Assessing the Experiment:

Communication via Prototype

by

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A Thesis Exhibition presented to OCAD University

In partial fulfillment of the requirements

For the degree of

Master of Fine Art

in

Interdisciplinary Master's in Art, Media and Design

Graduate Gallery, June 2

Toronto, Ontario, Canada, August, 2014

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Abstract

The thesis project *Assessing the Experiment* records and reveals the complexity of transformation from two dimensional work into the work created within the digital realm. My goal is to create an environment in which these disciplines collide and commingle. The work is concerned with both the formal quality of the materials and the theoretical discourse surrounding complex structures found in nature and manmade objects. Through the study of space, light, perspective, shadows and rapid prototyping, I expand the work in three dimensional realms and develop a coherent conversation between geometry and form.

The new field that this thesis explores is complex and intermingled within a variety of disciplines and frameworks: painting, sculpture and installation, working within the digital environment and production of prototypes. It is fertile territory for further exploration and refinement. The work's current resolution, informed by a simplification of material and process, anticipates subtleties in development that can only occur when things are stripped down to their essence.

Acknowledgements:

Dedication

1.	To my gentle mother Larisa Chudnovtseva , my strong father Sergey

Chudnovtsev, my wise older brother Ruslan Chudnovtsev, my kind grandmother

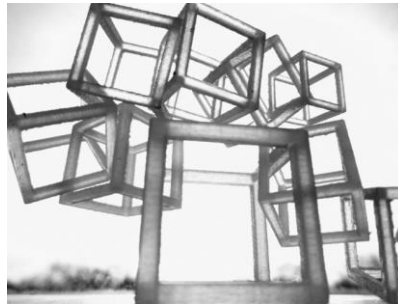Tamara Semenenko and "moy samuy sladkiy" son Daniel Demirel.

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Prototype no. 4 (2014), fig. 1

1. Introduction

My work is a continuation of my previous study of abstracted shapes, pictorial illusion, and transformation from painting and drawing to installations and prototype production. My studio research based art practice is an exploration of the visual language driven by the crossroads from two-dimensional to three-dimensional spatial organization. Through the exploration of digital environments and 3D printing technologies my vision expanded from the notion of material to that of the immaterial. Furthermore, my research led me to experiment with new materials such as light, shadows, and space, which became an integral part in my work.

My goal is to push the media and explore the materialization to suit the subject of hybrid quality of drawing, painting, sculpture and installation. I am interested in plasticity and depth-less possibilities that the combination of the above mentioned disciplines can bring. Through the study of space, light, perspective, shadows and drawing, I explore three-dimensional realms and develop a coherent conversation between geometry, light, form and space.

Documenting the process of how I proceed and making decisions with my experiment-based research is as important to me as the outcome. Documentation is compiled of photographic data that records what has transpired, revealing the complexity of the transformation from two-dimensional work into the work created within the digital

environment.

1.1 Personal Position

My research is based on an intuitive approach and also influences that came from growing up in the Soviet Union and the impact of the Constructivist movement. As a child, I was interested in mathematics—specifically, geometry. My fascination with geometric forms made me question angles, study dimension and document the interactions between spatial environments and form. Geometric forms, lines and squares are elements tied closely with the work of Russian Constructivists, in particular, El Lissitzky. I will further examine and analyze Lissitzky's works and their influence on my own practice.

It was common and expected during the Soviet Regime for young children to be involved in activities, such as model building classes, during which the basics of architecture were taught. The activities included building bird houses, wooden boxes, doll houses, puppet theatre sets and so on, which forced the maker to study the basics of geometry and the environmental relationship between an object and space. Other craft activities consisted of cross stitching, weaving and kneading. As my research progressed, I could not help but relate these childhood leanings as an influential component of my work: how something as simple as building a bird house made me turn to geometrical form and space understanding; how cross stitching was adapted and later questioned as a method of building an object with the unit; embroider lines, when multiplied, make a final design; how my work now consists of squares as units and, when multiplied, the result is that a form is born.

Influenced by the materials the Constructivists used, I too work with string, wooden sticks and wire, which are not necessarily art materials per say. I look for formal qualities that the materials provide. Wooden sticks, for instance, are chosen for their straight lines.These wood lines like are later used as a starting point to draw and build the geometric form. Constructivist artists also worked with industrial materials, making them part of the art piece. For example, Naum Gabo combined wire and string; Aleksander Rodchenko built his spatial constructions, such as Spatial Construction no.12 (1920) and Oval Hanging are Spatial Construction (1920) out of plywood and wire.

Linear Spatial Construction no. 2 (1970), fig. 2   *Spatial Construction no. 12* (1920),

fig. 3

1.2 Characteristics of the Work

My square, the building block and the form that it becomes, is the main component in my process of making. It is not my intent to seek an end result, a final piece, a finished artwork, but to keep an ongoing experiment, a test that opens up new questions: from line to square, from square to form, from flatness to dimensionality. Sometimes these experiments require the ideas to be reworked and revisited.

"*Line Progression*" is a series of paintings where I began to question the two-dimensional surface of the canvas. I layered the grid on a stretched canvas and used washes to soften the lines. After "*Line Progression*" was complete, instead of building layers on the two-dimensional plane, I began to work with string, wanting to build the form in a spatial environment.
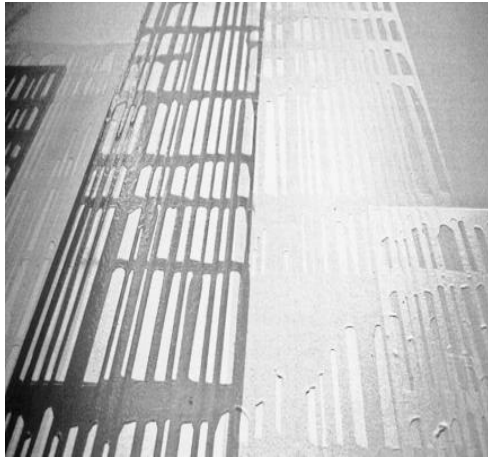
Line Progression (2007), fig. 4   *Line Progression* (2009), fig. 5
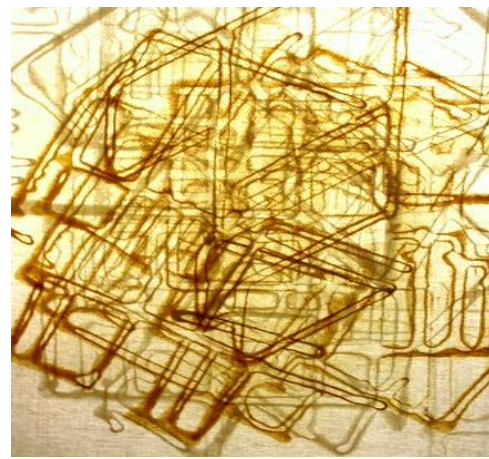
Introducing an unknown material into my work—string—helped me to question and feel space differently than I had before. The resulting body of work String Drawings (2010), began the process of transferring my ideas into the realm of the physical spatial environment. String replaced the brush as my tool and resulted in the installation-based work, Line Progression 2 (2010). In this work string is used to draw cubes directly on the wall; the wall replaced the paper and canvas.

