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Expanding the boundaries of form theory
Developing the model *Evolution of Form*

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Introduction

There is an increasing awareness in the design community to recognize the organizing capacity of form and space as an scientific method of its own right. The past decade of design-oriented research as well as research in *embodiment* has put focus on how the physical qualities expressed through form directly reflect and affect our way of reasoning (Lakoff and Johnson 1999). Since the qualities of form can be directly *imported* to us through our senses there is an experience of immediacy that can be shared over disciplines and cultures at a very basic level (Langer 1953, 31). Learning to differentiate form and spatial activities within and around form is therefore a fundamental skill for designers (Akner-Koler 1994, Greet 2002).

Form is pluralistic in nature: The physical 3-D form-sketches and mockups created during the design process bring concepts into reality. Form offers *basic level experience* that integrates parts into a holistic expression (Lakoff and Johnson 1999, 28-30). Form supports the structure and function of a product. It gives substance to intangible emotional ideas making them tangible. Form defines the boundaries of the prototype. Form carries the pragmatic semiotic signs and symbols of the product (Monö 1997).

Recent research in strategic brand identity also points to *three-dimensional product characteristics* as the central method to communicate brand identity (Karjalainen 2004). Industrial designer Jan Capjon´s (2004) thesis *Trial and Error Based Innovation*, explores how creating a rich spectrum of 3-D form (through rapid prototyping) offers scientific methods for perceptual reasoning that improves complex problem solving.

Aesthetical domain

The key to understanding this *pluralistic nature* and *organizing capacity* of form lies in the realm of *aesthetics* with roots in the active process of experiencing the real world. In this paper the concept of aesthetics concerns the active involvement of our senses through direct and indirect perception which inspires emotional involvement (Dewey 1980, 4-5), play (Schiller 1995) and aesthetical abstraction (Akner-Koler 1994).

Historical background

The present paper builds on a form and space theory that was initially developed by the painter Alexander Kostellow and sculptor Rowena Reed. Kostellow and Reed founded the first industrial design education in USA in 1934 at Pratt Institute, New York City. Their teaching approach, according to Kostellow, "drew on modern scientific methods" that supported self-expression as well as design for industry (Greet 2002). Kostellow´s early education in psychology and linguistics at the University of Berlin, Germany, taught him analytical methods that he transferred and greatly expanded to artistic activities (Reed and Adele Kostellow, personal communication) There is, however, no literature that documents how he linked scientific methodology to art and design. [I find connections to the early work of Max Wertheimer in the development of Gestalt theory and indirect perception (King & Wertheimer 2006)]. Kostellow´s and Reed´s close collaborative working relationship created a comprehensive system of aesthetical reasoning. This system was applied in an educational program that successively introduced different levels of visual complexity through concrete experiences in a variety of different 2-D and 3-D media. Their program offered a system of concepts, abstract terms and principles that supported perceptual and conceptual involvement of the active designer and artist under the different phases of the design education process (Greet 2002). They referred to their program as *the structure of visual relationships*. The terminology was consistent throughout the program and reinforced at each level.

One of their many contributions was an analytical approach for discerning 3-D properties of form and space that started with geometric form in a static, spatial framework and gradually deviated from the law-bound geometric properties to dynamic and organic principles of tension and expansion. This *geo-organic vision* was based on assumed principles of beauty and growth inspired by classic sculpture through Alexander Archipenko (Michaelsen & Jánszky, 1986) and Rowena Reed (Greet 2002), which gave a unique coherency to their educational program distinguishing it from the modernistic approach developed at the Bauhaus and through the Russian Constructivist movement.

Kostellow and Reed sympathized with the growing needs from industry that asked for creative methods to define and integrate aesthetical activities throughout product development. They became very instrumental in shaping the roots of the profession of Industrial Design in the USA.

My relationship with Rowena Reed developed as I worked as her personal teaching assistant and private student for two years between 1976-1978. It is through these two years of working and studying with Reed that I build my fundamental understanding of 3-D abstract aesthetics.

Terminology

In the different professions of design, art and architecture there is little consensus regarding 3-D form- and space terminology or definitions. Although the abstract aesthetical language of modernism from the early twentieth century is fairly established in the art and design world today, the exact definitions of the modernist vocabulary are not agreed upon. Modernist artists correlated scientific thinking with their artistic development.

