (BVSR process). His model has its origin in the Darwinian theory of evolution. As the model described by Campbell is not only intriguingly similar to what I observed in my personal creative process in some of my explorations but also touches on points highlighted by the design field, it is worthwhile to detail the *BVSR* concept. A BVSR process involves two theories; the generation of blind variations (BV) and the selective retention (SR), but because only the first theory of the process is of interest in the present investigation I will begin by mentioning the second theory cursorily and then proceed with a more detailed description of the first theory. The *Second theory* refers to the SR (selective retention) portion of BVSR. SR is influenced by a set of criteria that lead to an ideational variation which is retained for further use (Campbell, 1960). From a design perspective this seems to be common practice in the design process: the most appropriate solution to a given design problem is selected out of a variety of solutions and is used for further development, a notion confirmed by Briskman (2009). The *First theory* of the BVSR process contains, according to Campbell, the BV– generation of blind variations. He describes it as procedure in which the creator engages in some process the outcome of which is uncertain in any given trial. This phase of the BVSR process deals with the two points that I outlined above: the creation of variations without knowing where they will lead. Cross (2011) confirms this phase when he states that a designer does not known their goal; the designer creates the goal in creating a solution concept. Campbell offered suggestions about what kind of mental process would generate the blind variation of creative thoughts. His suggestions are built on previous speculations of various thinkers, but especially those of Henri Pointcaré (Brain, 1874, as cited in Simonton 2009). The gist of Campbell's argument is that *"in essence, the variations emerge throughout some variety of combinatorial process, a process that involves some degree of chance or unpredictability."*(Hadamared, 1921, as cited in Simonton 2009).

Picasso himself provides a good example for a BVSR process in a visually based field. He saved the sketches that he made in the process of creating *Guernica.* His sketches (see Fig. 19) show that the development of each figure in the painting was developed separately (Simonton, 2007). An analysis of all his existing sketches strongly supports the argument that the creative process underlying Picasso's *Guernica* (see Fig. 20) was accurately identified by several scholars as a BVSR process.

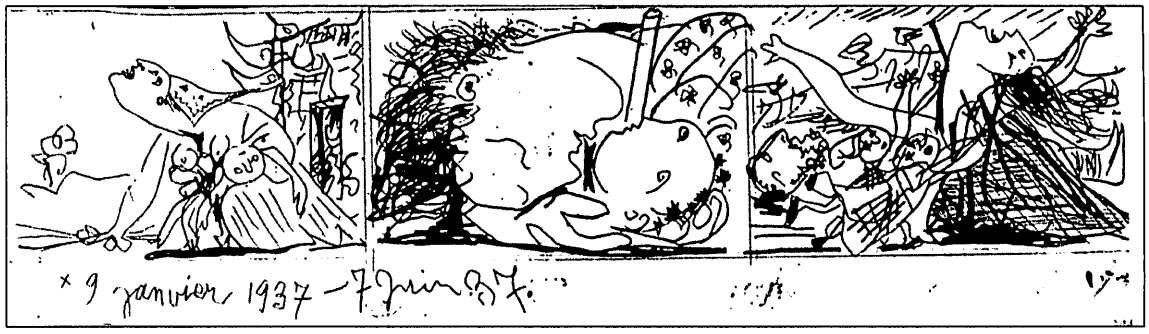


Figure 19. Pablo Picasso, last three sketches of *The Dream and Lie of Franco* are directly related to studies for Guernica, 1937. 12.4" x 16.5", Etching.
Figure 20. Pablo Picasso, *Guernica,* 1937. 137.4" x 305.5", Oil on canvas.

Picasso was clearly engaged in the generation of illogical variants instead of sequential variations towards a particular aim (Simonton, 2009, 2007). Simonton (2007) states that Picasso could not foresee the solution until he saw it in front of him because the creative process relied on blind variation; throughout most of the process he was *"groping in the dark"*. I am by no means trying to compare myself with Picasso, but with regards to blind variation his process quite closely mirrored my experience, for example in my explorations

Remaining Eyes (see Fig. 18) and *Body Parts* (see Fig. 17) described above. Other explorations that followed the same process are *Rectangle Mix* (see App. 3.2) and several of my computer-generated explorations, such as *Overlay Toronto* (see App. 1.4) and *Changing Face* (see App. 2.1 & 2.2). In the computer-generated pieces the Processing program takes over the generation of variants and the designer resumes control for the selection process.

Simonton (2007) separates ideational variants that are completely random, unconstrained, and unpredictable from those diametrically opposed to the former group, namely variations so systematic, constrained and predictable that they should be considered improvements rather than variants. Similarly, Picasso's artwork displays remarkable differences in the degree to which they likely depended on blind variation and even in the sketches for *Guernica* levels of varying versus improving variants can be found (Simonton, 2007). The same phenomenon is observable in those explorations of mine where I only elaborated and improved upon my initial ideas: *Walking Shoes* (see App. 1.5) *Scribble Painting*, *B/W Pattern* (see App. 2.3 & 2.4) and *A-R-T Letters*, (see App. 3.2). I think the difference of varying versus improving variants signify how varied the creative process of even one individual can be.

Beyond BVSR we find the concept of uncertainty or 'being loose' applied in another area of psychology, the process of 'play'. Huizinga (1955) and Fullerton, Swain & Hoffman (2004) emphasize the intensive mental absorption as representing a state of mind which emerges within a play activity. The deep involvement in an action with a loose state of mind expresses a similar condition as in a creative design process where periods of in depth work without knowledge of the resulting output occur.

The field of design certainly identifies both the concept of 'blindness', uncertainty or intuition in the creative process and the generation of variations as crucial. However, my theoretical engagement gave me the impression that design does not highlight the connection between each as strongly as psychology does. Lawson (2006) is only one of many who talk about the phenomenon of uncertainty in the design process. He states that good designers are capable of coping with uncertainty in their process.
Jones (1992) claims that to be creative is to be necessarily and productively "*irrational*" and comments on John Cage's approach to music, *"The Cagean method of composing not only music but life itself was, I learned, to give up intention, to seek unpredictable results."* (Jones, 1984). With regards to the design field,

then, "*being in the dark*" in place of control is key in a creative process, a fact confirmed by two different theories related to the same field.

Concerning the generation of variations, the terms 'variations', 'alternatives' and 'variants' must be clarified and put in context as to how the different authors use them. Simonton (2009) uses the terms variations and variants interchangeably when referring to Picasso's sketches. However, in his analysis he notes that there is large amount of different sketches for each figure and states that some of Picasso's sketches, for example of the warrior, display *"a nearly zero correlation"*. This raises the question, at what point does a variation of an idea turn into a variation into a new idea/concept. The divide between these two terms becomes particularly unclear in a fluid process of creation without linear stages. Looking at my own experimental practice, I could perceive when an exploration continued to deal with the same idea during its entire process, but I could not estimate in every case whether my initial idea changed into a new one through the creations of a large amount of variations. This blurring of terms must be kept in mind when looking at Lawson (2006), who introduces the generation of alternatives as one of several design tactics in his book *How Designers Think*. Lawson uses the term "alternatives" to describe the importance of pursuing different ideas instead of focusing on one idea at the beginning of a creative process. Lawson represents two different approaches based on individual practice of two architects. The first architect approaches issues based on materials *"... calculated stimulus of trying different combinations of materials ..."*. The combinatorial process depicted can be seen in a modular manner, which I will describe in more detail in the following section. The second architect explains the process of the generation of alternatives using a series of layouts (see Fig. 21).

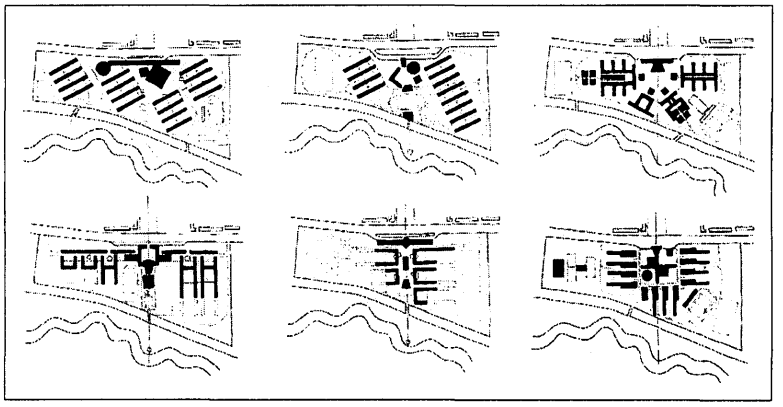


Figure 21. Michael Wilford, *Architectural Layouts – Temasek Polytechnic*, in Lawson (2006).

A closer look at these layouts reveals that the spatial frame remains the same and only the combination and placement of a similar set of elements changes *"... it is much more about the deposition of major elements..."*. Both approaches show parallels to the modular approach outlined through this paper. Cross (2006) mentions the phenomenon of fixating upon an idea early on in the process, which he explains is quite common among designers. According to Cross, this fixation hampers the discovery of new solutions and can lead to conservative results. The point which Cross makes refers directly to the fact that previous knowledge can be counter-productive for a creative process, which will be discussed in detail in the following section. Both my use of a modular approach to broaden my own creative process in order to break out of exactly this kind of creative pattern and the relative success of these attempts led me conclude that both concepts of variations and alternatives, described above, were not as different as they initially appeared. The fact remains that a designer must overcome initial conventional thoughts; they must break out of established patterns in their making process in order to discover novel combinations (Michalko, 2001).