The logical progression of my studio work comes out of the process of working out the ideas, which consist of studio experiments. Often, as an ongoing thought process, I refer to the photographs and notice new elements not addressed before, and from this source, new questions are formed. Studying the recorded photographs and revisiting them, I ask the questions: What would happen if the image was painted or scanned and digitally manipulated? What will happen to the original idea if it is experimented with?
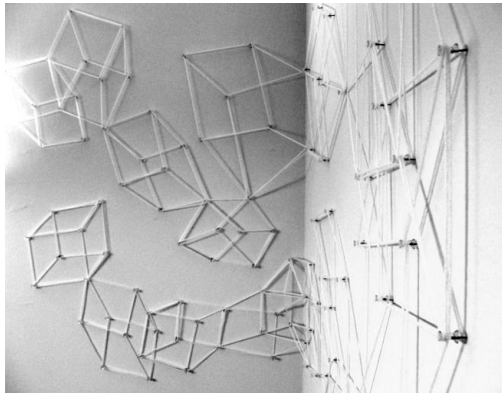
String Drawing (2010), fig. 6   *String Drawing* (2010), detail, fig. 7
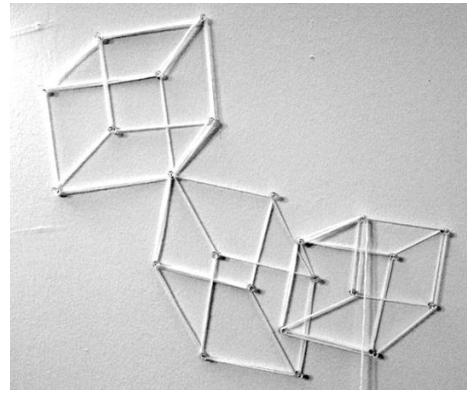
My work is developing through an organic and intuitive process. Each idea and experiment

leads me to the next one. There is no obvious leap from one piece to another, and sometimes it

is arbitrary. The idea and the experiment may lead to a finished form—a final state—but it

does not have to.

My practice has moved from painting to installation-based works and from there to rapid

prototyping and working within a digital environment. Working with string led me to making

three-dimensional forms. Which in turn lead me to experiment in "digital studio," working

with three dimensional software.

During my studio experiments, I have compiled a library full of visual recordings and

information in the form of photographs and digital files, which are my own informational pool

of ideas. My process circulates among the making, documenting, material studies and

manipulation of form, which I will discuss further in this paper.

The act of arrangement, manipulation and documentation in my practice has moved toward an

exploration of material or and form. The material itself has become the work dissolving the

support and activating the space.

1.3 Objectives

The interdisciplinary of my research lays in colliding various disciplines, such as 3D

technology and drawing. 3D technology is a scientific media which requires technical

knowledge of the software. During my research I question and embrace the technology and rapid prototyping, later interpreting these disciplines through an artistic lens. My intent is to use technology through art making and fuse these disciplines together.

My studio practice pushes me to understand the potential of the materials I am working with. My aim is to reinforce the transition that occurs within an art practice when material is transformed through tests into finished work. Using both simplistic and technological tools, I use space and shadow to eliminate the two-dimensional quality of the walls.

1.4 Thesis Questions

The pivotal question steering my studio production is: How do I simplify my practice to reveal its fundamental elements? My work has been unfolding in an experimental and intuitive manner with the elimination of what is no longer needed. This process raised other questions: Do progressive studies need to materialize as objects, or can they, too, be discarded? Can the work exist only in a digital format, and what are the advantages and disadvantages of this? I explore installation as an ephemeral presentation of what had previously been object-based artwork. I question the results of my material experiments and fuse them with solutions from past work which gives rise to additional questions:

- How could I disassemble the process and retain its essential armature?

- What is the relationship between structure and space?

- What role does material play in the work?

From the above sub-questions and opportunities for further research, I have drawn these main questions as the primary focus of my research:

- How does the transformation from two-dimensional works to installation-based works happen in three-dimensional realms? What role does space play in it? What challenges occur during the process?

- How did my experiment-based practice move from working in the studio to working within the digital environment?

1.5 Theoretical Framework

Many contemporary artists attempt to explain the art making with complex theories that seek to tie them to social and cultural concerns. While often interesting, this approach relies on the strength of rhetorical argument and other methods of persuasion that are not part of my practice. Frequently, these layers of theory hide what I value most and explore in art— its material properties and the possibilities they hold.

My modernist ideals are tied to my education under the Soviet Regime and have formed my approach to art and created the foundation for my studio process. There is a great value in looking very closely and intently at the marks and evidence of process an artwork presents. These sometimes-subtle marks are full of information that can reveal the artist's intention and methods, if we are attentive to them.

I am interested in answering the questions I pose by demonstrating, rather than explaining, these answers through a process that emphasizes material and studio experimentation. The theoretical framework of my practice is art as research. I also draw from well-established scientific theories related to geometry, mathematics, physics and optics. I apply these principals in my laboratory style art practice.

These theories are fundamental to my work and will be discussed throughout this paper in relation to the descriptions of my research and investigations.

In the methodology section that follows, I will focus on theories of art as research, specifically on how these ideas inform my studio research and production methodologies.

2. Methods

2.1 Art-Based Research

"Arts based research represents an effort to explore the potentialities of an approach to representation that is rooted in aesthetic considerations and that, when it is at its best, culminates in the creation of something close to a work of art" (Barone, 1944, p.1).

My studio (both physical and digital) is a laboratory for such experimentation. Artists as connoisseurs (Eisner, 1991, p. 4-10) can only gain knowledge through the exercises and

studies done in the studio; an artist becomes a researcher to discover new meanings, possibilities and state new questions: "all good art is an enquiry and experiment. It is by virtue of being an artist that the teacher is a researcher...[t]he artist is the researcher *par excellence*" (Stenhouse, 1988, p.43-51).

During my art-based research, I have created a relationship between my studio experiments and work within the digital space. There is an ongoing transformation that takes place between the physical experimentation in the studio and the technological intrusion of the digital environment, which makes the task of my discovery a never ending learning process. The art-based research that I have engaged with has given me the possibility to question, study, test and explore within an environment that consists of a variety of methods and approaches that span from painting to prototypes. For example, using different tools and strategies, I have allowed the work to transform from two-dimensional surfaces to become part of the spatial surroundings, manipulating the object digitally.

2.2 Practice-Based Methods

Studio practice is a powerful mode of communication and discovery. Researchers and artists often define art processes using terms such as "visual thinking," "studio thinking or "tacit knowledge" (Frappaolo, 2008; Arnheim, 1969; Taylor, 1998, p.300-312). These terms and their use change our conception of and thinking about making visual work. Often, these changes in our ideas and thinking lead to the multifaceted processes that occur in the studio.

My methodological process consists of recorded experiments that take place both in the physical making of work and in the digital environment. It consists of circulating steps: making, photographing, revisiting, researching, remaking, manipulating and repeating. All the steps are recorded either in sketches, drawings, notes or, most importantly, photographic data.

The experimental process, which happens in the studio, led me unconsciously to adapt interdisciplinary qualities. I am challenged to search for alternative non-permanent solutions, which forces me to surf and collect knowledge from various studies: from painting and drawing to installation-based work, from model making to working within the digital

environment. This is a fascinating process that produces a rich collision and collection of ideas. I believe artists today can no longer be bound to one particular discipline: technology changes, materials are new and methods vary. Artist, as an observer—as a sponge—collects these changes and brings them into the work. This range of approaches is what constitute an interdisciplinary practice for me.

The art-based research I have engaged with has made me realize that the outcome and findings during the research process are tentative rather than permanent. The findings pose questions that need more research. Experiments are tests that enable me to challenge my research questions. Art-based research, for me, was the process of realization that conclusions are temporary and, like the history of art, results are ever-changing, "like the conduct of art, is much less a quest for certainty and much more a quest for *plausibility*" (Barone, 1944, p.4). Research, indeed, is the process that is influenced by the organization of ideas that change and develop overtime: "The artist must allow various interpretations of his plan" (Lewitt, 1970, p. 169).

When I work I fully rely on my intuition and only after, the logic comes into the play. The process of making is the coherent conversation between intuitive decision-making and later logical critique. My intent is to embrace the process of experimentation, to experiment and not necessarily reach a resolved ending.

