Creativity and the Development of New Ideas:

The Generative Potential of Visual Literacy

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Abstract. The goal of this writing is to expand our understanding of visual literacy to include the capability to create and think using visual media. It begins with a reference to the way we ourselves work, think, and create. Following a brief examination of historical and contemporary descriptions of visual literacy, the current understanding of creativity is reviewed. How we create, whether internally through visualization or externally through distributed means is discussed. The use of external media to examine and develop ideas is mapped onto visual methods such as informal drawing, sketching, and thinking drawings. An examination of our own visual practices extend the scope of visual literacy to include thinking and creation.

Keywords: Creativity, distributed cognition, visual media, visual thinking

> *Words crystallize thoughts, they give articulation and precision to vague images and hazy intuitions; but a crystal is no longer a liquid. Language can act as a screen between the thinker and reality, and creativity often starts where language ends…* (Koestler, in Brazier, 1964, p.333)

Imagine the challenge of organizing a new studio, arranging equipment or furniture in this new working environment; or adding to a house, laying out new rooms and spaces on a lot; or developing a design for a quilt with varied fabrics. These are all spatially complex, non-linear problems with a number of different variables in a structured setting. If we are able to visualize effectively, we may be able to mentally solve the problem, inside our own head. But being visually literate, many of us would choose to use drawing to explore, examine, and think about how to resolve this problem. We would draw or sketch different alternatives seeking the best solution and exploring a range of possibilities. Our creative capability is extended by sketching. This distribution of our mental capabilities outside of our "skin and skull" (Clark & Chalmers, 1998) is inherent to the work of designers and artists, among others, but is not widely recognized as an essential aspect of visual literacy. While much attention of the field of visual literacy is centered on the reading and evaluation of visual work, the greatest creative potential lies with using the skills of visual literacy to produce, generate, and explore. Generation of new ideas through our chosen medium is how creativity is made most evident through visual literacy.

Demarcating Visual Literacy

As defined and researched, most efforts in visual literacy focus on communication and representation. Visual literacy is often described as being able to read, decode, understand, communicate, and remember. In what has been described as one of the first definitions of visual literacy skills, Debes (1969) wrote: "When developed, [visual literacy competencies] enable a visually literate person to discriminate and interpret the visible actions, objects, symbols, natural or man-made, that he encounters in his environment ... Through the

appreciative use of these competencies, he is able to comprehend and enjoy the masterworks of visual communication" (p.14). In short, in his view, visual literacy is about perception and understanding, that is, reading. The common short-fall, is that descriptions of visual literacy do not include thinking, as noted by Goldschmidt (1994) "When visual thinking is considered, however, we tend to concentrate on visual and almost forget thinking, which fades into the back-ground" (p.158).

Dondis (1974), however, sees and hints at the potential: "A verbally literate person is defined as one who can read and write, but this definition can be extended to mean an educated person. For visual literacy, the same extension or meaning should hold true. Beyond providing a body of shared information and experience, visual literacy holds the promise of an educated understanding of that information and experience" (p. 182). Dondis can be seen to include the productive aspect of visual literacy, the ability to "write", to generate ideas, through visual media.

Most of the aspects of current definitions of visual literacy seek to understand and "read" images, with attention focused mainly on *understanding* the visual message. This is also often described as being able to "decode" communications (Avgerinou, 2007; Avgerinou & Ericson, 1997; Avgerinou & Pettersson, 2011; Ausburn & Ausburn, 1978). For example, Ausburn & Ausburn present the basic elements of visual literacy in their definition. The description provided recognizes visual literacy as a skill primarily used for communication with others. They comparably noted "Some principles of visual literacy can be defined as a group of skills which enable an individual to understand and use visuals for intentionally communicating with others" (p.291).

While many of the definitions and writing on visual literacy focus on the communication functions of the viewer/receiver, some definitions also include the ability to analyze and synthesize. Creative interpretations may be cited as a trait which is reactive to visual communication such as imagining different understandings of an image, but it is most often evident in generative acts such as drawing, writing, making, and inventing. Similarly, people can creatively interpret written texts, but the greater creative output is seen with productive writing, such as poetry or fiction. The generation of visual work is more closely allied with creativity than with the imaginative interpretation of visual examples. In this direction, Avgerinou (2007) includes, in a summarization of definitions, authorship as an important, broadly held understanding of visual literacy. Additionally, Avgerinou and Pettersson (2011) included other terms dealing with the generative nature of visual literacy as the ability "… to write/encode/create visual statements, and to think visually…" (p.4).