3. The Recombination of Elements

This section touches upon the previous one but shifts focus from blind generation to reorganizing and recombination. At the same time this section deals with the main point of the definition of creativity stated at the beginning of the chapter "Modularity & the Creative Process", namely that the term 'creative' includes the idea of creating something new out of old parts/elements, a fact about which the field of design and psychology are in agreement. An example from my exploratory practice would be *B/W Pattern* (see Fig. 22), where I noticed that the combination of (a) an underlying structure (primary design rules) provided by an interface which defined how elements could be connected with each other with (b) my own limitations from the secondary design rules (2D, only black/white and must create the same rectangle format) prevented me from judging and steering during the creation process based on my previous knowledge. The release of control to the modular concept encouraged me to try combinations which I would not have tried without this underlying structure. Admittedly, most of these combinations were predicable, but they led me to further, novel variations and even to the idea of combining not only the small units with each other but also the rectangles with the individual patterns as created by these units.

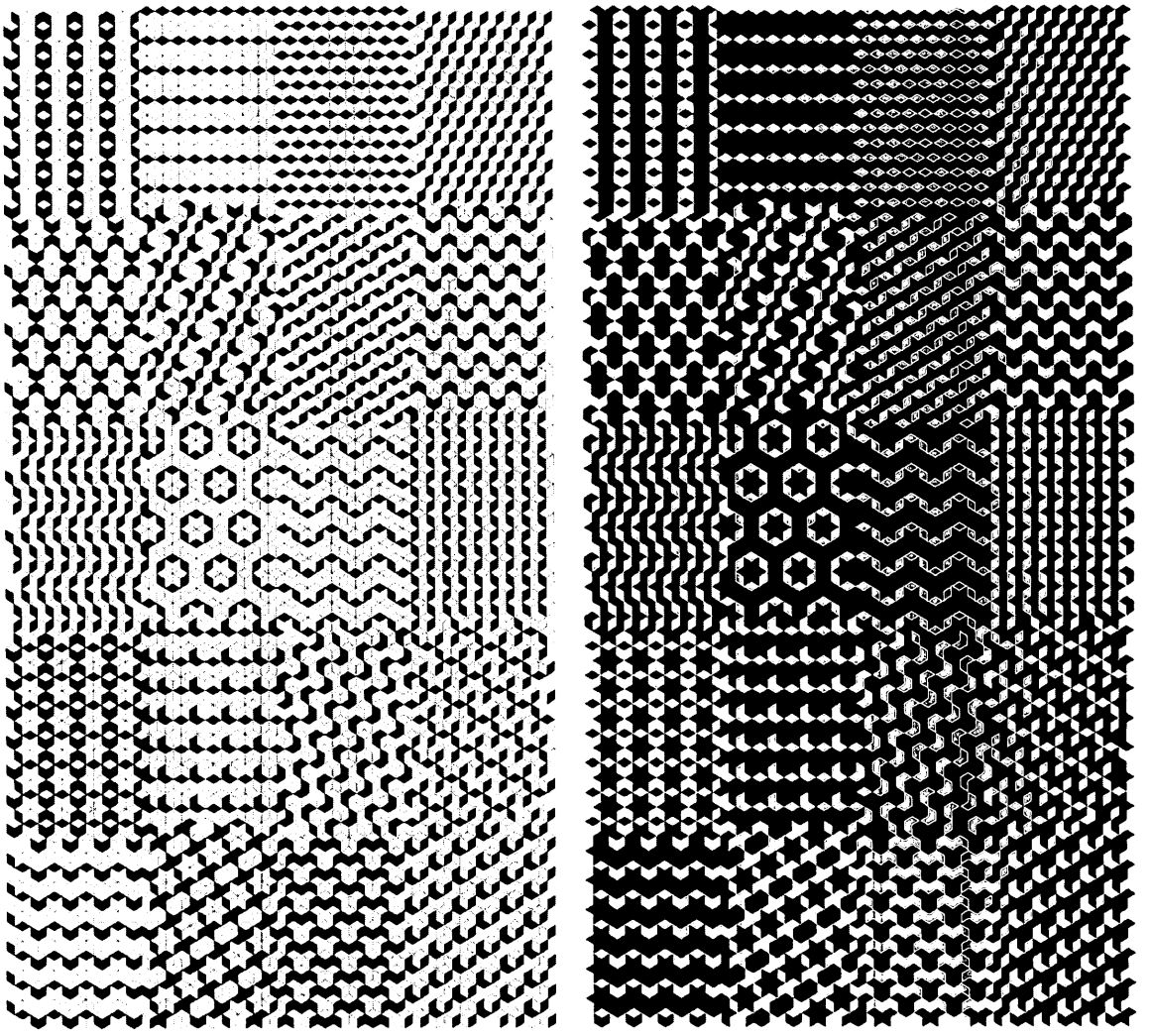


Figure 22. Franziska Erlebach. *B/W Pattern*. 2013. 2 Posters 24" x 44", Laser print.

Another example from my exploratory practice is *Overlay Toronto* (see Fig. 23). In this exercise the actual recombination of different images of sights and architecture of Toronto was conducted by the Processing program which used a palette of images to create a mix of novel and conventional combinations bearing no resemblance to each other in order to create a new image of the city based on overlaps. In this case my judgement was suspended because decisions concerning images and their combination were made by the program; my role was confined to the set up the elements and the frame in which the program would act. Many of the combinations generated did not correspond to my understanding of 'good' from a design

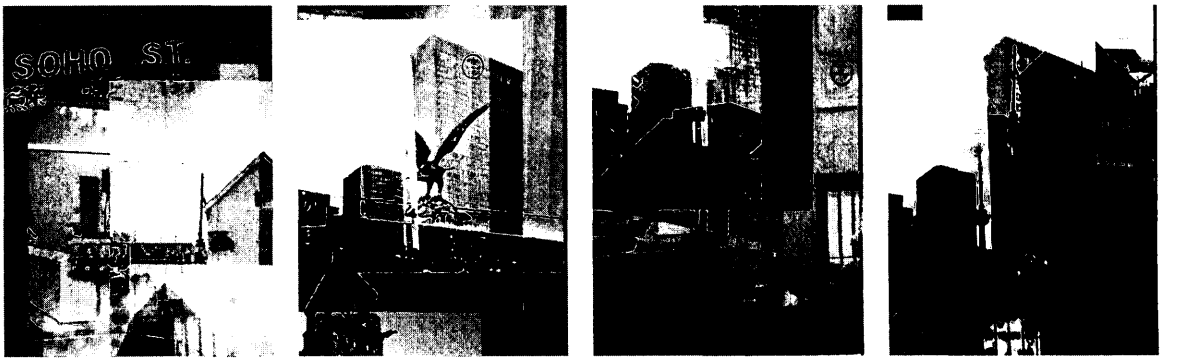


Figure 23. Franziska Erlebach. *Overlay Toronto*. 2012. Processing application 600px x 750px. digital collage (see CD).

perspective, but others did so quite strongly. The same results were discernible elsewhere in my explorations, for example, in *Changing Face* (see App. 2.1 & 2.2) and *Welcome* (see App. 3.6).

The fact that previous knowledge can be counter-productive in the actual making process is also indicated by Simonton (2009). Lawson (2006), while commenting on the importance of objective and subjective evaluation for designers, promoted the suspension of judgment in order to allow a creative flow of thoughts and the growth of ideas before their elimination through invasive criticism.

The psychologist Guilford (1968) came to a similar conclusion. He focused on cognitive processes in his research and a made major theoretical contribution addressing the question of which cognitive processes are involved in the creative process. Guilford's work was based on principles which continue to be used as the basis for creativity research today (Russ, 1993). One of Guilford's principals states that creative abilities falls on a continuum. All individuals have the ability to be creative to some extent; the ability is not awarded to only a few eminent individuals. It seems to me that Guilford tries to make the point that creativity depends more on the continual investment in the investigation/exploration of a topic/issue than an individual's ability to be creative. Simonton (2007, 2009) suggests the same fact, that creativity is rather quantitative than qualitative, but he also concedes that a tremendous amount of variations of a particular idea (as in the example of *Guernica*) is not required. Another of Guilford's Principal seeks to demystify creativity: it is not a magical, mysterious occurrence, but the product of cognitive processes unique to it. He concluded that two major categories of cognitive processes were important for creativity. The first was that of divergent production abilities with the underlying concept of variety, a concept with direct links to the remarks in the previous chapter. More important for the present

discussion is Guilford's second category of cognitive processes: transformation abilities. These, according to Guilford (1968), enable an individual to transform or adapt previous knowledge into new patterns or combinations; they foster the flexibility to reorganize and to break out of old patterns. This is a process of reordering, redefining or reinterpreting of things which are already known, much like those described through my own practice.

The concept of reorganizing is another aspect that is discussed as important part of the creative process in the fields of psychology and design alike.