Terminology was therefore strongly linked to the sciences such as physics, biology, mathematics, psychology, engineering etc (Lodder 1983, Wick 2000). Examples of such terms are: forces, movements, spatial activities, elements, properties, orientation, position, point, mass, negative, positive, static, dynamic etc. The aesthetical vocabulary of modernism and constructivism was therefore to a large extent, both directly and indirectly inspired by the definitions formulated by the sciences. The vocabulary used in this paper further develops and expands this modernistic language and the visual language of Alexander Kostellow and Rowena Reed.

The word *form* in the present paper refers to both the cognitive activity of thinking in abstract form and the transfer of abstract form to the concrete properties, structures and relationships of form elements in space (the limits of this paper does not allow for an in-depth presentation of spatial reasoning). Form involves the haptic and kinesthetic senses as well as the direct and indirect visual perception that is stimulated through physical features. Form is the manifestation of the gestalt. The aesthetical involvement needed to organize concrete form for product development is referred to here as the *formgiving process*, which is derived from the Swedish word *formgivning,* meaning to create the physical form that reflects the goals of the product.

Aim and questions

My particular aim is to define an embodied analytical method for the development of a visual/conceptual model showing a sequential development of form from the geometric to the organic. Some questions raised in this paper are:

1) What is the value of developing aesthetical knowledge based on geometric structures sequentially developing into organic properties?
2) How can reasoning through dichotomies and void expand knowledge of form?
3) How does the organizing capacity of form and space handle complex problem solving?

Methods

Pedagogically framed art/ design research

Traditionally art and design educational institutions have had little academic structure or funding for doing research, especially if the research was not "contract research" geared to areas that are sponsored and controlled by industry. One way of doing more practice-based, theoretical and explorative research is to combine teaching with research which is referred to here as *pedagogically framed research*. The artists / teachers at the Bauhaus and at the VKhUTEMAS in Moscow as well as Reed, Kostellow, all developed their ideas through teaching (Lodder 1987, Wick 2000, Greet 2002). My work continues and expands this pedagogical framed research tradition..

Translation

Most of my teaching has been conducted in a bilingual atmosphere of Swedish and English. During my early years of teaching it was imperative for me to learn to understand Swedish. I therefore spent a great deal of time discussing with the students the general definitions and the subtle nuances of terms. This culturally imposed struggle with translating the visual language into Swedish and then using both English and Swedish (or any other language spoken in the group) to further develop the terminology has proven to be a very vitalizing process. To constantly re-examine the concept veiled in a term has made me keenly aware of the semantic problems all perceptual terms impose. The concept defined through the term(s) is never wholly understood until embodied in a perceptual / physical solution. Today I apply this process of translation even though I speak fluent Swedish. Due to the abstract nature of the terminology I use, it is important to spend time examining the concept and expressing its meaning through form. This is why I continue to use this translation in the method below.

10 step Concept-Translation-Form method

Through close collaboration with industrial design students the following practice-based, 10-step "Concept-Translation-Form" method was developed. The different steps reflect a) sculptural methods from my own education with Rowena Reed, b) the students´ need for translation of aesthetical concepts, c) students´ participation in practical/analytical studies that advanced 3-D aesthetical knowledge and d) my need to create teaching material that was based on a comprehensive analytical structure rather than teaching material that was defined for each isolated form study. The below described *participatory action research* method (Reason 1994) has been applied since the mid 1980ies in numerous case studies involving 10-12 participants /students from the first and second year classes in the Dept. of Industrial Design at Konstfack as well as in other design schools in Scandinavia, see figure 1. The students applied a qualitative investigation through creative problem solving that produced form compositions uniting theory and practice (Merriam 1988).

The method is outlined in the following 10 steps:

1. *Lecture on abstract concepts*

A short lecture in English is given to the students introducing the general concept underpinning a geo-organic sequential reasoning. One selected abstract concept and its definition is then presented, eg: "adapt - to fit one geometric form up against or around another geometric form without subtracting or reducing either of the forms". The concept is further defined by discerning two contrasting poles such as: "assimilate - willing to adapt" and "dissimilate - unwilling to adapt".