The broadly accepted Visual Literacy Competency Standards for Higher Education of the Association of College & Research Libraries provides a well-developed and detailed examination of the skills of visual literacy. There are seven Standards areas, that contain subskills which are briefly described with performance indicators and learning outcomes. Most of the Standards deal with reading and appropriately using images for communication and aesthetic reasons. Verbs used in Standards One through Five include “determines,” “finds and accesses,” “interprets and analyzes,” “evaluates,” and “uses” (Hattwig, et al., 2011, unpaginated). Standard Seven deals primarily with the ethical use of images and visual media.

The description of the creation of images and of deeper thought is specifically addressed in Standard Six. It focuses on "The visually literate student design[s] and create[s] meaningful images and visual media" (Hattwig, et al., 2011, unpaginated). Much of this Standard deals with communication and the development of finished work.

While this Standard recognizes the generative nature of the visually literate, it centers on finished works of visual material. It does not include the cognitive capability of *developing and thinking with* visual work. As one can see, the development of new ideas, that is, generative thinking sits at the edge of most definitions of visual literacy. In order to better understand the possibilities, it is important to understand the nature of creativity itself, and the connections to visualization and distributed cognition.

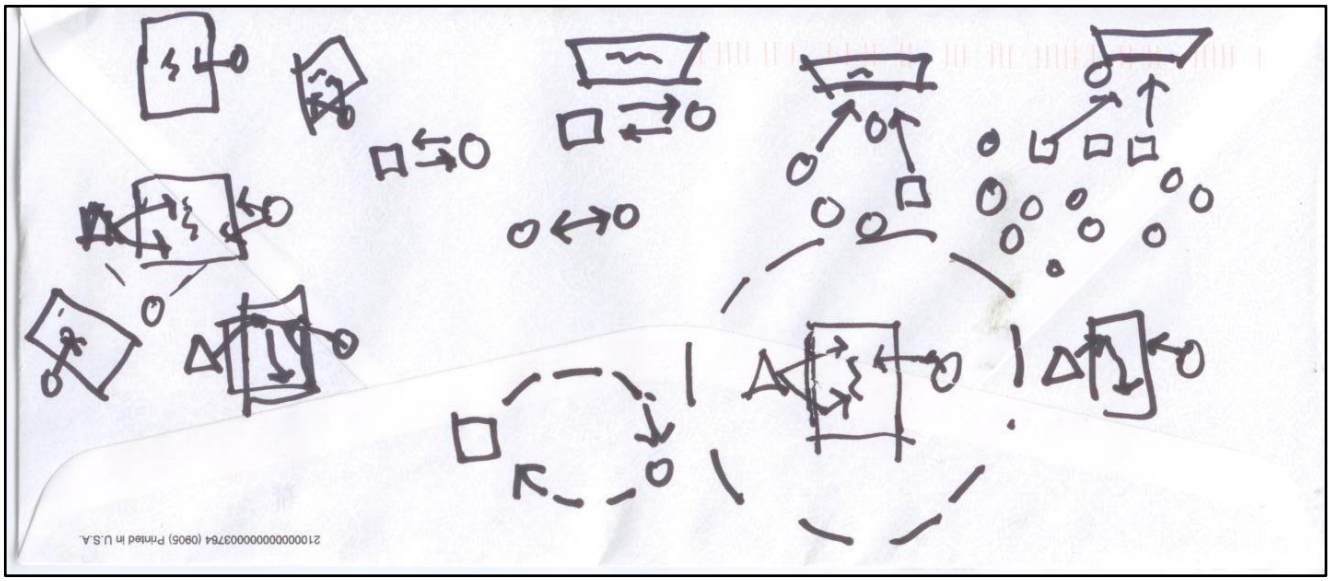

Figure 1. Back of envelope sketch developing representations of design critique formats (Hokanson, 2012a)