4. Key Strategic Aspects of Design Thinking

The following three aspects refer to my entire experimental practice including all eighteen explorations and should be seen hereafter as an all-embracing analysis which reveals conjunctions between modularity and the creative process as well. Nigel Cross (2011) formulates three key strategic aspects of design thinking which are crucial for a creative design process. The first is taking a broad 'system approach'. According to Cross's research, the innovative designer has a systems mind, one that sees things in terms of how they relate to each other. The 'modular systems approach' incorporates Cross's point as can be seen throughout my investigation. The second aspect is framing a problem in a distinctive way. This aspect can also be dealt with using modularity, and Cross describes the exploration of the problem from a particular perspective as necessary in order to frame the problem. Each type of modularity frames an issue from a different perspective based on their definition provided earlier (see Table 1).

TYPES OF MODULARITY	FROM THE PERSPECTIVE OF ...
Bus	... the underlying structure
Sectional	... a particular way of connecting elements with each other
Cut-to-fit	... the proportional relationships of the elements to each other
Mix	... a set of elements
Component – Sharing	... one important element
Component – Swapping	... a stable base

Table 1. *Perspectives of Modularity*

The third and last aspect of the discussion is designing from first principles. Based on Cross observations, the innovative designer either explicitly or implicitly relies upon 'first principles'. Different designers have their own idea about the basic principles of design. To that effect, it is important to note that I choose to explain 'first principles' using those expressed by Lupton & Phillips in *Graphic Design the new Basics.* According to Lupton & Phillips (2008) rhythm & balance, scale, figure/ground, framing, hierarchy, layers, grid, time & motion, modularity and pattern (see Table. 2) make up the common basic design principles with respect to the technological development of the last decades. Lupton & Phillips include modularity as a basic principle on its own. Their definition of modularity equals the core definition which I gave at the beginning of the paper. Therefore, I have left out this principle because it would apply to all of my eighteen explorations. The "Grid" creates a principle on its own as well, but I include it in my analysis but because it is only one kind of a possible underlying structure of bus modularity.

Within any design, interplay of different design principles occurs. According to Cross (2011), however, an innovative designer uses first principles to drive their process and work. A retrospective analysis of my work produced in the last 8 months shows an approach based upon first principles (see Table 3). It is worth mentioning that this approach was not used intentionally while I was working on the eighteen explorations, but it seems to me that the modular approach forced me to concentrate on specific features and supported working with first principles.

Cross's 'Key Strategic Aspects of Design Thinking' showed parallels between his research about an innovative design process and the modular approach and they reinforce the findings in the three earlier sections of "Modularity & the Creative Process". All four points highlight the links between a creative design process and modularity.

BASIC DESIGN PRINCIPLES	EXPLANATIONS ACCORDING TO LUPTON & PHILLIPS
Rhythm 	Rhythm is a strong, regular, repeated pattern. In graphic design rhythm is used in the construction of static images as well as in books, magazines, and motion graphics that have duration and sequence.
Balance 	Balance achors and activates elements in space. Visual balance occures when the weight of one or more things is distributed evenly or proportionately in space.
Scale 	In objective terms, scale refers to the literal dimensions of a physical object or to the literal correlation between a representation and the real thing it depicts. Subjectively, scale refers to one's impression of an object's size.
Figure/Ground 	Figure/gound is also known as positive and negative space. Graphic design often uses the relationship between figure and ground to bring energy and order to form and space.
Framing 	Cropping, borders, margins, and captions are key resources of graphic design. Whether emphasized or erased, frames affect how we perceive information.
Hierarchy 	Hierarchy is conveyed visually through variations in scale, value, colour, spacing, placement, and other signals. Visual hierarchy controls the delivery and impact of a message.
Layers 	Layers are simultaneous, overlapping components of an image or sequence. The concept of layers can be applied in the physical world as well in the digital.
Modularity 	Modularity is a specific kind of constraint. A module is a fixed element used within a larger system or structure.
Grid 	A grid is a network of lines, an underlying structure that unifies pages of a document and makes the layout process more efficient. A grid can be angled, irregular, regular or even circular.
Pattern 	A pattern is created by composing a single element in different schemes, endless variations can be created.
Time & Motion 	Time and motion are closely related principles. Motion is a kind of change, and change takes place in time. Time and motion are considerations for all design work in still and time-based media.

Table 2. *First Principles* expressed by Lupton & Phillips in *Graphic Design the new Basics*.

Table 3. *Retrospective Analysis*, 'First Principles' which occurred in each exploration.

TYPES OF MODULARITY	REPRESENTATIONAL	ABSTRACT	SYMBOLIC
BUS	**Image Grid** Cropping and spacing of the images are driven by the underlying structure of a regular grid.	**Changing Face** Functions based on an underlying structure of a face and plays with changing dimention of a 2D circle which creates a pulsating motion.	**Dot Grid** The word "perspective", deconstructed into dots, changes its textural appereance through movement on top of a underlying dot grid.
SECTIONAL	**Cube City** Concerns the cropping of images from Toronto street signs based on the six sides of a cubes and a cutout of the original image which, steers perception. Each cube is a part of a larger system.	**B/W Pattern** Two elements of the same shape, one white and the other black, create a large variety of different schemes. A play of positive and negative space is created caused by the colour of the elements.	**Fake Type** 26 different shapes treated as letter forms which create words and sentences through tracking line spacing. They create a balanced appearance which occurs as legible type.
CUT-TO-FIT	**Body Parts** Plays with the literal correlation between the representation of the body parts and the actual scale of the elements to each other.	**Colour Pattern** Four rectangles, flexible in their dimentions to each other, form together a larger rectangle with constant dimentions. A specific amount of larger rectangles create together different schemes.	**A-R-T Letters** Creates 190 variations of the letters A, R & T based on dimensional changes of the different parts of the letter forms.
MIX	**Overlay Toronto** Images of different sights and architecture of Toronto are overlaped simultaneous by a Processing program in order to create a new image of the city.	**Scribble Painting** A large a mount of scibbles are layered on top of each other in order to create a motif of a painting. The scribbles move around within an unchanging frame and create a picture in motion with a repeatedly changing motif.	**Rectangle Mix** Letters deconstructed into rectangles are overlayed by a field containing rectangles of the same size. By repositioning the field with respect to the letter various appearances of the letters occur based on the colour of the rectangles.
COMPONENT – SHARING	**Walking Shoes** Separate frames of a pair of shoes, the sky and the view straight ahead of a walking person provides three very detailed and seperate perspectives of a person moving on the street.	**Remaining Eyes** A pair of eyes remains a stable element on top of another repeatedly changing layer, these two layers combined create something new (e.g. character, face, animal).	**Half Circle Type** A typeface which is created out of two layers, one layer with at least one half circle in each letter and another layer with unbowed forms which complete each letter form.
COMPONENT – SWAPPING	**Public Square** Frames a part of a public square and depics the changes in the amount of people passing by, the general movement and hue of light within a set timeframe.	**Death Poster** Stable and flexible elements in each poster of a series are distributed on a page to create a visual balance within different motifs.	**WELCOME** Provides a light, regular and bold base of the word "welcome" where the user can add and combine different parts with different characteristics on top.

CONCLUSION

My investigation reveals that a moderate underlying structure/strategy in a creative process offers guidance and space for explorations simultaneously. This conjunction encourages playful phases where uncertainty can easily occur in the process which promotes the discovery of new combinations. Within these uncertain and playful phases the generation of numerous variations and recombinations aids in the discovery of innovative design solutions. A modular approach encourages all these points. The key aspects of Cross (2011) affirm these facts and in addition expresses that a focus on first design principles positively influences the achievement of an innovative result, which is also fostered by modularity. Thus modularity not only contributes to the design practice from a visual perspective, it also inspires us to rethink the creative process.

Throughout my exploratory practice I noticed that *Sectional Modularity* did not contributed as greatly to the creative process as the other modular types. This fact is not particularly surprising because *Sectional Modularity* is limited in its use, it requires an interface that restricts the play with meaning and reduces the visual results to a formal exploration of form. That is exactly the type of modularity which represents our conventional idea of modularity. The other modular types go beyond our general notions of a modular concept and provide new insights and perspectives for a creative design process.

The connections between the BVSR model and a creative process in design warrant more detailed research. Though many aspects of the BVSR process support its validity for a creative process, my theoretical research also revealed that the importance of the first step of the BVSR process, the generation of blind variations, for the creative process of humans has been called into question. Sternberg (1998) argues that experience-based knowledge is preferable for humans, who would need to spend an inordinate amount of time to reach a suitable resolution for problems if they relied solely on BVSR. While true, this statement does not outright deny the efficacy of BVSR, nor does it address the fact that, in the absence of experience-based knowledge or access to it, BVSR remains a feasible – perhaps default – alternative (Perkins, 1998) Furthermore, it is arguable that all experience-based knowledge is itself a product of a previous BVSR-process. Based on my experience, working with a modular structure definitely accelerates the creation of variations. In respect to the creative process, then, where reliance on previous knowledge can be a disadvantage, Sternberg's argument loses some of its strength. On the other hand, BVSR was a

small part of my theoretical research and I have chosen to include this section only to reveal the model's relevance to my experimental practice, which could aid in finding perspective for further research of BVSR.

Interestingly, the contributions made to the creative process from a design perspective throughout my research were exclusively provided from researchers, educators and practitioners from the fields of architecture, product-/industrial- design and engineering design. Lawson (2006) and Cross admit that their research is primary directed toward problems that are solved within 3-dimentional design and partly engineering. Nevertheless, the analysis of notional maps referring to the creative process in various fields show significant resemblance, which suggests that the design process is perhaps the same in all fields (Lawson, 2006).