2.3   Analysis and Intuition

My studio practice has incorporated new methods and measures for analysis with the use of the cube, the prototype and the photograph. The work progressed from questioning transparency and the geometric form, explored in previous paintings, to an ephemeral installation-based practice.

Intuition plays an important role in my decision-making and analytical process. While I work in my studio, intuitively, I look for simplification of a form, for formal qualities of an object and only than the logical critique follows. Documentation of the process is essential as it allows me to track my Intuitive thinking and making steps. It is a constant conversation between simplicity and complexity, what elements to keep and which to eliminate.

My intention is to display and show how the process of decision-making happens. The work itself is an end product, an object of art. The prototypes I create are the finished work and not something to be scaled up later; however, they hold that possibility.

3. Context

3.1 Relevant Art Practice

My multifaceted artistic practice leads me to explore what it means to be working within the digital environment. I will explain and discuss my research methods and how the prototype and 3D printing technologies extend the notion of the physical object and how I used it as a conceptual strategy during my studio research. In my work, I use materials to construct structures with lines, shapes and shadows, according to my perception of the studio or gallery space environment I am in. These structures are symmetrical or somehow numerically balanced, producing a dialogue with space.

This dialogue with space is what interests me. With new technologies artists and designers have opportunities to create work in the new way. For example, the group of designers called FRONT Design are experimenting with the possibility of drawing directly in space by using unique technique. FRONT members combined the Motion Capture and Rapid Prototyping techniques and while the connected cameras recorded the sketch, "drew" directly in the air. Later Motion Capture data become a digital file and was send to be printed through Rapid Prototyping. (2005, p. 199)

Prototypes for Materializing Sketch, (2005), fig. 8

FRONT group designers are just one of many examples of how the drawing can be transformed with the use of technological advances. Further in my paper I explain what other possibilities the collision of technology and art might bring and what opportunities such union can unfold for the artists and designers.

3.2 Relevant Literature

El Lissitzky's *Exhibition Rooms* was a part of the Abstract Gallery (Lissitzky, 1927-1928) and was also the first installation created as a site specific work. Lissitzky's *Exhibition Rooms* concept was an obvious transformation of the traditional gallery experience. "I did not think of four walls in the room assigned to me as a support or a shelter, but an optical background for the picture. That is why I decided to dissolve the wall surface as such" (Lissitzky, 1929). Lissitzky was not interested in drawing the spectator's attention to the walls but to the picture itself, resolving it by optically dissolving the wall and creating interactions within the room. "With every movement of the viewer in the room, the effect of the walls changes: what had been white becomes black, and vice versa. Hence an optical dynamism is generated as a consequence of human striding. This play makes the spectator active" (Lissitzky, 1929). Lissitzky was successful in bringing the spectator inside the room making him a part of the artwork, an active participant in the visual illusion. Lissitzky engaged the spatial environment and became one of the first modern artists to experiment with the viewer as an internal part of work of art. His installations are early steps towards interdisciplinary in the arts.

Proun Room (1927-1928), fig. 9

Lissitzky developed his own style of painting, which consisted of geometric and abstract shapes. He called these shapes "prouns." The artist invented the word *prouns* and its meaning: "for the new art" (Lissitzky, Russland, 1929). Lissitzky often referred to the prouns as a transmitter of ideas from architecture to painting and vice versa. His paintings developed three-dimensionality and were in constant interaction with the space they were placed in. To achieve this transformation, Lissitzky often turned works upside down and hung them at irregular heights. My own experience with installation-based work involves experiments with objects and their interactions within the room which are then recorded as photographic data for later study.

László Moholy-Nagy was influential in the way he used light as a foundation for his practical and theoretical work. According to Maholy-Nagy, art became meaningful when it reflected light. Painting was also reinterpreted by this idea of light as the basis for the work. As Lissitzky challenged the notion of space, Moholy-Nagy used light to occupy the room. Maholy-Nagy's practice as a painter underwent a transformation from the canvas to painting with transparency using light—painting free of representational limitations. Maholy-Nagy created a possibility of painting not with colours, but with light itself. Light became an extra tool that opened up a

new realm for artists to work with. The theory of painting with light took on and reached its full potential in film and photography.
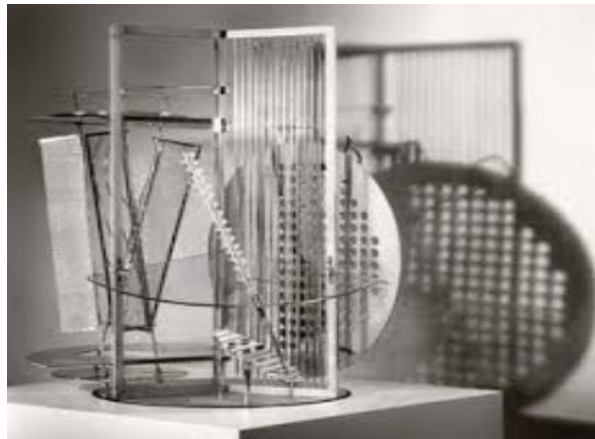
Light-Space Modulator (1922-1930), fig. 10

In my own practice, light is an essential element that lets me engage with the environment I am in. Light creates shadows, and as Moholy-Nagy painted with light, I use light to paint with shadows. The *Light-Space Modulator* (1922-1930) is an excellent example of continuous light movement and "painting" with light beams. "Light beams overlap as they cross through dense air; they're blocked, diffracted, condensed. The different angles of the entering light indicate time. The rotation of light from east to west modulates the visible world. Shadows and reflexes register a constantly changing relationship of solids and perforations" (Maholy-Nagy, 1930).

3.3 Artist Review

My fascination with geometry, architecture and drawing led me to discover the works and writings of Gertrud Goldschmidt, also known as Gego. In particular, I was drawn to her spatial net-like installations called *Reticulareas*, and how she talks about space, light and geometry in art and what role her architectural background played in her three-dimensional installations.

In regards to her installations, Gego spoke of "line as objects to play with" (1960 p. 91-95),

indeed, she played with line—chaotic, yet ordered drawings in space, which gave the work

freedom and transparency. In *Tronco, no 1* (Trunk), 1974, *Tronco, no 3*,1975 and *Tronco, no 6*,

1976, pieces she took from the previous *Esphera*, totally dis-forming it and letting the line, the

form, define itself. It seems as though Gego was not only "playing" with the line but also the

shape in space. In comparing *Espheras* and *Troncos*, the *Troncos* seem to have more freedom,

whereas *Espheras* is reminiscent of architectural or mathematical models.
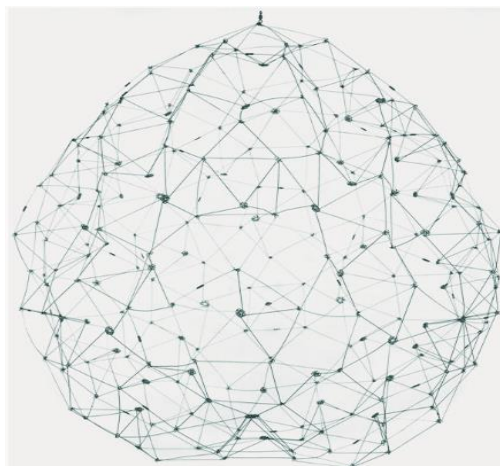
Espheras, fig. 11   *Troncos,* fig. 12

It is also important to consider Gego's understanding of space within an exhibition.
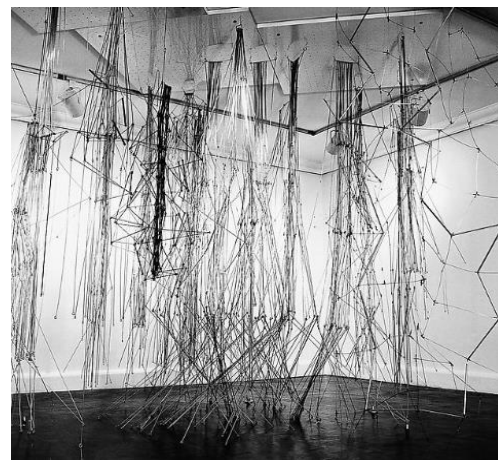
Her progressive artistic and pedagogical practice helped her to master a method of

connectivity. Starting with smaller scale structural formations, such as *Esfera, no 3* (Sphere,

1976, p. 175), which measured 74 cm and could have been held in one's hand, Gego "played"

with line to such a point that the whole inner and outer space of the room/building was

occupied. Gradually, the forms of her installations grew to be what seemed like an enormous

and uncontrollable, as it appears at first sight, organism-like formation, thus bringing together

science/nature and art (Traba, p. 210).