2. *Translation/interpretation of concepts*

The students are asked to translate the abstract concepts from English to Swedish or to any language spoken by the students. All suggested translations and interpretations are recorded on a white board. We discuss the list of suggested concepts and arrange them in order that best match the present understanding of the concepts. Some words may be crossed out if they are either not specific enough, too specific or defined a different problem (which could be used later). Through an iterative feed-back process each successive student group questions and critically analyzes both the previous Swedish translations and the original English concepts.

3. *Experimental 3-D modeling*

The students begin an open experimental sketching period of quick 3-D models (Kolb clay:

http://www.kolb-technology.com/) showing spontaneous creative solutions that aim to embody the abstract concepts.

4. *Individual support*

Individual support is given to the students concerning specific properties of their sketches and craftsmanship.

5. *Gathering the work*

The 3-D models are gathered for evaluation.

6. *All-round perception*

Each model is slowly rotated on a turntable and the students are asked to quietly perceive and reflect on the 3-D clay sketches to experience the all-around, holistic gestalt. They are also asked to abstract the composition in terms of: axis, proportions, properties of form, orientation, tensions and the direct and indirect relationships between elemental properties and movement and forces. (These concepts of abstractions where introduced earlier in the introductory lectures and studies.)

7. *Articulate critique of aesthetical abstractions*

The students are encouraged to give suggestions about coherent ways to group the different models together and develop perceptually related form sequences. These groups or sequences of form could suggest aesthetical abstract reasoning beyond the limits of the initial concept (adapt, divide etc.).

The students are then asked to give *critique* of a single composition and articulate their all-round aesthetical response with respect to the holistic gestalt of the composition. The traditional way to give *aesthetical critique* in art and design is to create a dialogue with the creator in connection to the composition itself. The questions are presented to the composer so as to gain insight into the organizing concepts that are expressed through the composition. Particular views are pointed out to bring attention to the strengths or weaknesses of the composition.. A marker is placed on the turntable indicating the focus of attention. The turntable is then rotated so that everyone can see the particular view that is being discussed in relationship to the overall image. Asking carefully formulated questions, that correlate to specific direct and indirect properties in the composition, will open up possibilities for further development. The composer is asked to motivate her/his own formgiving decisions and subjective thoughts that inspired their forms as well as to point to problem areas that the group could help resolve. This phase aims to develop aesthetical consciousness, a method for collective aesthetical exchange and personal involvement on the part of the person who gives a critique. For the continual education of the students I introduce many other aesthetical principles and ways of reasoning expressed through the models (Akner-Koler 1994, Greet 2002).

8. *Bipolar spectrum – supporting and questioning beauty*

Selected models were grouped in a bipolar spectrum that clearly exemplify the initial abstract concept, eg. adapt: “assimilate - dissimilate”. Different interpretations of the spectrum are set-up by the students, focusing on different qualities that illustrate the pluralistic nature of form. We also discuss the excluded models in order to determine if there are any qualities of interest that might further inspire a new area of exploration.

9. Summary

Notes on the conclusions from the group are summarized and the selected models are stored for further reference.

10. Feed-back loop

I then re-examine the results of each case study, photograph key models and again look for ways to change the prior concept or add a new abstract concept. This dynamic process modifies the material offered to the next group of students.

Throughout this whole 10 step method we always renew our understanding of the initial problem in an iterative process relying on continuous interaction between abstract reasoning and concrete work.

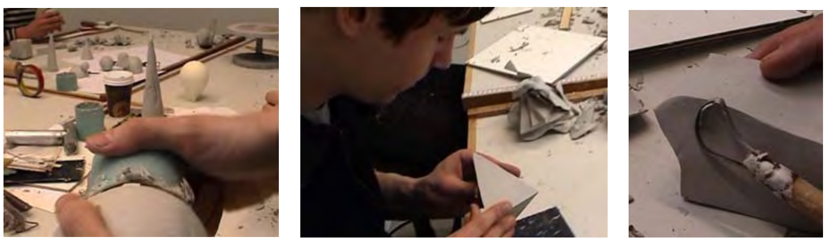

Figure 1a-c. The figure shows the studio situation in which the *10-step Concept-Translation-Form* method was developed. We used Kolb industrial design light-grey clay, which was developed through a recent collaboration with Kolb Technology.