Another point which I wish to mention concerns the creative process and my experimental practice. As I described, my process included working on six explorations simultaneously, which influences the creative process positively, a fact which both Cross (2011) and Lawson (2006) note as crucial for the working strategies of innovative designers. Experiences gathered in my present investigation confirm their deliberations: my explorations informed each other and often material initially created for one exploration was used for another. Hence, we must consider what role simultaneous projects played alongside modularity in influencing my creative process positively.

Despite any influence stemming from the parameters of my experimental practice, my practical and theoretical investigation reveal that modularity promotes several important aspects that are required for a creative design process according to the literature. Of course, the creative design process is a highly personal and multi-dimensional process (Lawson, 2006), one therefore different for each designer and also dependent on their backgrounds, personalities, experiences and motivation, points which I have not addressed in the present paper because they did not fall directly within my current research. For these reasons the results of this investigation cannot be seen as a general method for promoting creativity in graphic design, it is rather a strategy. One of many, which helps me and perhaps others to open up their personal creative process and serves as a guiding principle. However, the insights gained from my study enrich the graphic design field and can even contribute to our approach to design education, one shifting away from a linearly structured process and towards an nonlinear process with a framework enabling

efficient exploration. Not only do these insights have relevance to an educational context, but they can also be applied in the professional field where they can improve the process and quality of work in design agencies and studios. I hope that my research encourages a broader look at modularity in a more contemporary light in the graphic design field, as is the case in other related fields, to show the potential of the modularity concept beyond our previous knowledge and experiences.

AFTERWORD

As described in the paper, my exploratory practice was divided into a three stages of exploration. The first stage, representational explorations, took place in a three months period, the longest of the three stages. All three stages were periods of discovery, but this first period was particular important because I discovered and defined details of my thesis which I built upon in the following two exploratory stages, this fact demanded a greater investment of time. Furthermore, less experience with the representational form in comparison to the other two forms necessitated a longer making process. The six explorations belonging to the abstract form took place in a shorter period of only two months because I could build upon the knowledge which I gathered during the explorations of the first stage and work towards defined aspects of my thesis. The creation of the last six explorations within the symbolic form of information retrieval required only one month to complete and took place after the submission of the paper to my committee. Thus, examples given detailed descriptions in the paper in order to explain specific aspects of my practice are limited to only explorations out of the representational and the abstract form. Stated examples of the symbolic form which refer to material in the appendix were added afterwards.

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APPENDICES

Appendix 1. First Part, six explorations based on the Representational Form

1. Bus Modularity:

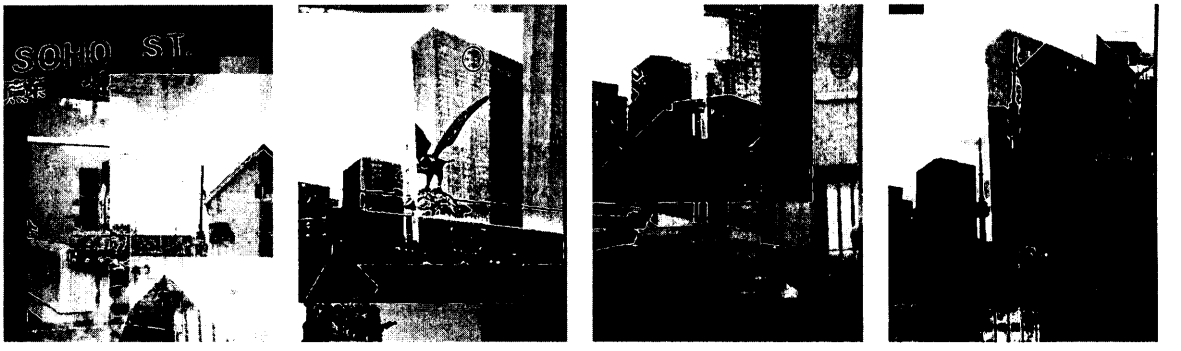
App. 1.1. Franziska Erlebach, *Image Grid* (sequential selection). 2012. 153 Pages 6" x 6", inkjet print & animation (see CD).

2. Cut-to-fit Modularity:

App. 1.2. "_____", *Body Parts* (sequential selection), 2012. Flip-book 6" x 6", inkjet print & animation (see CD).

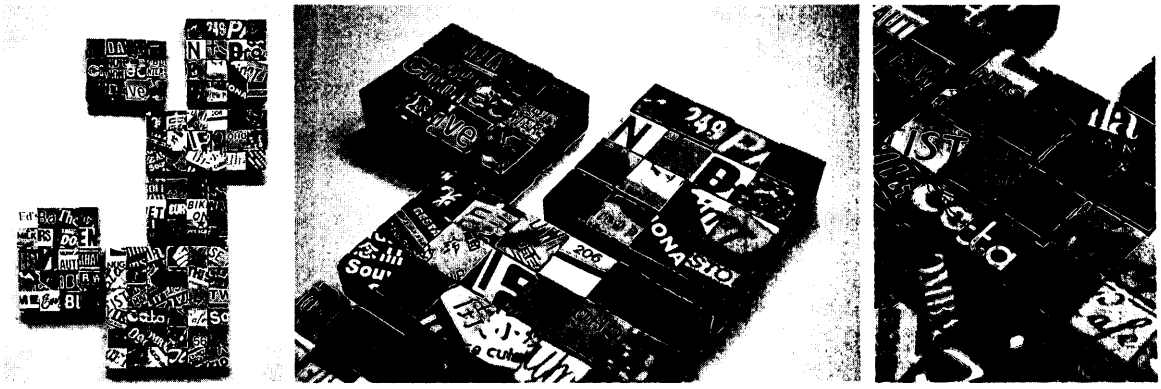
App. 1.3. "_____", *Body Parts*, 2012. Poster 17" x 25", digital collage, inkjet print.

3. Mix Modularity:



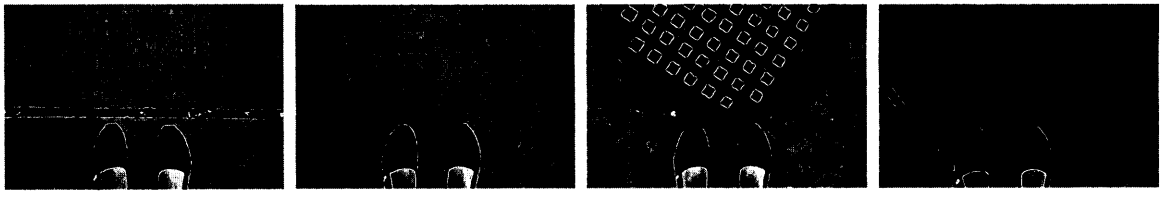
App. 1.4. "_____", *Overlay Toronto*, 2012. Processing application 600px x 750px, digital collage (see CD).

4. Sectional Modularity:

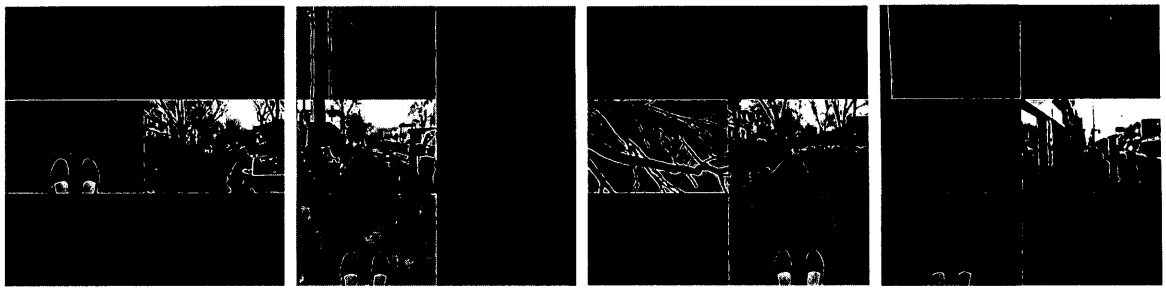


App. 1.5. "_____". *Cube City*. 2012-2013. Wooden cubes 0,6" x 0,6" x 0,6", inkjet print.