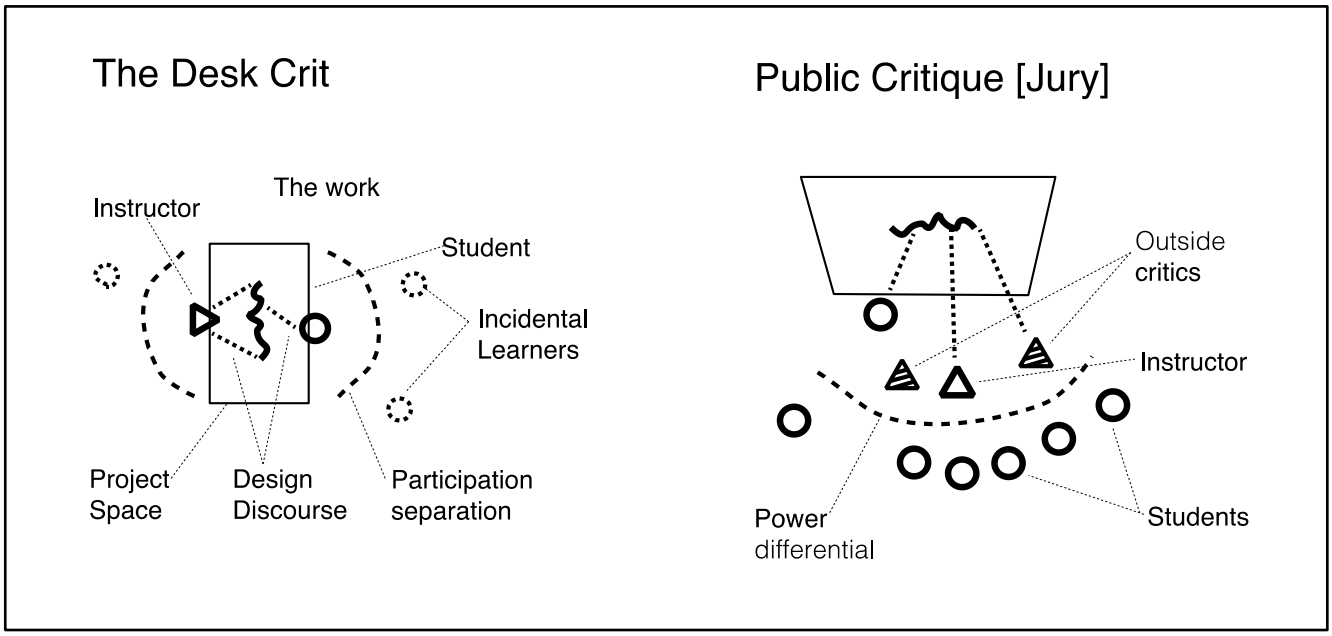

Figure 2. Resulting diagram illustrating design critique formats (Hokanson, 2012b)

Creativity

Creativity, as with visual literacy, is an often-misunderstood skill or capability for which definitions remain challenged and evolving. However, there is a commonly held base definition: creativity is the ability to generate ideas that are *original* and *valuable* (Plucker, Beghetto, & Dow, 2004; Robinson, 2011; Sawyer, 2011). These two terms vary, but the dual nature is always present. The pairing may include, on one side, ideas that are new, novel, unique, unusual or unexpected, and on the other side, ideas which are also useful, helpful, effective, or appropriate. Both characteristics are essential to creativity.

More recently, this classic two-part definition has been strengthened to include a reference to context: What is original in Baltimore may not be even out of the ordinary in Bangkok, and vice versa. Plucker, Beghetto, & Dow (2004) offer this as a more refined definition: "Creativity is the interaction among aptitude, process, and the environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context" (p.90).

Creativity is recognized and studied in a number of different ways, and two of the many directions are described here. Most common is an examination of people who are understood to be creative. When people are asked to list famous creatives, they often list Einstein, Picasso, Marie Curie, Beethoven. This is called "Big-C" creativity. It is the recognition of those whose lifelong creativity has affected their domain or society at large, and it is a recognized research direction for examining creativity in individuals. The most recognized research on Big-C creativity is Csikszentmihalyi's (1996) work in interviewing hundreds of renowned creative individuals from various fields.

Expression of creative ideas and their development is not limited to the famous and inventive. Some argue creativity is an essential human skill, one which is present in everyone, and one which originally evolved as a survival trait (Findlay & Lumsden, 1988). Creativity resides in all humans. It is generally believed that creativity is present in all the population, albeit in varying levels of expression. One challenge is understanding creativity present in a broader range of people who have not complied a life-long body of work.

Creativity as a research direction has been explored since the early 1950s, when, with Guilford's call for creativity research as president of the American Psychological Association, creativity began to be examined in terms of the everyday experience of people's lives (Guilford, 1950). Now referred to as "little-c" creativity, this focus recognizes how humans are creative in solving problems and challenges in their regular lives.

Much of creativity research deals with the capability for ideation, that is, the capacity to develop new ideas, which is predictive of creativity capability (Plucker, 1999). Creativity assessment takes many forms, but many of the means and metrics of assessment derive from the ideation assessment called the Alternative Uses Test. The AUT asks for alternative possible uses of a common object such as a brick, newspaper, paper clip, or binder clip. This method is employed by the widely used verbal Torrance Test of Creative Thinking (Torrance, 1966). The Verbal TTCT uses a series of different prompts to solicit written, verbal responses. The timed tests are mainly scored in three measures of Fluency, the ability to generate multiple ideas to a prompt or challenge; Flexibility, the ability to produce multiple types of answers; and Originality, the ability to generate ideas that are unusual or different from responses by others.

The ability to generate a large number of initial ideas, Fluency, is closely linked to Originality as research has shown generating a greater number of ideas leads to a higher number of original answers. Kudrowitz and Dippo (2013) said "… as the quantity of ideas goes up, the novelty of those ideas goes up…" (p.10). Previously Osborn (1963) had also noted "… early ideas are unlikely to be the best ideas generated during an ideation session …" (p.23). This is consistent with research in the long-term valued production of visual artists. Greater quantity often leads to greater artistic development (Simonton, 1997).