Throughout Gego's work, the presence of dualities and opposites are clear and essential: from

geometry to formlessness, from order to chaos, from science to art. It is as though Gego is

unscrambling the schematic order by confusing and overlapping the structures of nature, plants

and organisms' behaviours. It is as though she looks into the future and *Reticularea* takes the viewer through this process. The whole installation is poetic and flowing (Bosteels, 1999, p.21-38).

The interdisciplinary nature of Gego's approach and practice is clear in her earlier works, throughout the works she produced in 1980 and after. She had a background in architecture, which enabled her to understand space and have freedom with lines and geometric formations. Gego never bound herself to one field of practice, as she explained in conversation with Maria Fernanda Palacios: "My intention is to 'make visible' and not make 'artwork'; therefore, I cannot see a substantial difference or a basic opposition between my activity as a designer and my work of art." (1973, p. 222). Further, Gego explained how she did not see the necessity to establish "categorical differences between art and design." (1973, p. 220). Gego like many contemporary artists today has numerous practices and participated in collective research. My own practice requires me to study and learn new techniques, opening a new range of possibilities and limitations.

What is truly remarkable in *Esphera*, *Tronco* and *Retacularea* is the absence of a focal point and perspective that is seen in drawing, painting and architectural sketches. Note that all terms of perspective are tools of certainty for an artist to create depth and illusion of space in a picture. In my practice, I often stumble upon the same dilemma, between perspective (which is so natural for a painter) and its absence. How does one artist formerly trained in a particular "understanding of perspective"—cone of vision, horizon line, vanishing points, shadows, isometric drawing and other formal elements—dismiss them all and find the freedom of space while still working with geometric formations? By freedom of space, I mean creating the environment where the form can dissolve into the background and where the drawing is no longer constrained by the physicality of surface.
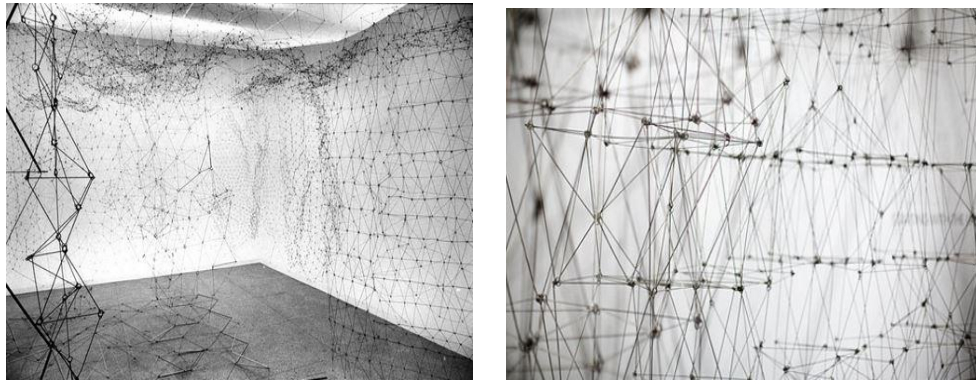
Retacularea , (1981), fig, 13, fig. 14

Perhaps transparency, which was Gego's main goal, opens up the possibility to invade the space, morph the environment, and introduce a different, unknown dimension. Gego used transparency as a well-crafted tool to unfold the spatial layers and step-by-step destroy the limits of dimension. As discussed previously in this analysis, Gego rejected the idea of creating sculptures; she stated numerous times that neither mass nor volume were subjects she was interested in, and that they would not serve the purposes of her practice. (Bosteels, 1999, p.21-38). When I work in my studio, I also look for airy and transparent elements to reveal the simplicity of a form.

4. Studio Research/Material Practice

4.1 Shadows

Shadows are one of the main elements I use to create my installation-based work. As per physicality of light, it naturally creates shadow when it meets the object. Depending on where a person is, perception of space changes; shadow follows as an inevitable part of it. Through light and shadows I visualize the meaning of object. I choose to work with existing light and then make a decision as to whether additional artificial light sources are needed. Working with continuous and impermanent light enables me to experiment and study the object. Often, it is through light that the work exists.

Forming shadows requires an object to block the movement of light. Everything is

visible because of light, that electromagnetic wave that enables us to view the object. Although light (or the lack of it) is responsible for forming shadows, without an object that blocks the movement of light, there are no shadows.

During my research on light and shadows, I have observed that the density or darkness of the shadow depends entirely on the amount of ambient light falling on the shadowed area. I have learned that by controlling all of the light falling on the surface, the shadows projected will be dark and dense. However, any other light in the area will reduce the density of the shadow and turn it from black to a lighter shade.
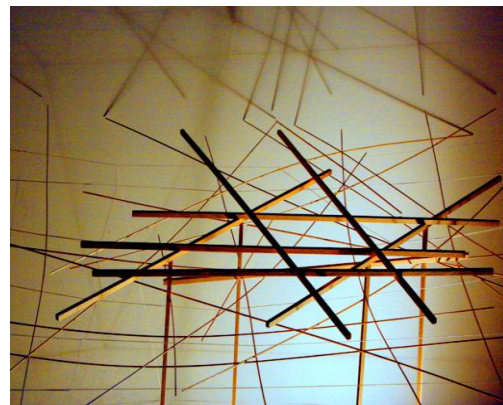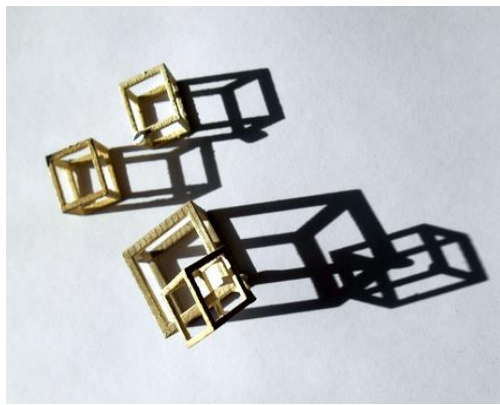
Shadow Studies (2013-2014), fig. 15, fig. 16

4.2 Sticks and Line

For my experimental studies, I often use chips of wood and toothpicks as a main building material to create geometric forms. When multiple pieces are connected and interlocked, the form begins to emerge; the form is then photographed, studied and changed. When I work with wood, string or wire, I look into how the materials can be transformed from soft to hard, from uncontrollable to fixed, from organic forms to geometric. Sticks build the cube the cube builds the form. It is a coherent conversation between the material qualities of the wood and the square as a building unit.

Line Progression no. 3 (2011) fig.17, fig. 18

My artistic practice involves the process of visual thinking and brainstorming through the process of building forms, working with prototypes and creating concepts. However, as I choose the materials to work with, I often find a detour because of the material itself. Be it wood, string, or wire, each has its own quality and physical limitations. I was able to eliminate these limitations by choosing and using the material for its linear qualities. For example, a wooden stick is a line that can be manipulated to form a cube, which becomes the unit to build with. The material in this instance, takes on a different purpose, it becomes invisible reinforcing the illusion, it morphs into the work. When I project a light on the objects placed on the wall or suspended in the space I create shadows. This play of light and shadow confounds what is real (material) and what is illusion (shadow).