Results

A theoretical and practical model - "Evolution of form"

The 10-step Concept-Translation-Form method gradually gave rise to a seven-stage, bipolar visualization model called "Evolution of form", see figure 2-3. The model consists of two axes: one horizontal "evolutionary" axis and one vertical "bipolar" axis. Here I present a general summary of the model and refer the reader to a more detailed description in my book "Three Dimensional Visual Analysis" (Akner-Koler 1994).

Evolution of form – horizontal axis

Figure 2. The figure shows the horizontal axis of the model *Evolution of form,* that bridges geometric and organic properties.

Horizontal axis

On the *horizontal axis* in figure 2, there is a logical sequence of seven stages; from compositions of geometric forms to organic form. The stages are:

1. JOIN - cutting away part of one geometric volume to exactly fit with another geometric volume
2. INTERSECTION - the common mass within the joint of two geometric volumes, defined by the geometric properties of the surfaces of the joined forms
3. DIVIDE - to cut through geometric forms creating two or more parts
4. ADAPT - to fit a *compliant* geometric form up against or around another form that is *stable*
5. MERGE - to blend two or more geometric forms into a combined figure
6. DISTORT - to expose a geometric form to a force(s) affecting its inner structure and elemental parts
7. ORGANIC - to begin with formlessness (clay) and create complex movements and tensions in the form that are expressed through convexities and concavities having no geometric reference

The sequence moves from *simple* to *complex* by introducing properties altering the structure
and symmetry of the original geometric form towards organic properties. See also "Contribution" below.

Vertical axis

The added dimension to this evolutionary model is the bipolar spectrum that moves vertically crossing the horizontal axis of the evolutionary model at each stage, see figure 3.

Evolution of form – horizontal and vertical axis

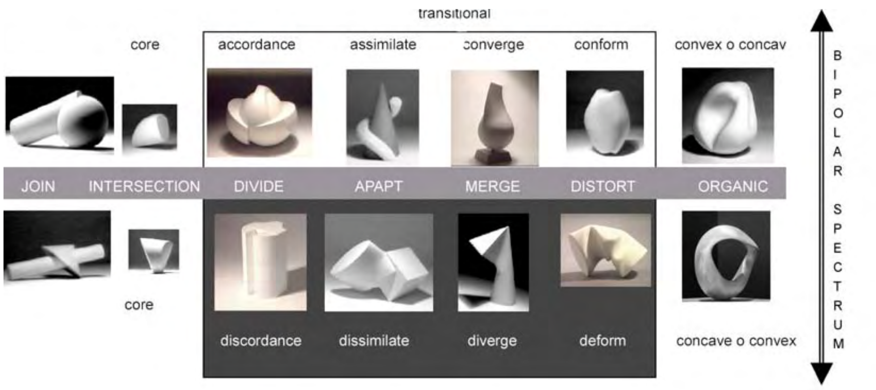

Figure 3. The figure shows the full version of the model *Evolution of form*, including both the horisontal- and the added vertical axis of the bipolar spectrum at each stage.

Bipolar spectrum

The *bipolar spectrum* in figure 3 moves *vertically* at each stage along the horizontal axis in the model "Evolution of form" that introduces a dichotomy between a positive and a negative pole which expands the practical and theoretical dimension of this evolutionary model. This spectrum both supports and challenges the classic aesthetical aims of achieving beauty and expansion. It gives equal weight to activities that build up and break down the geometric structure.

The top half of the model represents the positive pole which supports *congruency* with the original geometric structure. The terms *accordance, assimilate, converge and conform* indicate support for the geometric structure or identity of the original form. The bottom half of the spectrum represents the negative pole, which supports incongruency with the original geometric structure. The terms *discordance, dissimilate, diverge and deform* are meant to disturb, take away and work against the geometric structure or identity of the original forms. It is this negative pole that expands the evolutionary model and challenges the concept of beauty.

Furthermore, the negative pole of this spectrum offers a way to include negative form (void) as equally important as positive form, i.e. concavity is place toward the negative pole. This sculptural concept of *equating positive and negative* originates from the work of the Russian sculptor Alexander Archipenko (http://www.archipenko.org/aa_chron_1967.html) and was transferred to the field of industrial design through Rowena Reed (Greet 2002).

Example of bipolar spectrum

A more detailed description of the bipolar spectrum can be found in *Three Dimensional Visual Analysis* (Akner-Koler 1994).