This methodological observation is well supported by notable creatives. Double Nobel Laureate Linus Pauling (1960) once said, "The

best way to have a good idea is to have a lot of ideas" (p.5), and Alfred Nobel is reported to have said "If I have a thousand ideas and only one turns out to be good, I am satisfied" (found in Weis, 2010, p.10). Starting or continuing the process with more options and ideas and delaying selection of an idea is well supported by other research in creativity as well.

Visualization

Where do creative ideas come from? Most research indicates ideas are often developed when two or more elements are combined or juxtaposed. Exposure to possibilities may also trigger recognition of usefulness (Epstein, 1996; Epstein, Schmidt, & Warfel, 2008). Changing our visual and social environment and increasing visual experiences can provide the brain with greater resources and stimulation, which Epstein contends leads to greater creativity.

Manipulating images in the brain, i.e., internal visualization, can provide a strong basis for a connection to visual literacy, whether in connecting different remembered visual elements or in building new forms or allegories. People use and transform mental images as a way of developing ideas, and in some cases, history has recorded the more significant advances, as "… many famous scientists have described how mental imagery contributed in an essential way to a key discovery or insight …" (Finke et al., 1992, p.45).

Science has been particularly notable in having used visualization to develop new ideas: "Miller (1986) has shown mental imagery, often visual, has played a decisive role in the work of several of the greatest scientists of the twentieth century" (in Goldschmidt, 1994, p.160). There are numerous anecdotal examples. Many high school students learn of the development of the concept of the 'benzene ring' being conceptualized by Kekulé while dozing in front of a fire. Faraday visualized lines of electrical and magnetic force, and similarly, Tesla could visually represent and operate new machinery in his head. Feynman used visual images as well to develop ideas sub-atomic particles, and his diagramming system remains in use today, a narrow form of visual literacy (Miller, 1986).

Perhaps the most far-reaching example of the use of generative, visual imagery for creation was the process Einstein employed in the development of his theory of relativity. His visualization and imagined physical aspects allowed far more exploration than text: "….Yet if all thinking were verbal thinking Einstein would not qualify as a thinker" (Koestler, 1964, p.173). Using his powers of internal visualization, he used visual thought experiments to explore the universe. "From a psychological viewpoint this combinatory play seems to be the essential feature in productive thought … The elements are, in my case, of visual and some of muscular type. Conventional words or other signs have to be sought for laboriously only in a secondary stage when the mentioned associative play is sufficiently established and can be reproduced at will" (Einstein, in Ghiselin, 1952, p.43). Visually, his thoughts could be fluid and dynamic, not crystallized as in a verbal mode, and more easily manipulated.

Einstein's ability to use mental images flexibly, i.e., to examine and manipulate spatial/ temporal relationships, enabled him to explore concepts in depth (Gardner, 1993). Einstein's mental skills were such that he required no external media to represent or manipulate ideas. He had sufficient cognitive ability to edit, store, and revise images without support from external representation.

Combinatory Play

The combinatory play of Einstein can be used as a model for visually developing ideas and is comparable to a research method used by Finke and collaborators (1988, 1992). They examined creativity through visual means and by using a limited set of symbols with verbal summaries. In a series of experiments, participants were randomly assigned three of the shapes as shown in Figure 1. They were assigned a general category of a functional device. They were allowed a set time to generate combinations of shapes to represent a new invention and were given two minutes to name and explain the value of the new object. Finke

found the number of creative ideas was substantial whether choices of shapes or functions were limited or chosen by the research participants. In various studies, from 17-42% of designs were judged as creative by a series of skilled judges; restricted choice leads to a higher percent of creative output (Finke et al., 1992).

These pre-made shapes and a specific design challenge were an easy way for unskilled participants to assemble new visual form ideas. The shapes provided some structure for those less literate in drawing and representational skills. The later naming/labeling in verbal form helped with any visual skills shortfall.