Sometimes the material directs the work. For example, I chose wooden sticks to work with, because I was interested in how it could be handled to construct a geometric form, a cube. I did not see the wooden stick as a material that meant to be used in crafts, but as a building line that could be changed and added, to become a part of the form.
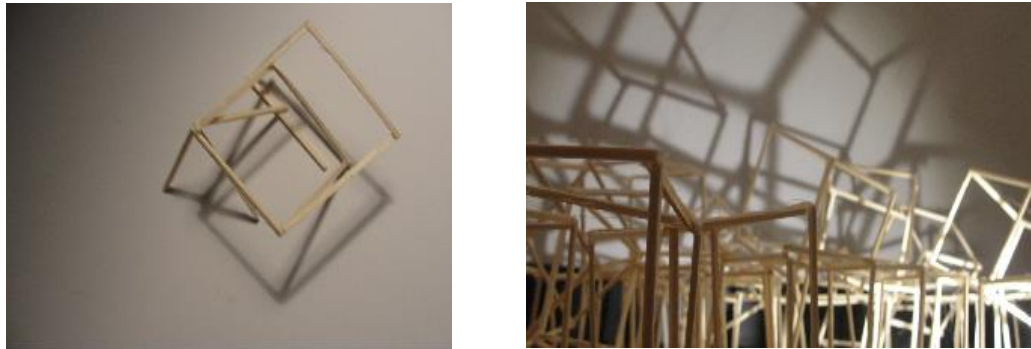
Wooden sticks studies (2011), fig. 19, fig. 20

Materials that I use, wire, string, sticks, all can create lines as I am seeking. Line and drawing are the elements that link my work. The presence of these elements is evident in my paintings, installations and digitally created prototypes.

4.3 Cube as a Unit

Early in my research I began studying and sketching the cube. That work consisted of linear perspective drawings, networks of dot patterns on Post-it notes, pencil constructions held together with elastic bands and stick/toothpick drawings that build cubes. I used the cube as a building block in developing geometric composition. Lewitt writes about the cube: "The most interesting characteristic of the cube is that it is relatively uninteresting. Compared with other three-dimensional form, the cube lacks any aggressive force, implies no motion, and is least emotive. Therefore it is the best form to use as a basic unit for any more elaborate function, the grammatical device from which the work may proceed" (Lewitt, 1966, p. 169). Because the cube is a simple geometric form, it does not need to be interpreted in any way other than what it is: a building block that is used to invent another form.

4.4 Photography

As I experiment in the studio, I document the process to fully understand my constantly changing thought process. Photographic data is an aid; it acts as a silent recorder of each experimental step. Taking photos serves a similar purpose to that of note-taking: The

photos are a visual image collection for future review and analysis. Collecting snapshots of visual experiments enables me to revisit the process and notice new elements that might otherwise have been missed.

It is important for me to continually keep a digital record of the process that sometimes exists only as photographic data. Some experiments that take place in my studio are impermanent and ephemeral due to the fragility of their form or material. Photographs of such experiments are artefacts of the work; therefore, the photos are more than a collection of data. The photos I gather are both tests and results. Some are taken for the purpose of documentation in the process of research; others are chosen to be finished works. The way I make choices to decide which are which, is constant consideration of the essential elements present throughout my practice: line, drawing, geometric form, and shadows. The photos also have the possibility for future use when they are revisited.

4.5 Digital Laboratory and Prototype

The interest in the prototype, as Kuchler mentions in her article is the phenomenon that appeared mostly to be a matter of the reproduction and replication of artefacts in the industrial age (Benjamin, 2008 (1936), p.278); Maniura and Shepherd, 2006, p.84). Kuchler (2010, p.302) states that "the intellectual spark for the prototype as artwork, I contend, lay in fact outside science and industry in the discovery of the new world and the arrival of collections of artefacts that served as models in their own right". The notion of prototype as artwork is what I am interested in. The prototype in the twenty-first century is the "ready-made" object.

Once the conceptual idea is born, with the use of rapid prototyping, it can be materialized. Prototype is a tangible expression of an idea. The prototype in my practice has become the artwork.

If ideas can be works of art (Lewitt, 1969, p.169), then the digital environment serves as a space for their development—a "digital studio" where works of art are born. Actual prototypes are those ideas that have taken physical form. "A work of art may be understood as a conductor from the artist's mind to the viewer's. But it may never reach the viewer, or it may

never leave the artist's mind" (Lewitt, 1969, p.169). Prototype serves as a transmitter between the idea and a physical representation of it (3-D print).

"The artist conceives and plans the wall drawing. It is realized by draftsman (the artist can act as his own draftsmen); the plan (written, spoken or drawn) is interpreted by the draftsman" (Lewitt, 1970, p.169). Now, I would like to focus on the interpretation of *Doing Wall Drawings* and compare the "draftsmen" to the digital tool. Lewitt refers and comments on the relationship between his conceptual ideas/plans for wall drawings that were often done by someone other than him. Lewitt stresses the importance of an artist to conceive an idea and how it is of a minor importance who executes the final work. He makes it clear that the relation between the "artist" and the "draftsman" is what causes the work to take physical form. (Lewit, 1970, p.169).

Working within the digital environment and being in constant conversation with the computer leads me to compare Lewitt's notion of "artist" and "draftsman" to my own relationship with technology: me, being an artist, and the computer as draftsman. The concept is born in my mind, then I engage and communicate the idea via the digital program as an execution; as a result, a prototype is made. "There are decisions that the draftsman makes, within the plan, as part of the plan. Each individual, being unique, if given the same instructions would understand them differently and would carry them out differently" (Lewitt, 1970, p.169). Here, the "draftsman" is the computer program, interpreting the data individually, depending on the chosen software options and digital tools, however, it is the artist, who creates rules and sets the guidelines. The understanding between the artist and "draftsman" is unique and individual. "The artist and the draftsmen become collaborators in making art" (Lewitt, 1970, p.169).

4.6 Art and Technology

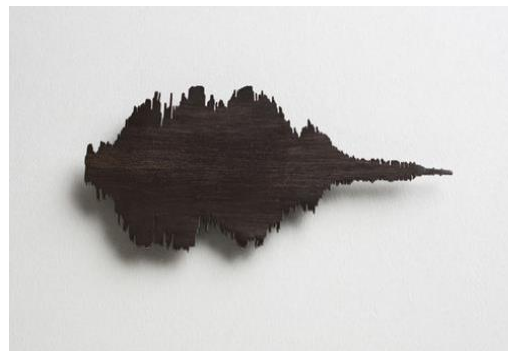Artists have embraced technology in different ways to achieve desired results in their work. Some artists are focused on working digitally, because the forms they choose to work with are either not mold-able or non-existent, for example, Sakurako Shimizu and Anish Kapoor, who focus on the material itself and use technology as a tool, as a machine that creates the artwork without an artist's hand.

Anish Kapoor worked with Adam Lowe and both of them were interested in making the machine that could generate form. "The printing machine formed a model for basis of our thinking. After much trial and error, we found a surprisingly simple way of making a workable engine. Once we had started making objects, a new reality began to emerge" (Kapoor, 2009, p.39). "New reality," a reality of art making made by the machine, that produces objects like no other, objects without hierarchy of form, but objects that have meaning and translate into art, as Kapoor states: "Meaning is the translation of art" (Kapoor, 2009, p.39). Working with CNC (computer numerical control) milling, Kapoor created an Identity Engine, which is a relatively simple machine, and which offers a variable territory of play when digital data enters the physical world: "an artful balance between deterministic mechanics and free play" (Lowe, 2009, p. 43). The relationship that Kapoor established during the creation of the Identity Engine is one of the new ways of communication between the artist and the machine.