5. Component Sharing Modularity:

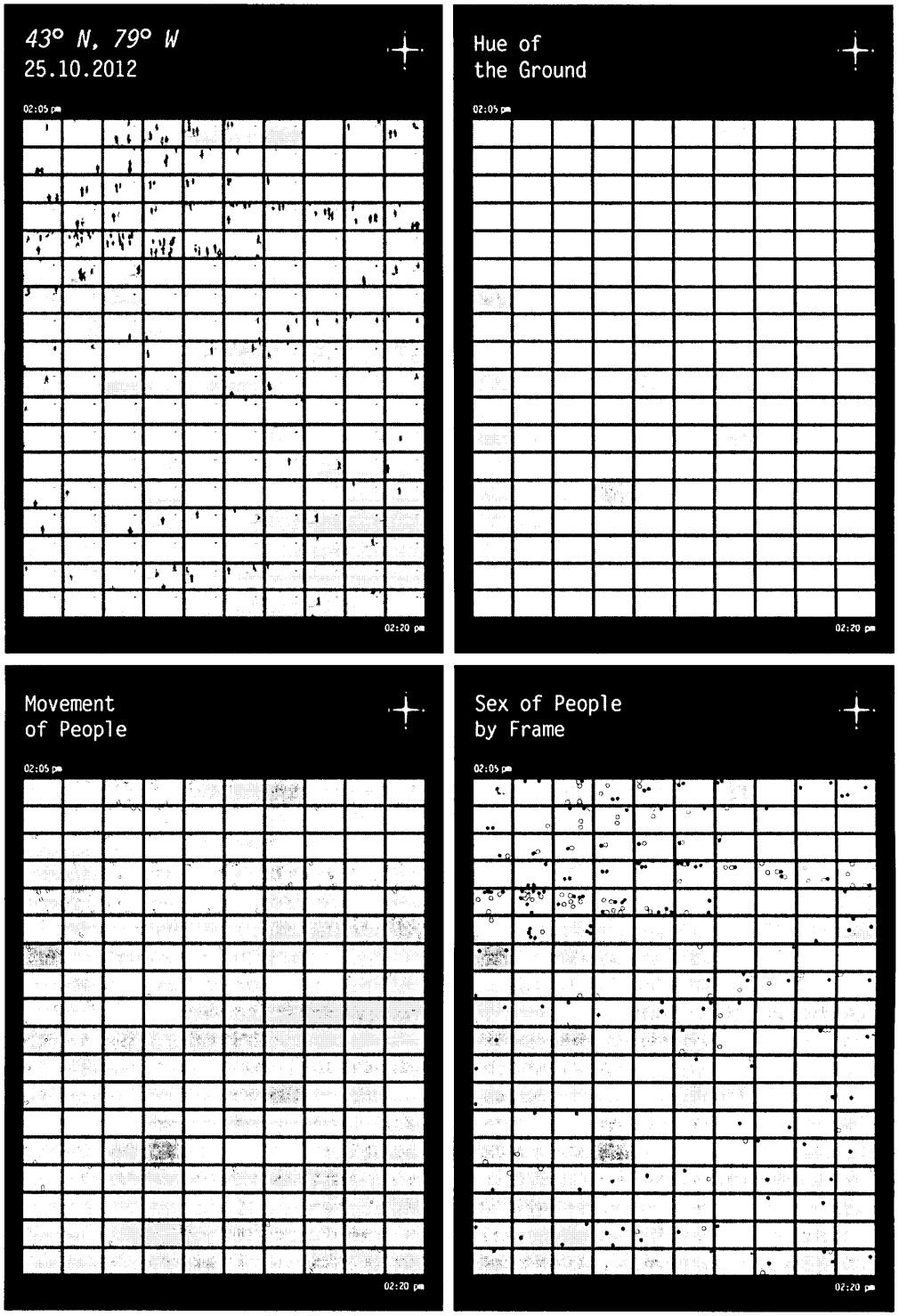


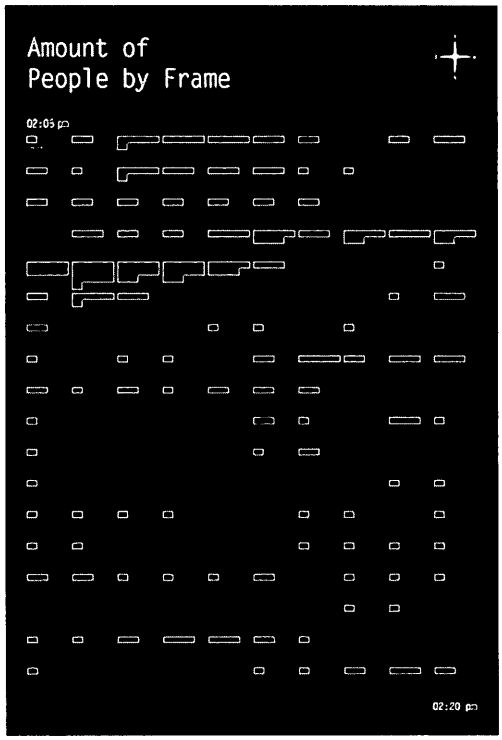
App. 1.6. "_____". first version *Walking Shoes*, 2012. Processing application 800px x 538px (see CD).



App. 1.7. "_____", second version *Walking Shoes*, 2012. Processing application 800px x 800px (see CD).

6. Component Swapping Modularity:

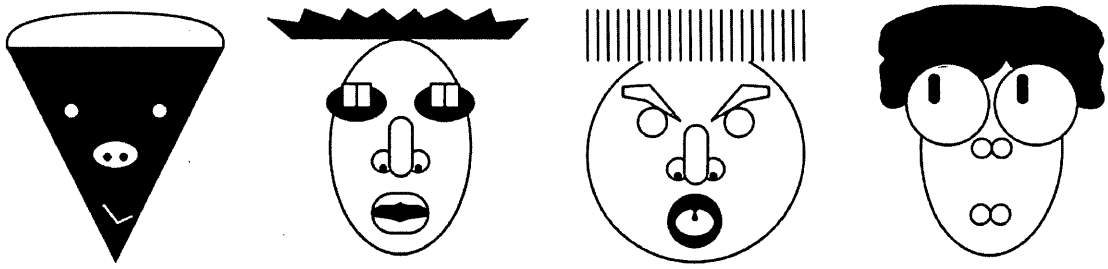




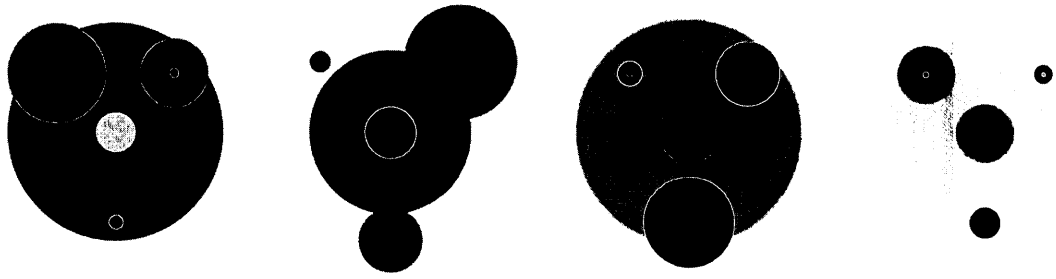
App. 1.8. "_____", *Public Square*, 2012. 7 Posters 11.5" x 17", inkjet print.

Appendix 2. Second Part, six explorations based on the Abstract Form

1. Bus Modularity:

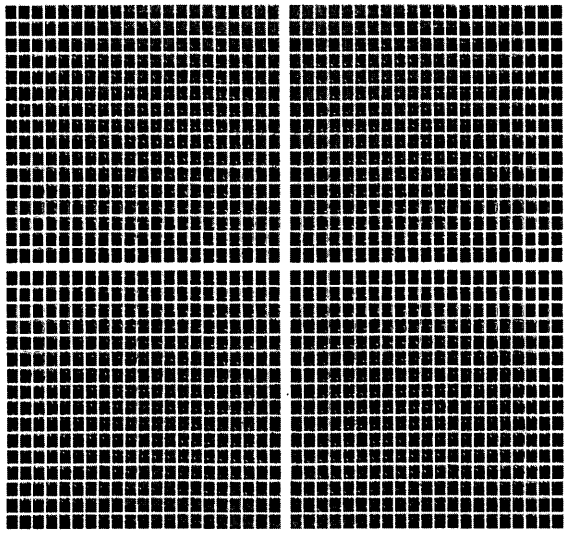


App. 2.1. Franziska Erlebach, first version *Changing Face*, 2013. Processing application 775px x 775px (see CD).



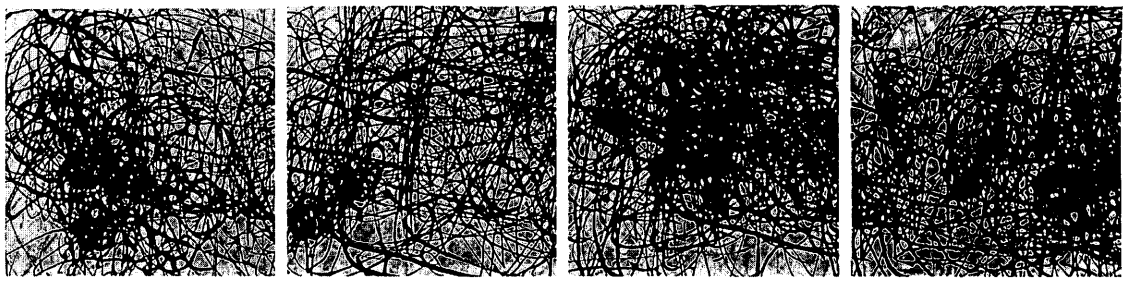
App. 2.2. "_____", second version *Changing Face*, 2013. Processing application 575px x 575px (see CD).