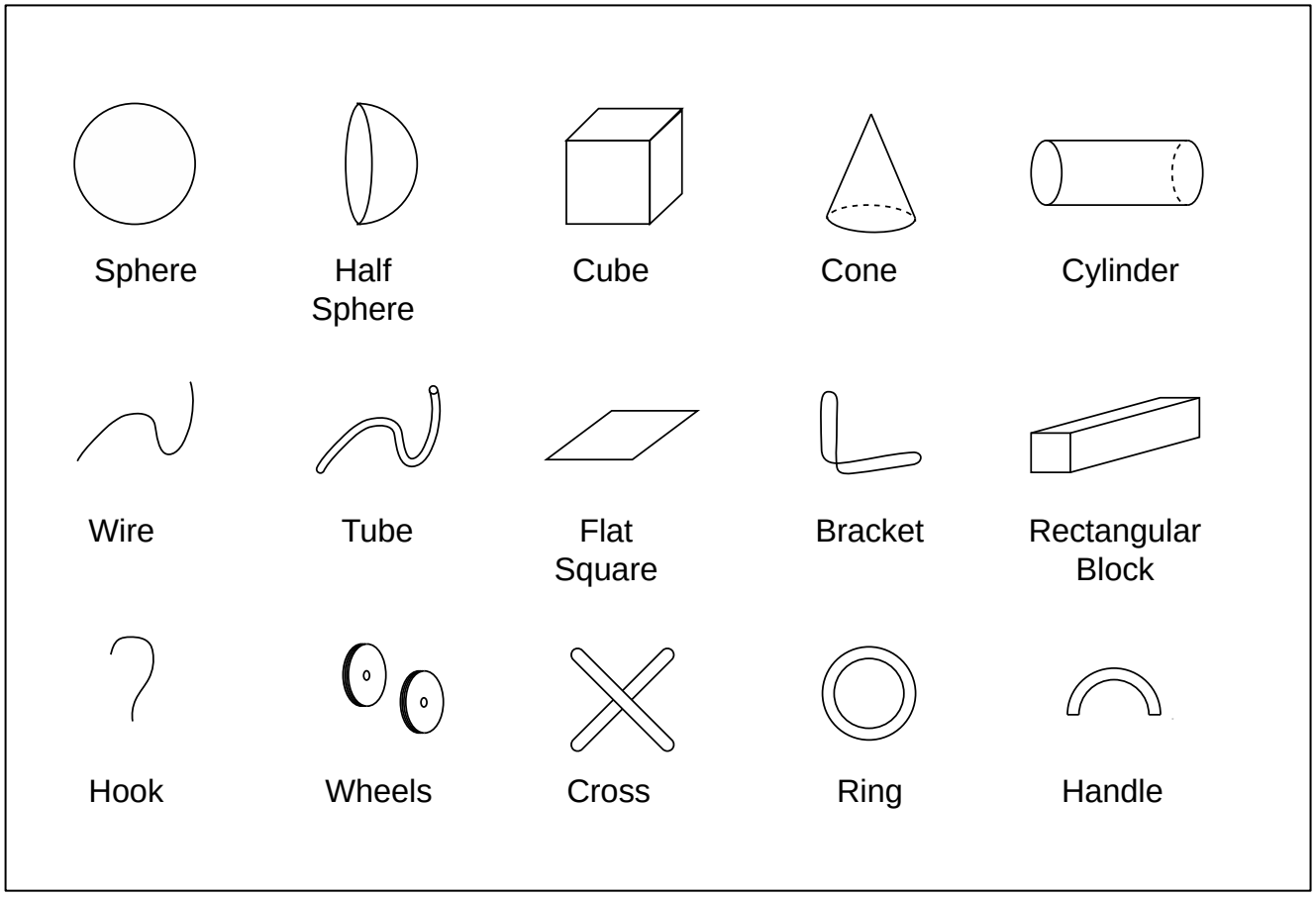

Figure 3: Finke's 15 parts used in creative invention experiments. (Illustration by the author, after Finke et al. 1992.)

Readers are invited to select one of the five shapes in the top row and use the other two shapes below the selected shape in the same column. Combine the three chosen shapes in a simple drawing to invent something from one of these areas: transportation, weapons, furniture, or appliances. Multiple iterations of the same shape may be used, and the size of the object can change as well. Ten minutes is a reasonable amount of time with which to experiment and draw the combinations of the forms. Such a drawing begins to distribute the cognitive effort, recording and allowing more diverse inventions.

Distributed cognition

The manipulation, organization, and development of visual symbols and representations can also be used to quickly depict and develop ideas, to generate concepts, to invent the new (Goldschmidt, 1991, 2003). However, "Few [people] have that level of ability to use complex symbol systems without mediation (i.e., external symbol systems)" (Hokanson & Hooper, 2000, p.546).

This use of external media is what is commonly referred to as "distributed cognition" (Clark & Chalmers, 1998). Humans, whether skilled in visual media or verbal symbols, often externalize their thought process. The idea of distributed cognition or the 'extended brain' is the use of external resources to remember or to think; Einstein was known to not remember his own telephone number as it was written down in the phone book. It is well examined in the field of cognitive science. It is a sharing of the cognitive effort between the brain and external resources where "… the individual brain performs some operations, while others are delegated to manipulations of external media" (Clark & Chalmers, 1998, p. 8).