Sakurako Shimizu's work is another example of how the transformation of the conceptual idea takes a physical form. As a subject for her work, she chooses to materialize the sound wave using laser cut technology. Shimizu materialized vibrations that pass through an object, sound waves. An object that can be touched and experienced, an object brought to life. The idea was first in the artist's mind, which was visualized and became an object of art.

Identity Machine, detail (2008-2009) fig. 21   *Sound Wave*, variation (2013), fig. 22

To understand 3-D printing, the notion of layering the material in a sheet-like manner has to be adapted and realized. The most exciting notion of where the printing is right now and

where it will be in the future relates to dimensionality and the material itself. As for now, 3-D printing technology has gone far; however, there are unexplored territories that are open for discovery. The transformation between two-dimensional and three-dimensional realms now exists because of the technology; however, there are also fourth, fifth and 'n' dimensions that are still unexplored. Scientists and mathematicians have been questioning these multidimensional planes for a long time, yet what is remains exciting is the collision of science, technology and art.

I am treating the prototype as a possible finished work of art or as an equally-important step in the process of making the final piece. My interest in 3-D printing began with the frustration of making an installation-based work. At the time, I was using wooden sticks to build a geometrical form using glue to attach the wooden sticks together. I was limited by the size of the material (4" by 4" wooden sticks). The gluing process was unsatisfactory, because it left visible blobs of glue at the joints, which disturbed the composition of the work. I felt limited by the form and I could not multiply the units (squares) in the desired amounts. That moment of frustration led me to take my research to a different level and explore my idea in a digital environment. The file was created digitally and then 3-D printed. That is when the moment of realization and fascination with the digital happened for me. Seeing, feeling and holding my idea in my hand was different and unknown. Reminiscent to when a child is introduced to something new, I had opened a door into an unexplored territory. Digital tools that could be used to change the size, stretch, bend and multiply my idea made me challenge and question my initial design idea.

Kuchler (2010, p.303) articulates in her discussion: "model in art leaves open possibility that its final design can also become the prototype for production and even the actual art work as such". I tend to have the same approach to this fairly new tool that technology offers to the artists.

Kuchler (2010, p.303) analyzes the *Little Dancer Statues* by Degas (1879-1881), which were small scale models that have taken their own journey as art pieces. These wax

prototypes became independent of their previous function as a step in the process of bronze casting. Later, the wax models were displayed during the Sixth Impressionist Exhibition in 1917. Kuchler (2010) quotes David Summers' (1993, p. 303) comments on the promiscuity and instability of the wax prototypes, and suggests that the models had a profound effect on the perception of the work as they represented life-like images and clearly communicated with the viewer. Even with such a fragile material as wax, Degas' models were able to transport and materialize the idea with the information that was held by the prototype.
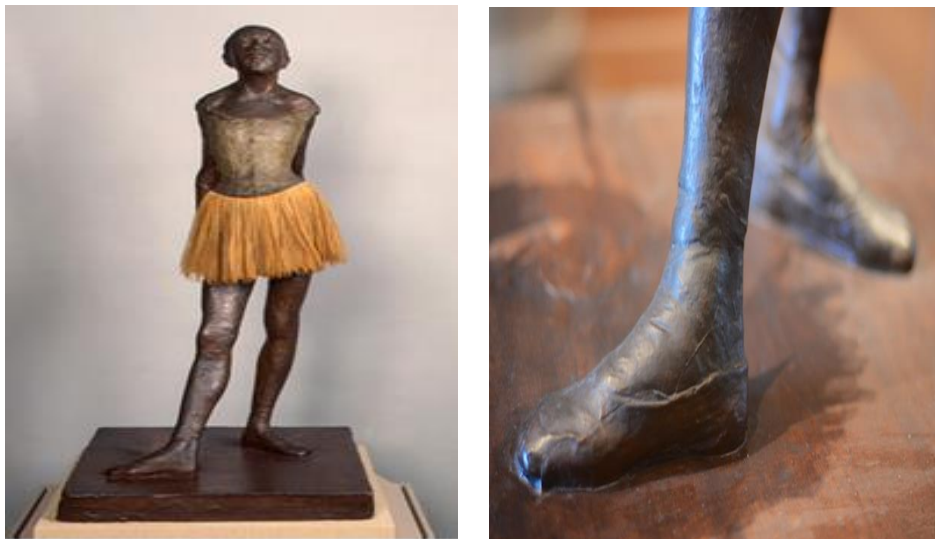
Little Dancers Statues (1879-1881), detail, fig. 23, fig. 24

The word *prototype* comes from the Greek "prototypon" (Grimm, Tom 2004, p. 24), meaning first form, an original, a pattern. When a thought takes a physical form, ambiguity, assumptions and perceptions are either eliminated or questioned even further. The difference between the model and prototype could only be in its basic meaning. I do not see the difference between model and prototype if both are products of a thought process. I create models as experiments, not as something to be scaled up later, which is a general notion of the purpose of a model in architecture. My models are studies and prototypes that aid me in examining the physical form. In this context, the difference between prototype and model is of little importance.

For me, being an artist who questions the details during the process of art making, prototype could be either an original pattern of gathered thought or a finished art piece. A prototype can be an artwork in its own right because its origin is within the idea first expressed in the digital environment. The digital environment itself becomes a studio. Travelling the road between the thinking (working with the digital file) and the making (3-D printing) is what interests me. As a painter, I am used to working with the two-dimensional surface and have developed a certain way of perception. Working within the digital environment—a three-dimensional space—was challenging because my vision of space had to change. I had to insert myself into this three-dimensional world and see the form from within, as opposed to painting, where the form is observed and projected on the two-dimensional surface. Through investigation and self-education of the digital tools available, I began to understand the grand scope of possibilities that this field offers; "Digital media translate the notion of three-dimensional space into the virtual realm and thus open up new dimensions for relations between form and space."(Paul, 2013, p.8).

Let me briefly explain the process I have experienced during my investigation of 3-D printing. The work begins with simple y, z, x axes and four views: top, perspective, front and right—usually well-known territory for designers and architects. After I adapted my perception to the digital environment, I created my first file to print. With 3-D printing, as in any other artistic making process, misprints and failures occurred. Each step and misprint was a step forward in my investigation, and these steps helped me to develop a coherent conversation between the digital environment and the physical 3-D printing, which helped the process to move further:

- First, the digital file was created and manipulated.

- Then, the form was studied within the digital space: its size was chosen and it was considered from all views: top, perspective, front and right to ensure I achieved the desired design.

- After I felt that the work within the "digital studio" was satisfactory, the prototypes

were printed using a variety of printers: MDM, MJM and wax, all of which provide different features and options.

- Holding the prototype in my hand, I examined and questioned the printed results. Seeing what I wanted to correct, I could go back to the digital file and fix the issue. (Several prototypes were produced.)

- The process of this production was then photographically recorded.

Printing the prototype and removing the support material (2014), fig. 25

Making prototypes has enabled me to question and resolve previous issues with my installation-based work. With the help of digital tools, the form I choose to work with is no longer limited by material or spatial constraints. I can keep the form free and make final decisions before it becomes physical. Working within the digital environment has ultimately changed the way I view my studio work.

4.7 Exhibition: *Assessing the Experiment*

The thesis exhibition "Assessing the Experiment" consists of works that have unfolded during the studio experiments, and installation work made specifically for the exhibition. The exhibition included painting, photography, prototypes and, silver casting piece

in order to show the process and make the viewer question the dimensionality of space.

The installation *Line Progression no. 9 (*2014) is an expansion of an earlier piece entitled *Line Progression no. 9* (2011) which consists of tubes that 'spill' string onto the floor creating illusionist drawings. This piece began my exploration of installation as an ephemeral presentation of what had previously been object based work. I questioned results of material experiments undertaken in the studio and fused them with solutions from previous work.