2. Cut-to-fit Modularity:



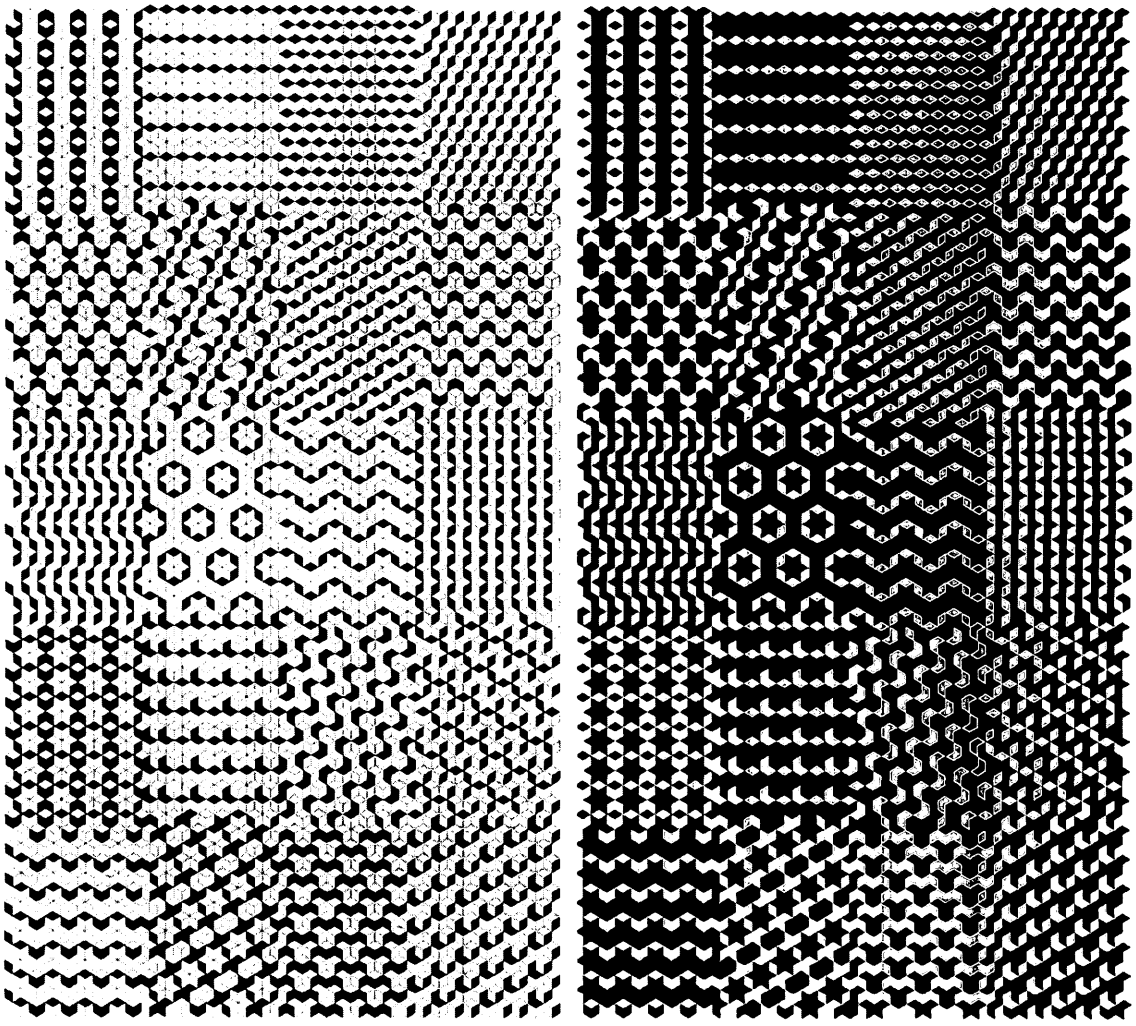
App. 2.3. "_____", *Colour Pattern*, 2013. 4 Posters 16" x 16", inkjet print & animation (see attached CD).

3. Mix Modularity:



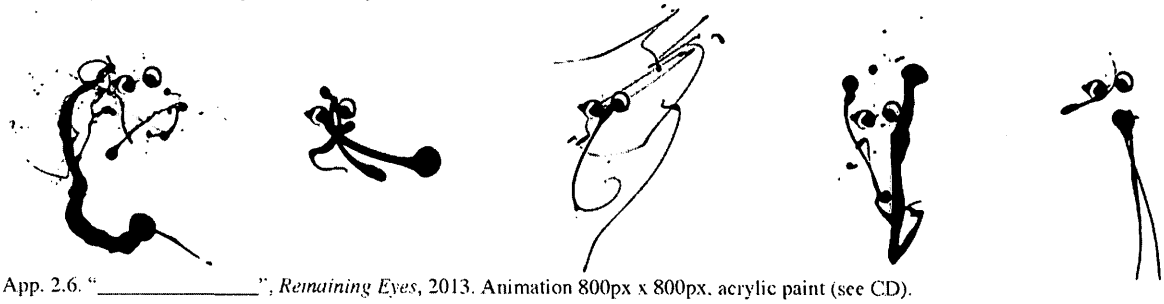
App. 2.4. "_____", *Scribble Painting*, 2013. Processing application projected on 20" x 20" Canvas (see CD).

4. Sectional Modularity:



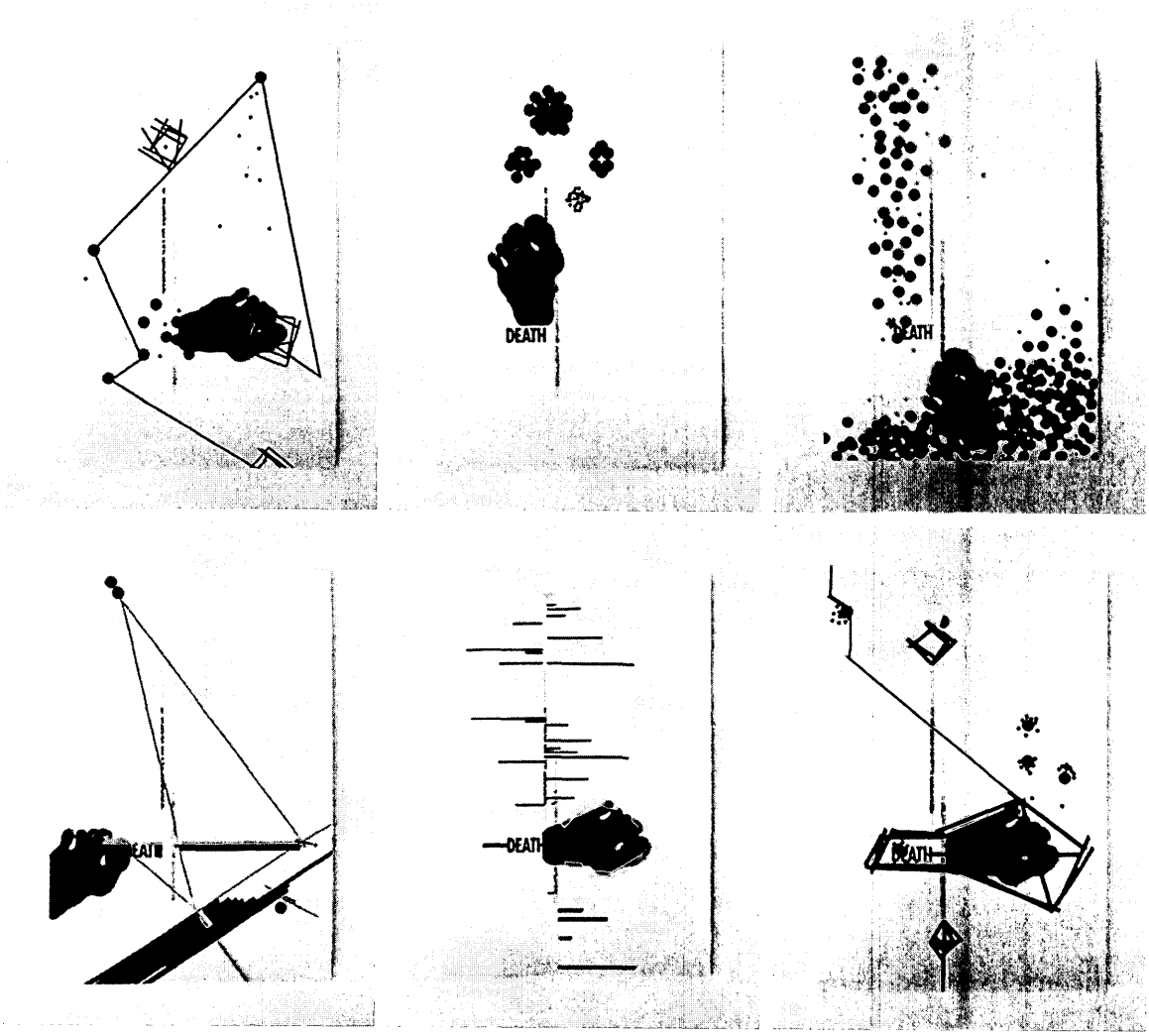
App. 2.5. "_____", *B/W Pattern*, 2013. 2 Posters 24" x 44", laser print.

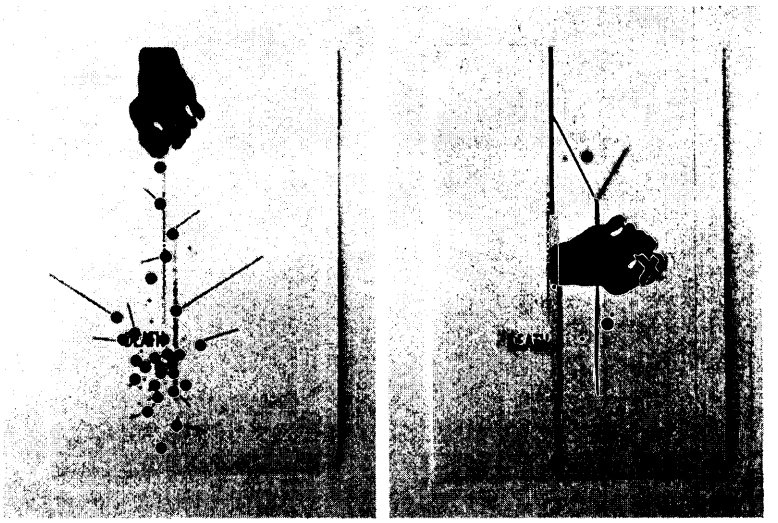
5. Component Sharing Modularity:



App. 2.6. "_____", *Remaining Eyes*, 2013. Animation 800px x 800px, acrylic paint (see CD).