As a memory aid, distributed cognition is evident in text-based information in our use of lists, meeting notes, and written reminders. We use written text to remember and record information so our brain will be freed for other tasks. Clark and Chalmers (1998) contend that cognitive evolution favored use of the local environment for memory aids, "… so as to reduce memory load, and even to transform the nature of the computational problems themselves" (p. 11). They illustrate the use of external tools in simple ways from counting on our fingers to playing games "One can explain my choice of words in Scrabble, for example, as the outcome of an extended cognitive process involving the rearrangement of tiles on my tray" (p. 9-10).

Much of distributed cognition relies on verbal language to store or communicate ideas. "Language … serves as a tool whose role is to extend cognition in ways that onboard devices cannot" (Clark & Chalmers, 1998, p.18). Verbal language is extremely efficient, but external storage of information is not limited to verbal/textual information The range of external cognitive media is myriad: "Algebras, alphabets, animations, architectural drawings, choreographic notations, computer interfaces, computer programming languages, computer models and simulations, diagrams, flow chart graphs, ideo-grams, knitting patterns, knowledge-representation formalisms, logical formalisms, maps, mathematical formalisms, mechanical models, musical notations, numeral systems, phonetic scripts, punctuation systems, tables and so on" (Peterson, 1996, p. 7). Each of these systems, these media offer their own affordances.

Literacy in any language, any symbol set, is limited by a number of factors. Its effective use as a thinking or generative medium is constrained to those with the ability. This externalization also extends to those viewed as highly intelligent or skilled in visualization.

The skill of being able to access and use these external resources is an important attribute of distributed cognition, whether it's using the familiar grocery store itself *as a list* to remind us or having the ability to visually represent conceptual elements and symbols at a mode-rate skill level. Clark and Chalmers (1998) found "… cognition is often taken to be continuous with processes in the environment" (p.10). They contended this *is* cognition, regardless of location, whether between the ears or in the grocery store: "Our thesis is that this sort of coupled process counts equally well as a cognitive process, whether or not it is wholly in the head" (p. 9).

Full Literacy and Cognition

Historically, writing was viewed as a way to represent ideas and concepts and to record and transmit information to others beyond the range of speech. However, current thought has recognized usefulness beyond mere storage: "According to the modern view, the essential innovation which writing brings is not a new mode of exchanging and storing information but a new mentality" (Harris, 1982, p.99). This is a comparable understanding of limiting visual literacy to the representation, communication, and decoding of images.

Examining *verbal* literacy can provide an understanding of the cognitive processes of visual literacy. "… much of the time, we use inscriptions in a notation as extensions to our cognitive system (Peterson, 1996, p.8)." Texts are changed and modified, much as a working model is modified by a sculptor or as architect works with a visual sketch. Each "… extends his or her cognitive system". Part of the distinction of *visual* literacy is an inherent recognition of the value of *verbal* literacy. Visual literacy may be viewed as parallel or an extension of verbal literacy, but some of the same aspects of verbal literacy occur in visual literacy. Ideas are generated, clarified, and structured by writing. Thoughts are developed by actively working within a medium. Concepts are recorded and revisited, becoming finished or being born. Within the disciplines of writing and language, it is called "writing as thinking" (Menary, 2007, p.621).

As noted, definitions of visual literacy rarely recognize the cognitive or thinking aspect, as it is usually seen only as an interpretive function. Visual literacy is generally focused on its use in decoding or communication of ideas. At its best, however, visual literacy should be used in pursuit of higher-order thinking, using visual means for analysis and synthesis, and also for creation, the generation of new ideas. Visual images offer a distinctly different means to creative thought than through the use of verbal tools and literacy. "Thinking calls for images, and images contain thought ..." (Arnheim, 1969, p.254).

The advantage of visual tools and media for thought is illustrated through some writings on visual literacy. For example, Curtiss (1987) argued for the value of visual literacy "… and the ability to express oneself..." beyond simple communication (p.11). Hortin (1983) noted "Visual literacy is the ability to understand (read) and use (write) images and to think and learn in terms of images, i.e., to think visually" (p. 99). Creativity deals with the development of new ideas. It is generative thinking, making the new, finding, and solving problems. New productions of visual images are part of this exploration, as are other compositional symbol systems such as music or dance or text. The importance of this aspect of visual literacy is matched by the strong participation of visual practitioners in discussing and advancing visual literacy, with their own expressions in varied media: "If the meaning of Goethe's Faust, of Van Gogh's Landscapes, or Bach's Art of the Fugue could be transmitted in discursive terms, their authors should and would not have bothered to write poems, paint, or compose, but rather have written scientific treatises" (Von Bertalanffy, 1965, p.44).