Line Progression no.9 (2014), fig. 26, fig. 27

In "Assessing the Experiment" the installation constructed of wooden sticks and cubes hangs from the ceiling with invisible thread, eliminating the support and activating the space with a complexity of shadows on walls and floor.

 I work with lines to build the cube, which in itself is a simple geometric form. In the installation I used cube as a building block to create delicate organic like structure. Lines and cubes, cold and uninteresting at first glance, become fragile links that fall from the ceiling and animate the space with light and shadow. My intent was to illuminate the transformation from a simple form into an intricate installation. Once the work was installed in the gallery it appeared to take on a life of its own, colliding with the space and embracing the room.

In the beginning the photographs served the purpose of digitally recording and collecting the information accumulated during the making of the work. Later some of the photographs

became an artwork. When analyzing the photograph I carefully consider the information that the picture holds. In selecting the photograph I chose to enlarge and display in the exhibition, I was mindful of spatial composition and collision of object and shadows. Additionally, I have decided on the final picture because it had a trace reminiscing my earlier paintings. Paintings that consisted of a grid like geometric structures that transformed into cube like pattern noticeable in the later silver cast.

What intrigues me about the photographs is perceptual play that creates an illusion of what is the object and how it merges into one form when light and shadows occur. In that sense, the photograph is no longer a technical record of the experiment but an independent artwork.

To conclude, "Assessing the Experiment" is both a collection of the results produced during my studio based research and installation based work. It is a manifestation of the process I have undertaken, and a vivid representation of how my research progressed and unfolded from constructing installations and collecting photographic data, to working within the digital environment and producing prototypes.

5. Conclusion

I have transformed the cubic form, into lattice-like structures. During my research and studio practice I have applied questions previously raised in my paintings about space and dimensionality. My goal was to make the cube invisible, to change it into an airy, delicate unit which would be a part of a new form. My interest lays in the process of this transformation, in the experiment itself, and not necessarily a finished work. The constant conversation between the simplicity of a form (such as cube) and the complexity of the resulting lattice-like armature is what I am driven by.

I work with shadows because they show both complex and simple qualities of the object by revealing its hidden lines. The shadows create an illusion of drawings on the walls, ceiling, the floor, captivating the space to become a part of it. With the use of light these invisible drawings become visible. I create scaffolding structures to reach atmospheric results

that embrace the space I work with. Shadows and light bring drama to the work creating a dialogue between the object and its reflection (shadow).

My intent is to dissolve the object into the background. For that I choose to keep the colour pallet light, almost invisible. My work has a potential of collaborative process of disappearance and optical confusion as to what is the actual object. With light and shadows, I reveal and manipulate the illusion and captivate the space. Is it shadows or is it an object that creates these illusions? It is both; it is a conversation between the two. The transformation of the cube and the shadows as drawings on the wall, the light source, the limited colour pallet, all of these elements are the work. What is important in this transformation is the intermingle of what is real (the material itself), and the immaterial (shadows), collision of which results in an optical perceptual play.

My own research led me to work with prototypes and pushed me to learn about the digital environment. Artists today search for resources in different fields: a painter has the opportunity to paint digitally if desired, an artist who draws can pick up a 3-D pencil and create directly in a spatial environment. It is not to say that the artist will or should; however, to have options and different tools available can benefit the work. An interdisciplinary approach opens possibilities that challenge the artist to search, to explore, and manipulate the material.

The exciting part of my research and experimentation lays in the interdisciplinary thinking. An interdisciplinary approach for me is the way the decision-making process happens. Coming from a painting background I often questioned space. Once I learned the digital technologies it allowed me to enter the realm of sculptural practices. As an example, the installation work in the exhibition started with a series of paintings and became an installation-based work; shadows activated the space and created a drawing on the wall. I translated the drawing of the cubes into the digital format and printed as prototypes.

Various artists are adapting new technologies and using the prototype approach in a creative manner. For instance, the work of Gilles Azzaro, Sound Wave (2013) is an idea that became physically visible using technology and 3-D printing. "I work in the invisible, I make invisible sound into something you can see and even touch" (Azzaro, 2013). Azzaro took the

invisible information of a recorded 39-second sound and created a five-foot long wave form.

Sound Wave (2013), fig. 28

My own exploration of working within the digital realm opened a new and fertile territory of this intangible media. The creation of the digitized information, the file allows me to manipulate the object, experiment with the form and materialize the idea via prototype. The digitally-created object takes on a form that can be stretched, bent and re-sized. The form becomes free of physical constraints before the print process is employed. It opens a possibility to experiment, play, and think about a final object in a different way. It allows the artist to question and manipulate the object before it is physically printed.

Matthew Ritchie is another artist who has adapted and used technology to advance his work. His transformation from painting and drawing to installation-based work happened with the use of laser cutting technique. Using laser cut stencils, Ritchie installs them in and outside the gallery captivating the environment. Ritchie's main focus is in drawings, which he first creates manually and then scans into the software and manipulates them digitally. Working within the digital environment enables Ritchie to re-size and change the drawing into the desired final work. Technological advances aid artists in the creative process. The studio is no longer bound to the physicality of making with the hands. Digital manipulation can be done on the computer before final decisions are made and ideas can take physical form via 3-D printing.

My mixed media practice led me to communicate between both the physical studio and the digital environment. The duality of this method of learning brought my production to 3-D printing and prototype making. As photography recorded the data, producing prototypes helps me to communicate the idea via prototype. Introducing a technological tool—3-D prototyping—enabled my studio practice to move from object-based production towards the exploration of the conceptual meaning of the studio experiments. For an artist today, new tools and technological aids are available to work through an idea in different formats.

The documentation of the research process is crucial to my practice. All of the attributes that I work with: photography, shadows, form building, cube as a unit, 3-D prototyping are building blocks that I collect during my research. My experimental practice opened up new methods of thinking and analyzing. For example, in the past I felt that my work was spatially limited by the two dimensional surface of painting. As my research progressed, I learned how the objects interact within the physical spatial environment and what it means to work within the digital dimension.

Today, new technological opportunities offer digital tools that open up portals for artists to work two dimensionally as well as exploring new dimensions that the digital environment contains. The collision of art and technology provides new approaches to execute conceptual ideas, creating a closer communication between the artist and viewer. The work produced during my collaboration in different disciplines has led me to new theories within which to frame my practice. Adapting new ideas and techniques, crossing boundaries between fields of art and technology has produced unexpected results and that continues to guide me in new directions.

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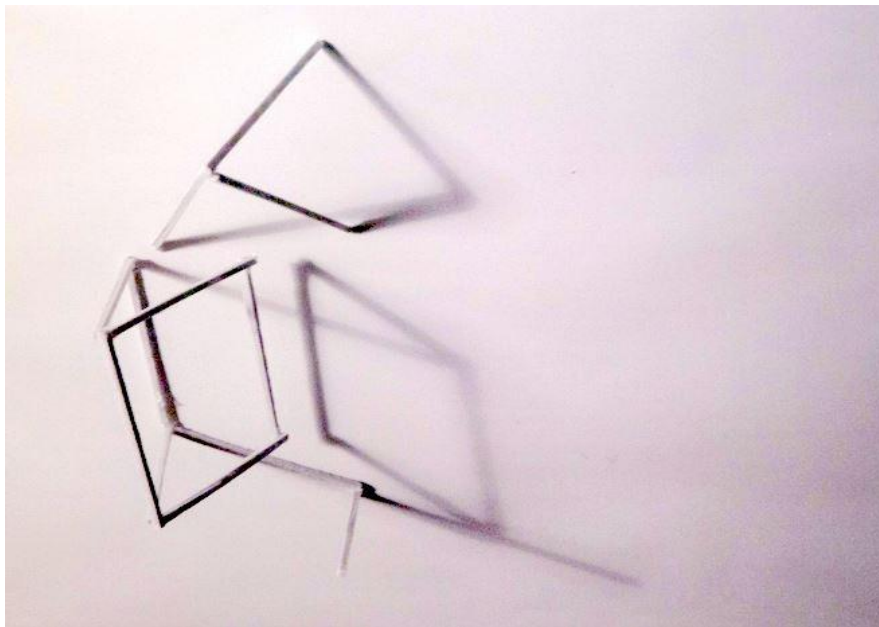**Appendix. 1 Assessing the Experiment, Images**