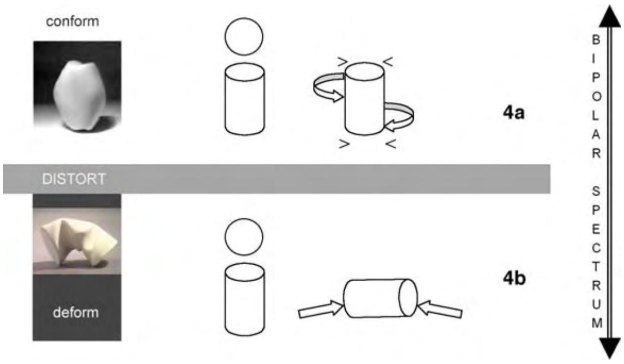

Fig 4. The figure shows the bipolar spectrum conform-deform at the stage distort.

Figure 4a-b shows a closer analysis of the vertical axis in the model at the stage distort and the bipolar concepts *conform,* meaning to work with the structure of the geometric form and *deform;* meaning to work against the structure of the form. Figure 4a, *conform*, was originally a circular solid cylinder that has been symmetrically squeezed at the two base surfaces and twisted in two opposing directions around its rotational axis. The result of these forces expanded the properties of the form. Figure 4b, *deform*, was originally also a circular cylinder. The forces contracted the original structure by asymmetrically pressing against the two base surfaces resulting in the collapse of the form, which contorted axial movement. Contraction and contortion together constitute criteria for deformation.

Dichotomy

Theoretical support for this line of thinking in dichotomies, that the bipolar spectrum (+ and -) represents, is found in Håkan Edeholt's *(2004)* recent thesis on *Design Innovation*. He recognizes the need to work with dichotomies in the design process in order to more openly deal with complex problem solving. By considering the opposite standpoint in relation to the preferred standpoint, new knowledge can arise that gives depth and stability to the area of study.

Abstractions of form and space

The presented model "Evolution of form" is an integrated part of a perceptual system of analysis and aesthetical terminology that were initially structured by Kostellow and Reed. This system and terminology was organized by the author into four major sections (Akner-Koler 1994):

I. *Elements and their properties* – involve proportions and the inherent relationships between the positive and negative volumetric parts: plane, line and point in reference to geometric law-bound structures.

II. *Movements and Forces* – involve indirect perception that is expressed through the axial activities and tensions within and beyond the physical elements.

III. *Relationships* – deal with the communication between the positive and negative elements and their movements and forces from all views and over time. The model *Evolution of Form* presented here belongs to this section.

IV. *Organization* – deals with putting everything in a *three-dimensional* spatial context. The organization strives to arrange the properties, movements, forces and relationships in three general spatial frameworks: *static, dynamic and organic.*

Each of these four sections presents a combination of definitions, concepts and principles which were derived from a) my sculptural experiences with Rowena Reed, b) literature in this cross-disciplinary field of aesthetics and perception, c) my own teaching, which added new models and concepts as well as formulated basic aesthetical terminology.

Contributions

The above described model, "Evolution of form", visualizes how to unite, within one model, both geometric and organic properties. From the 1930:s Kostellow/Reed began developing form exercises that united on the one hand the law-bound structures of geometry and on the other hand the balance of tensions and forces from organic growth processes and the traditions of sculpture. They developed the visual discipline and analytical approach that exemplified how these very different form worlds, could be bridged together. However, they did not develop any teaching material that mapped out a comprehensive overview of this bridge.

My contribution to further develop this visual/analytical methodology are:

1) Created the *Evolution of Form* (*EoF)*-visualization model
2) Developed four stages along the horizontal axis of the EoF-model, ex. *intersection, adapt, merge and distort*. *(*Reeds defined three stages: *Join*, *Fragment* (where Fragment is changed to Divide) and Organic.)
3) Developed the *bipolar spectrum* on the vertical axis of the EoF-model including the following eight concepts: *accordance / discordance, assimilate / dissimilate, converge / diverge, conform / deform.*
4) Expanded the conceptual limits of the EoF-model to work through a *dichotomy* of positive and negative features that build up and break down geometry, thereby questioning beauty.
5) Emphasized *perception* which involves all of our senses and questions the dominant role of *visual perception*.
6) Developed a 10-step concept-translation-form method that encourages students to participate in the conceptual and practical development of the EoF-model.