6. Component Swapping Modularity:

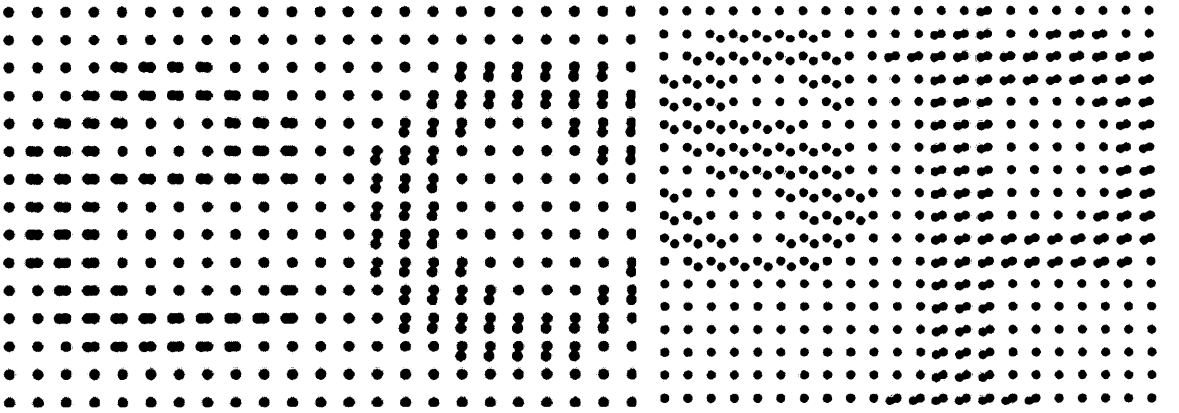




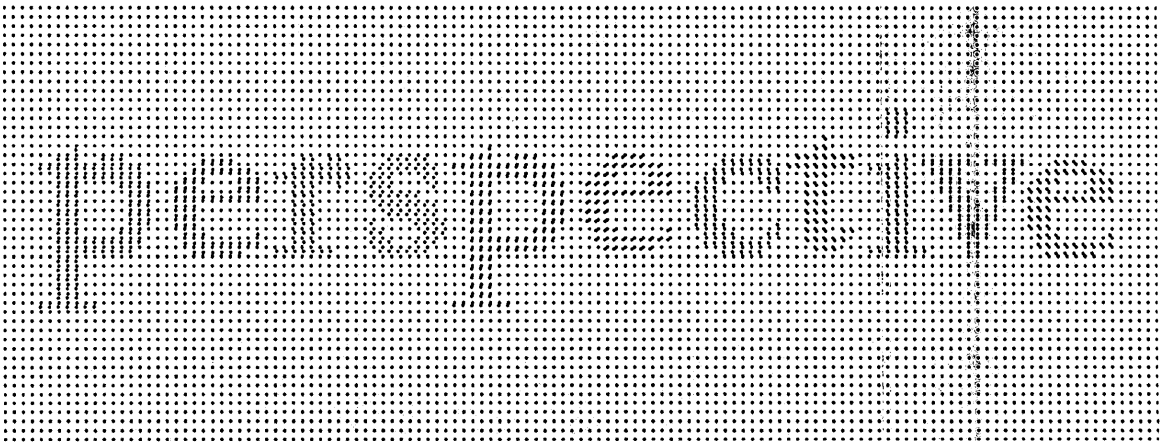
App. 2.7. "_____". *Death Poster*, 2013. 8 Posters 17" x 25". mixed media.

Appendix 3. Third Part, six explorations based on the Symbolic Form

1. Bus Modularity:

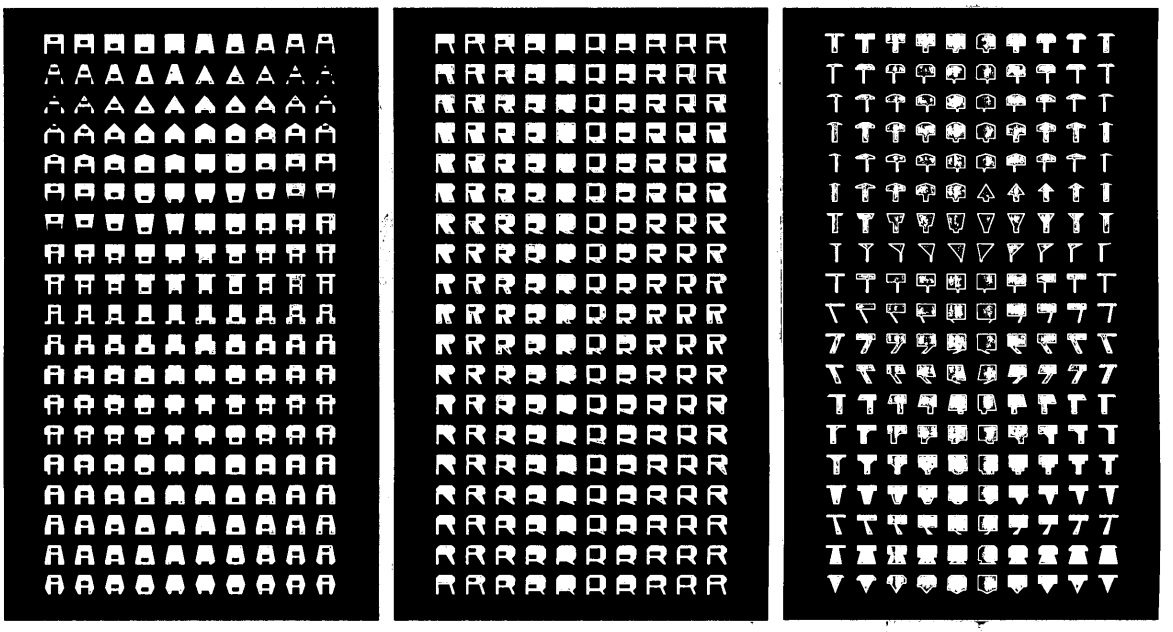


App. 3.1. Franziska Erlebach, *Dot Grid*, 2013. Animation 1400px x 850px (see CD).



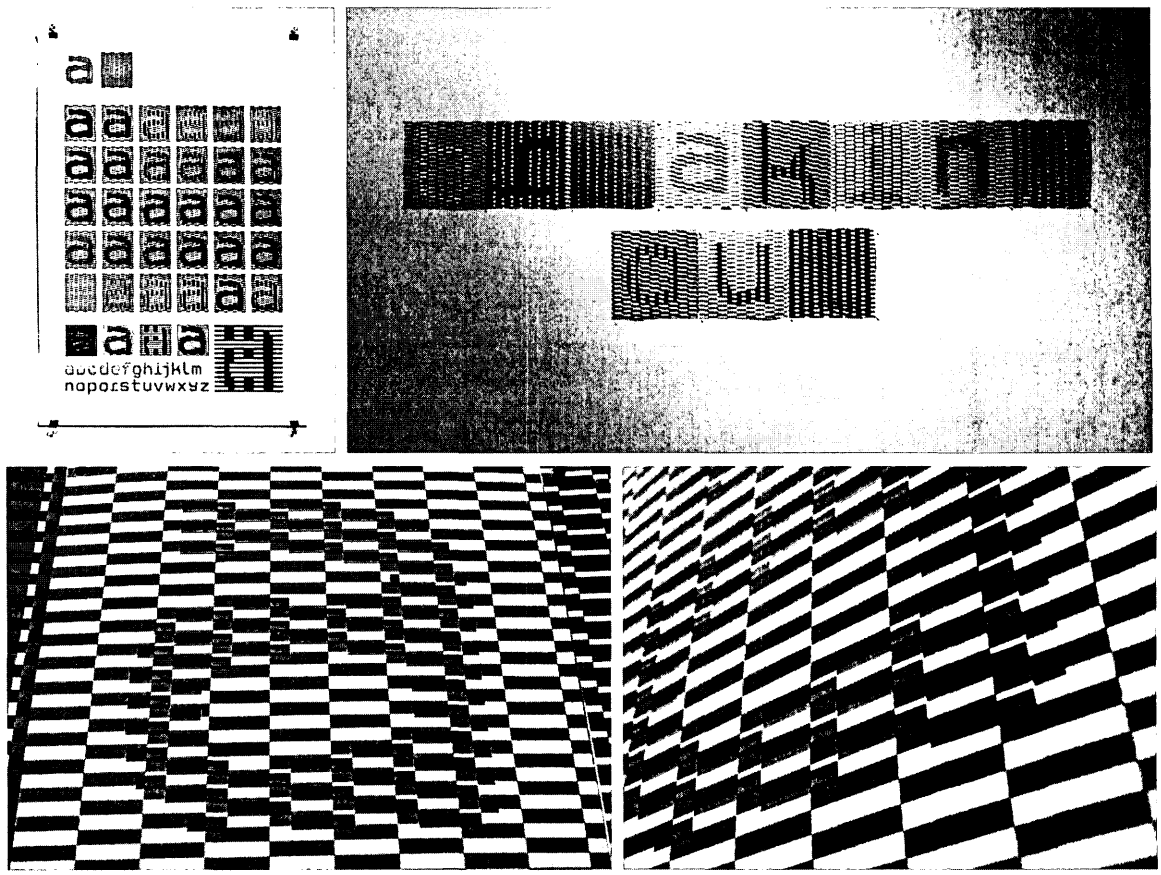
App. 3.1. (continued).