The appendix includes images of work from the exhibition Assessing the Experiment.
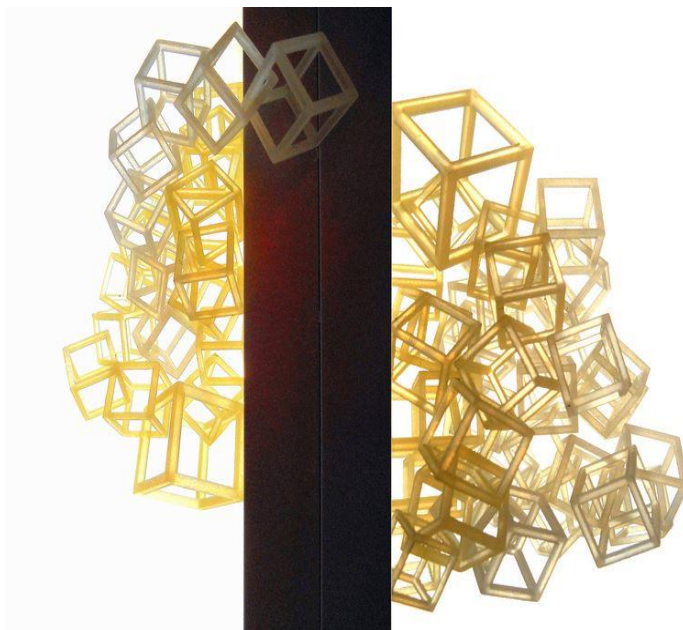

Line Progression no 9, (2014), wooden 4 inch sticks, hot glue, fishing line, light, shadows,

fig.29

Untitled, (2013-2014), 48 black and white photographs, 8 by 12 inches each, printed on matte paper, size and images vary, fig. 30
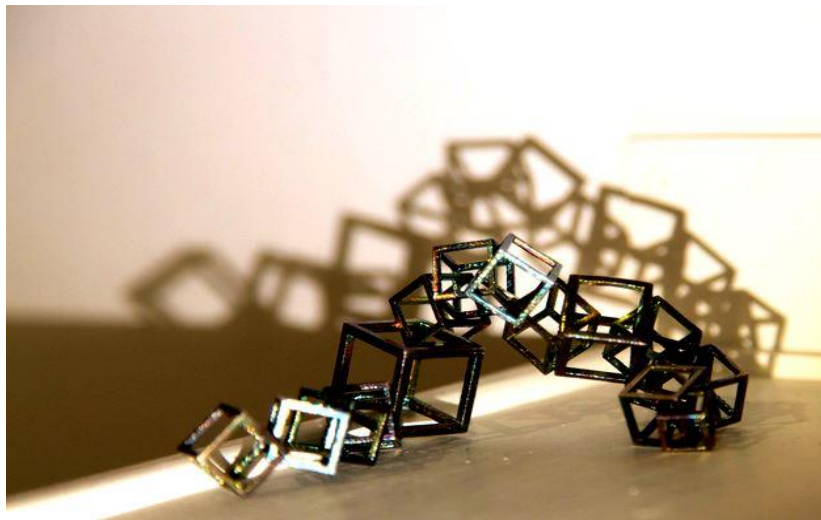
Shadow Play, (2012), 40 by 60 inches, digital print on semi matte paper, fig.31

One to One, (2014), 40 by 60 inches, digital print on semi gloss paper, fig. 32
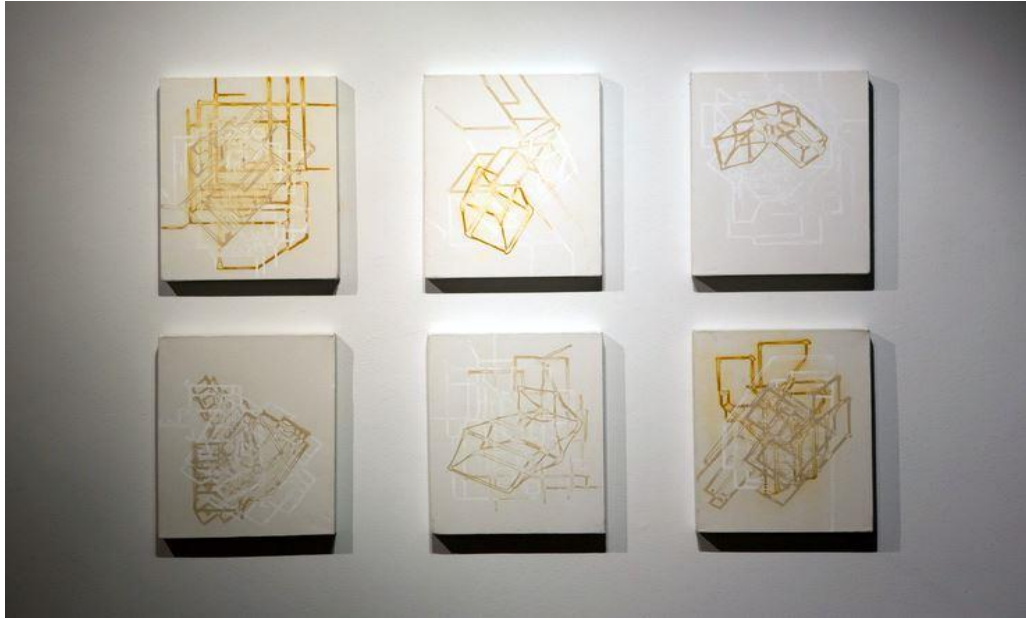
Untitled, (2014), 24 by 32 inches digital photograph, printed on matte paper, fig.33
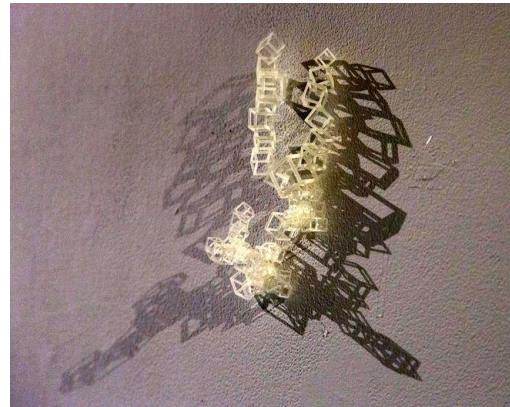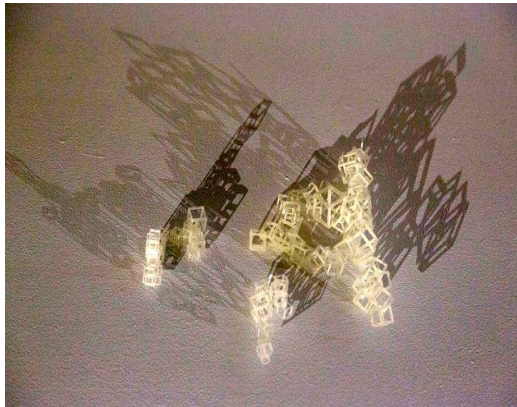

Untitled, (20114), 925 Sterling silver cast, 79.8 grams, oxidized, made

out of prototype, fig. 34

LineProgression 6, (2011), acrylic on canvas

Gathered, (2014), size and form varies, resin prototypes, printed from a digital file on MGM

printer,fig.36