Discussion

The active formgiving process

The "Evolution of form" model offers a way to differentiate form through activities that modify the fundamental structure of geometric form in space. The model is developed to support the active *formgiving* process of creating a gestalt. It involves innovative reasoning that aims to create form compositions that may or may not already exist. By understanding and perceiving the potential expressions of form that are embraced in the "Evolution of form"-model, a broad aesthetical attitude to formgiving can be developed. Formgiving is an ongoing process that is affected by a continual flow of input from ergonomics, technology, marketing, culture etc. Since the design process requires the ability to handle a vast amount of information that can be conflicting, contradictory, ambiguous etc, there is no single method that can rationally organize all the input (Margolin & Buchanan 2002). The organizational capacity that is represented through form and space offers this pluralistic structure that can create coherency out of seemingly disparate demands.

Experiencing the pluralistic nature of form through the 10 step Concept-Translation-Form method gives insight into the complexity of form and how to understand form through a continual process of change rather than as a fixed object.

Pluralism refers to diversity and contrast. The pluralistic nature of form comes from its complex role in our perception of both the abstract and concrete real world (Arnheim 1969, 153-159). Form can be perceived as an abstract geometric structure (see below) and as a concrete complex expression in the physical world that engages all our senses. Because form exists in the physical world it has the potential to fuse our senses together and involve our emotional response (Dewey 1980, Norman 2004). By involving emotions, form becomes open to subjective interpretations that invites pluralism.

Inner sense of form

Product designers are trained to offer a stream of form suggestions. The organization of the demands, desires and specifications for product development can be channeled through aesthetical abstraction, which offers a way to grasp the essential 3-D composition aiming to solve the problem. The roots of the aesthetical abstraction I apply comes from sculptural traditions that rely on an inner sense of form as taught by Reed (Akner-Koler 1994, Greet 2002). This inner sense puts primary emphasis on the indirect perception of axial movement, proportional relationships as well as relationships of forces and orientation in a spatial framework. The outer contours and surfaces that delineate shape are subordinate to these 3-D compositional structures. This priority of perceiving the inner qualities of form tends to reduce the dominance of pure visual perception and shifts to a kinesthetic sense that relies on a feeling of balance and equilibrium within a spatial framework.

Since form is constantly changing throughout the design process this sculptural approach of inner 3-D perception helps product designers simplify the compositional properties in order to explore a variety of solutions for complex problem solving. By touching and working with the forms, using proportions of the body as an embodied way to measure and *blurring* the superficial properties through rotation on a turntable you can improve your ability to experience the synthesis of the all-round composition. This interaction greatly increases consciousness by thinking with your body (Damasio 2005).

The limitation of this model and its aesthetical references is that it is strongly oriented toward sculptural traditions and 3-D abstractions. It does not include sound, texture, color, ornamentation, smell, taste etc. A future plan is to collaborate with artists / designers and researchers who work with aesthetical abstractions from the other areas in aesthetics in order to encompass a inclusive model for embodied aesthetical abstraction.

Pedagogically framed research method

An important aspect of doing pedagogically framed research through the 10-step translation method in an art- and design educational program is that the students assume they can creatively and aesthetically challenge the limits of the problem. They give energy to defining their own individual interpretations of the problem rather then trying to develop the most general interpretation. This explains why the forms I use to exemplify the different stages in the model for *Evolution of form (*figure 2-3) are not standardized and uniform.

The physical environment at the Department of Industrial Design at Konstfack has been optimal for conducting this practice-based research. Access to materials, studio spaces and workshops are generous and the industrial design students are trained as creative problem-solvers; they can easily take abstract ideas and create physical models that embody these ideas. Collaboration with industrial design students has kept this theory closely linked to "practical skills and authentic activity" referred to as a *practical cognitive* view (Gedenryd, 1998).