2. Cut-to-fit Modularity:



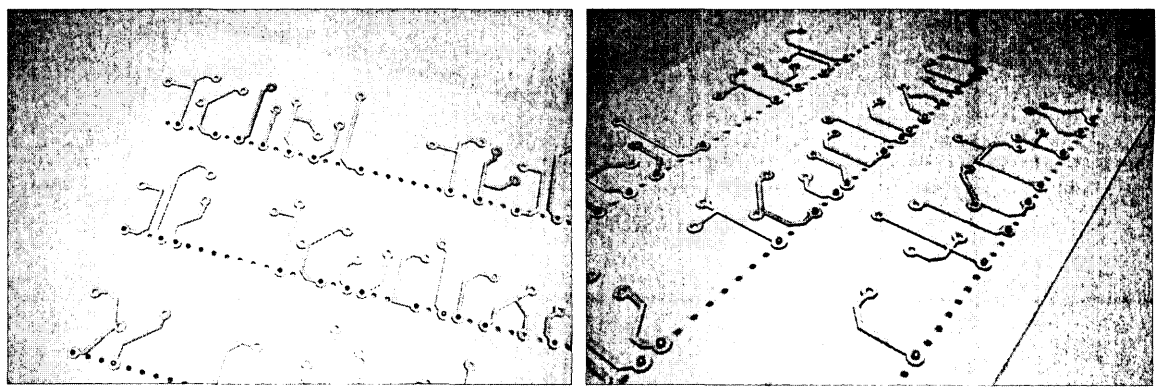
App. 3.2. "_____". *A-R-T Letters*, 2013. 3 Posters 22" x 36", laser print.

3. Mix Modularity:



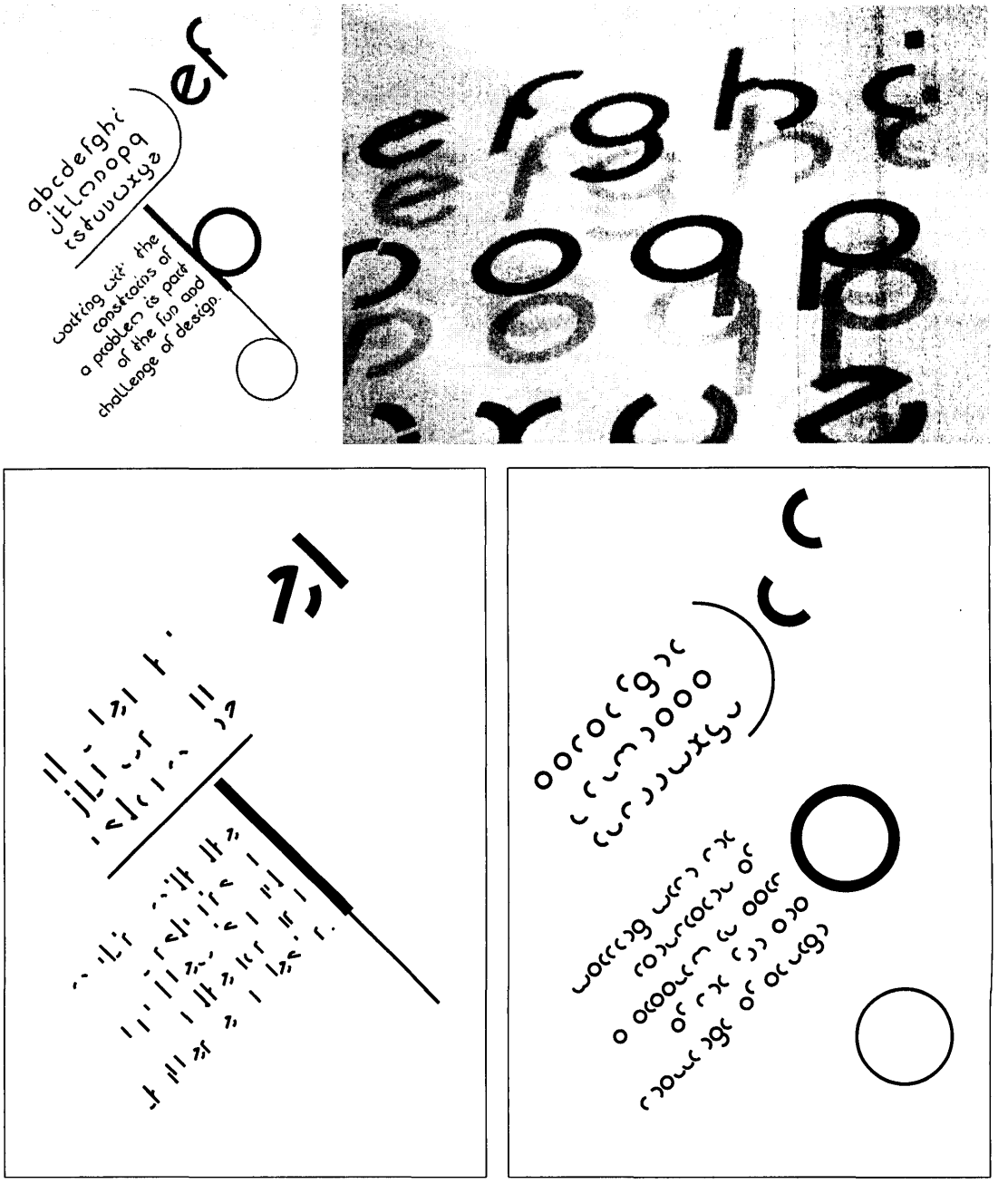
App. 3.3. "_____", *Rectangle Mix*, 2013. 1 Posters 24" x 35" & 11 squares 10" x 10", inkjet print.

4. Sectional Modularity:



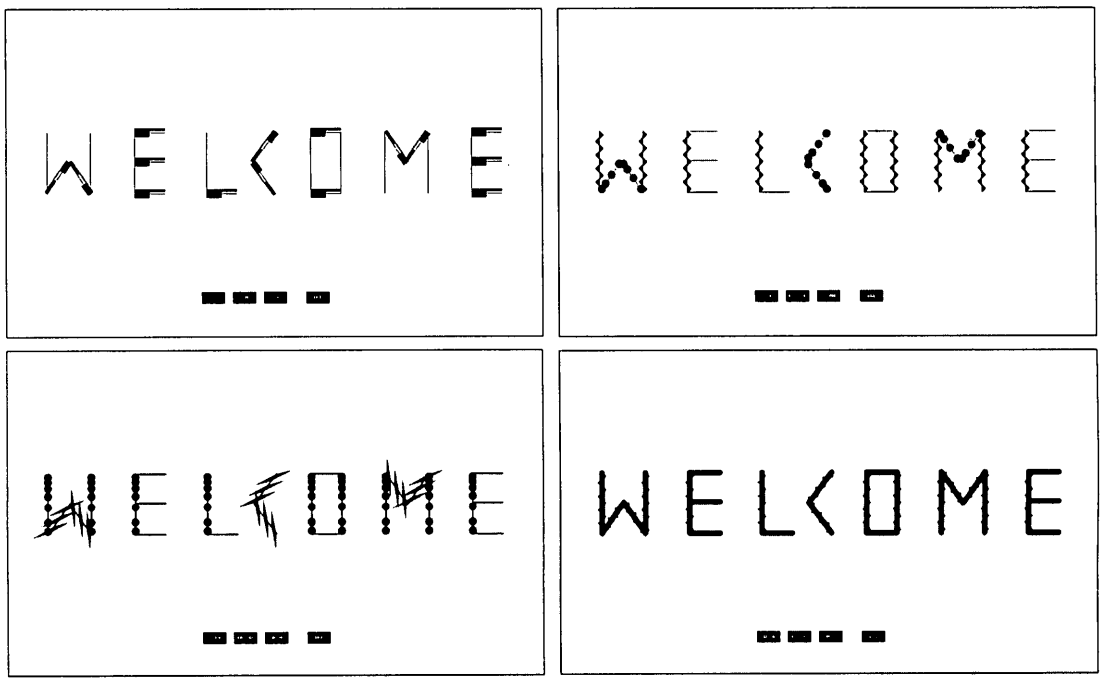
App. 3.4. "_____", *Fake Type*, 2013. 2 Arrangements 20" x 16", cardboard laser cut.

5. Component Sharing Modularity:



App. 3.5. "_____", *Half Circle Type*. 2013. Poster 24" x 36", vinyl on Plexiglas & Animation 750px x 1111px (see CD).

6. Component Swapping Modularity:



App. 3.6. "_____", *WELCOME*. 2013. Processing application 1400px x 850px (see CD).