While images can be descriptions or representations of the visual world, they can also be expressions of thought. The making of images can be used to directly explore and explain ideas, to show the thinking of the artist. An example of a conceptual leap is *Las Meninas* by Diego Velázquez (1656) where the picture plane was broken and pulling the viewer into the scene. Engagement of the audience, beyond mere representation is a central aspect of the piece and comes through the visual connection of the depicted space. *Las Meninas* had such an effect on the world of visual composition and meaning that centuries later, Picasso sought to recreate the painting in his own mode.

Picasso also used visual means to express the shock he felt from the horror of the Spanish Civil War, which was expressed through *Guernica* (1937). In perhaps his most consequential work, *Les Demoiselles d'Avignon,* Picasso explored the nature of time and space. The painting was completed at a time of the world when these concepts were being examined by other fields: "Picasso had done for art in 1907 almost exactly what Einstein had done for physics in his `Electrodynamics' paper of 1905" (Everdell, 1997, p.249).

Generative Visual Images

The development of new and worthwhile ideas is often sparked and driven by visual means as part of concept development. This process can be internal, through mental imagery, or external through representation and exploration. One generative process commonly used by the visually literate is to do multiple iterations of a single challenge, drawn at a smaller scale for easy and fast ideation. Called thumbnails or

thumbnail sketches, they are small rapid drawings of a specific idea or layout. Their purpose is to rough out a guess of what the final idea *could* look like, and to try out prototypes or to experiment with possibilities.

Many design classes include thumbnails in the process of design projects. Multiple ideas are generally required: three, five, ten, or even twenty ideas are commonly requested by instructors. The instructors inherently know multiple ideas will offer a better chance for students to produce better ideas. Those familiar with the visual fields will recognize this process. It is used as a resource by modern artists. For example, Picasso, when learning from *Las Meninas* by Velasquez, created over eighty developmental versions, before completing his final version.

Such sketches, whether starting from a blank page or from visual starting points, can also be used in the evaluation or encouragement of creativity. The Figural form of the Torrance Test of Creativity is based on a series of graphic challenges, each asking the respondent to complete and extend a series of graphic marks. It is scored on a comparable basis to the Torrance verbal test, with evaluations of Fluency, Originality, and Elaboration as well as other aspects. [Elaboration is the addition of details to a single idea.]

The Thirty Circles challenge is a widely used creativity exercise which is comparable to elements of the Figural Torrance Test. IDEO uses the 30 Circles Challenge in some training exercises. It is reproduced here for the reader to explore as an encouragement to greater creativity.

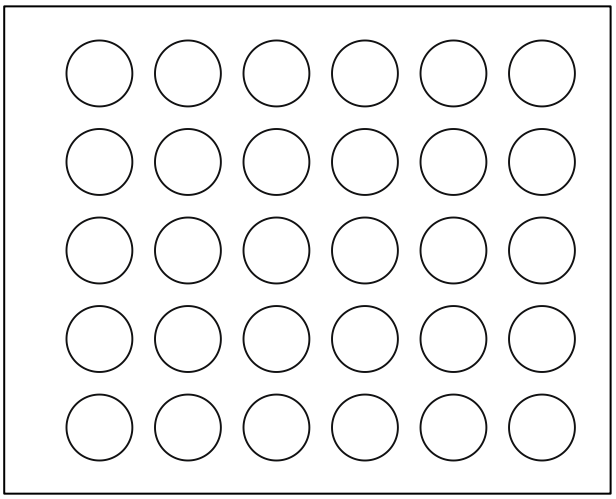

Figure 4. IDEO's 30 Circles Challenge (Illustration by the author, after IDEO, 2017.)

If you want to complete the exercise, give yourself three minutes to turn as many of the circles into recognizable objects as you can by drawing. The number of circles completed would give you an understanding of your creative fluency.

The Development of Ideas through Sketching

The most common ambiguous and fluid visual expression is sketching, the generative exploration through symbols. Sketching is a way to visually and rapidly examine a variety of ideas and applications as is worthwhile. It is sketching as a means to think and create where "… imagery tolerates idiosyncrasy in thought and supports novel forms of synthesis" (Goldschmidt, 1994, p.160). Here is exploration-based visual literacy, the generative thinking of visual literacy. Ideas are developed through the media. "Some of the sketching does not follow ideas in the mind but instead, pre-cedes them. In other words, architects quite often engage in sketching not to record an idea, which is not there yet, but to help generate it" (Goldschmidt, 1994, p. 162).