Validity the "Evolution of form" model

The validation and application of my methodology can be argued by the fact that I have conducted these qualitative case studies for more than fifteen years at Konstfack as well as in workshops in departments of Industrial Design throughout Sweden, Denmark and Norway. A textbook that summarizes the results of this research was published in 1994, "Three Dimensional Visual Analysis" (Akner-Koler, 1994) and a second edition was recently reprinted. In 2000 a revised edition was translated to Korean and printed 2000 (Akner-Koler 2000). I have also collaborated in product-oriented courses since the late 1980´s with industrial designer Rune Monö (Monö 1997). Monö´s pragmatic semiotic theory deals with the development of signs and symbols carried by form. Through our many years of working together on product oriented courses that begins with weaving together basic form, color and semiotic courses we have explored the boundaries and common territory between semiotics and aesthetics as we confront the work of our students. The curriculum that has developed through our collaboration is now a fulcrum for our formgiving culture at the Department of Industrial Design at Konstfack. Another important validation is that the form experiences the students receive through working with the "Evolution of form"-model are later applied to product development in established design firms started by our students. I am presently planing to make a survey that will offer insight into design application of this model.

Post-modern criticism

Since the fall of high modernism in the 1960s there has been little effort from the art and design community to renew or replace the modernist aesthetical language. Hal Foster refers to this period as “non-aesthetical paradigm” (Foster 2002). Post-modern criticism points to the limitations of the modernist discourse with its aspiration of defining universal principles, genotypes and the search for “pure form” (Rampell, 2003). This search for pure form created an elite attitude aimed to define criteria for “good” design, thereby excluding deviations from a “norm” and discriminating against alternative individual expressions.

I definitely agree with some of the post-modern critics, especially in their criticism of establishing an aesthetical norm for design. The organizational principles for this norm come from geometric reasoning and concepts in engineering such as what is a “good” or “corrupt” curve. The lack of interest that designers show in problematizing and renewing the field of aesthetics is a major problem today as design enters many new arenas.

There is a deep wealth of knowledge that has developed from collective efforts the modernists´ devoted in order to understand form. We need to recognize this knowledge and integrate it back into the sensuous world it came from to learn more about form through non-geometric approaches.

The model *Evolution of form* (EoF-model) to a great extent still resides within modernistic, aesthetical boundaries and discourse, mainly because it is introduced through geometric structures. However, the bipolar spectrum invites deviation from the “norm” by breaking down and disturbing geometry. Also the sixth stage in the EoF-model*, distort*, provides possibilities to explore distortion through organic material focusing on processes of disintegration, dehydration, decay, decomposition etc. Figures 5-6 show two organic studies starting with a geometric cube made from potato and ginger root, respectively, that demonstrate the effects of dehydration. This particular study of geometric form made in organic material opens up many possibilities for form theory to include ecological processes that greatly expand the EoF-model. (Akner-Koler 2006) This ecological form study was inspired by my work in the arts (Törner M 1997).

Fig. 5a-b. The figure shows two organic studies starting with a geometric cube of potato and ginger root, respectively, demonstrating the effects of dehydration expanding the ˝Evolution of form˝ model.

Since I published *Three Dimensional Visual Analysis (*Akner-Koler 1994) I have began to see the limitations of the discipline, language and methods I work with. Through my own art projects I have studied complex, non-geometric phenomena as a counterbalance to the geometric and optimised world of industrial design I teach in. My previous projects such as "*Degrees of transparency and material disintegration*" (Degerman 1997), *Empty space* (Cornell 1998) and *Cyclical processes* (Akner-Koler and Bergström 2005) all represent this quest. I have also recently headed a 3-year art-science collaborative project called "Cross-Disciplinary Studies in Complexity and Transformation" with the aim to find methods and concepts of abstraction that challenge geometric reasoning and aesthetics (Akner-Koler et.al. 2005, Norberg et al 2005) (www.complexityandtransformation.com).

Conclusions

The participatory 10 step method presented here gave the students a strong role in affecting the conceptual and concrete development of aesthetical knowledge. Working with concrete form and embodied methods aimed to unite practical and theoretical experience. The experiential aesthetical approach recognizes how logical thinking, perceptual awareness, abstract reasoning and personal involvement are intertwined together.

The experiences students gained through the development of the "Evolution of form" model prepared them to recognize sequential stages, work with dichotomies, handle transitions that are radical or predictable, deal with pluralism, as well as determine coherent relationships. These types of cognitive skills that go back and forth between parts that are connected to holistic organizational frameworks are especially necessary in the multidisciplinary field of product development as well as any complex problem solving field.

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