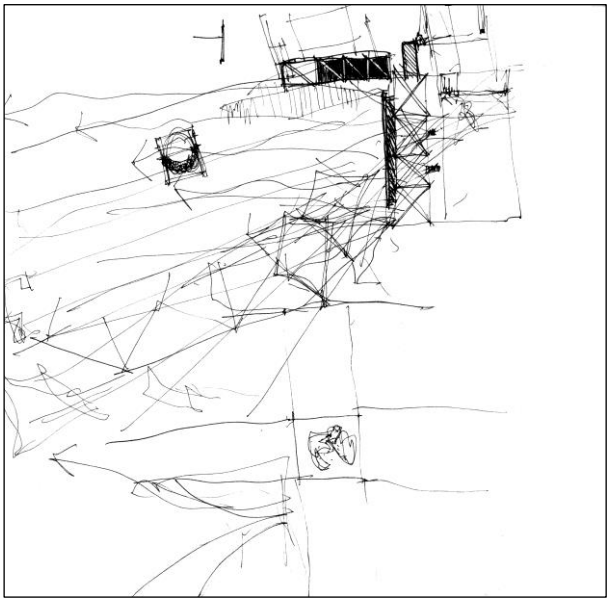

Figure 5. Architectural thinking sketch by the author (Hokanson, 1996).

This is a common and valued technique within design fields: "Sketching, or the production of untidy images to assist in the development of visual ideas is one of the oldest and most familiar activities of artists and designers" (Fish & Scrivener, 1990, p. 117). Renner describes this as "… 'practice-led iconic research' … a method to create image series in order to elicit their meaning through images as opposed to language (2017, p.17).

The ambiguity, the inaccuracy of a drawn sketch is part of its value, as we can re- or misinterpret the representation. Goldschmidt (2003) described it as "backtalk" (p.72). This is comparable to our memory being triggered or distracted by new things we experience in the grocery store, or the fortunate misreading of a grocery list. Verbal symbols are generally more specific, while visual images are often vague and allow for a divergent interpretation. "Besides, in drawing it is impossible to be successful if we think that every line set on paper has to be perfect" (Renner, 2017, p. 1462).

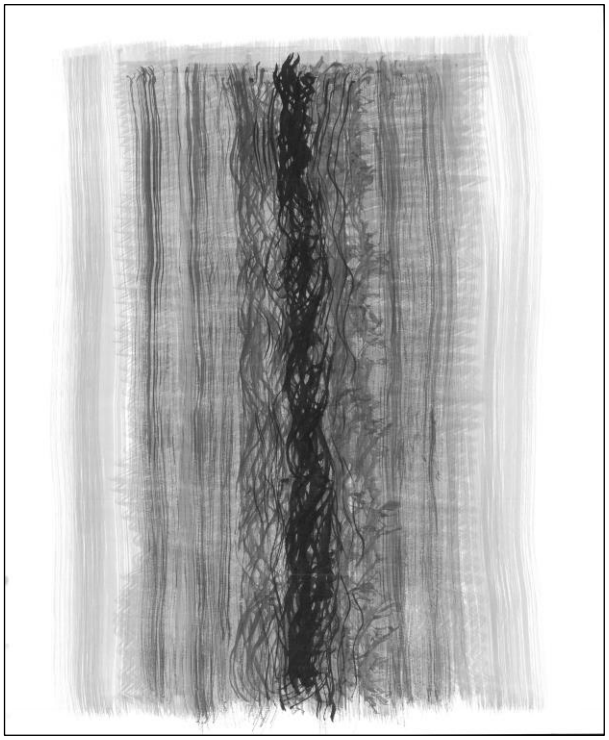

Figure 6. Temporal Distortion 1. Resulting work from practice-led iconic research (Martin, 2019)

As with written language, visual generative thought requires a skill level higher than simply viewing, reading, and decoding. Creativity in visual media may be limited by media skills as well, as "… intelligence is skill in medium" (Olson, 1974, p. 193). For example, in music, while many can read music, composing requires more skill in organizing and inventing. Similarly, highly representational drawing is not necessary to generate an idea. It is the rough, rapid thought processes interacting with the graphic results. Arguably, the most essential aspect of design education is the development of visual thinking skills inherent in drawing, sketching, and making. This process is well supported by the theories of cognitive science as well as numerous research protocols in the field of creativity.

Conclusion

Visual literacy includes the abilities of comprehension, analysis, and communication of visual material. As noted, some definitions for visual literacy include, as a minor element, the capability to "write" or create through visual means. The ability to visually represent and conceptualize is one of the most valuable capabilities of the visually literate, and needs to be represent-ted as such. An accurate definition of visual literacy must include the capabilities to visually generate and manipulate new ideas. Visual literacy can be viewed as a field which is both observational and reflective, but it must also be creative and generative. The argument is to return to the visual, to drawing, in the development of ideas, in our own practice and in the standards of the field.

Greater investigation and inclusion of the generative nature of visual literacy will advance the field and increase its reach. We know images help form ideas, and we know the act of drawing images has the capability to help invent and develop ideas. Definitions of visual literacy should explicitly include the ability to develop new ideas in visual or conceptual form, a capability well understood by most designers and practitioners.

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