

# Knowledge Visualization and Visual Literacy in Science Education

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# Chapter 7

## Collage Strategy: A Robust and Flexible Tool for Knowledge Visualization

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### ABSTRACT

*In this chapter the author analyzes and defines collage in some of its many forms and media. He introduces three terms (the gap, the seam, and contested space) necessary to characterize the unique aesthetics of collage. Via a review of specific artists and art historical movements he creates taxonomy that typifies three distinctive collage strategies. He extends this review into other media including artists' books, cinematic film, and digital media. In the second part of the chapter he describes the work of three artists (including the author) and their relevance to this theory of collage and scientific visualization. Following that, he reviews the use of digital software and the pedagogical implications of collage.*

### INTRODUCTION

*Collage enables us to experience everyday life in such a way that its disparate and idiosyncratic fragments resist coalescing into a unifying whole, which philosophers Gilles Deleuze and Félix Guattari (1983) refer to as 'disjunctive synthesis'. Instead of a totalizing body of knowledge, the composition of collage consists of a heterogeneous field of coexisting and contesting images and ideas. Its cognitive dissociation provides the perspectival multiplicity necessary for critical engagement. Dialectical tension occurs within the silent, in-between spaces of collage, as it's fragments, its signifying images and ideas interact and oppose one another. Such complexity and contradictions represent the substance of creative cognition and cultural transformation (Garoian & Gaudelius, 2008, p. 63).*

As many have commented, collage is the art form of the 20<sup>th</sup> and 21<sup>st</sup> Century (Ulmer, 1983; Durant, 2002; Kohler, 2012). The word collage will be used broadly and inclusively within this chapter. Strictly speaking, collage refers to the gluing of elements historically considered to be outside of the realm of painting, onto paintings or simply onto a flat surface. Assemblage extends this into three dimensions;

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photomontage consists of multiple images combined in a single photograph, and montage refers to the cuts between film clips in motion pictures. Collage will stand in comprehensively for these and the multitude of other “-ages” that exist, in addition to other words such as cut-up, mashup, etc. In many cases installation art and performance art can also be a collage. A more complete definition of collage will be found in the Background section of this chapter, and numerous examples will follow throughout.

Collage strategies are uniquely suited for visual presentations of information. However, there are few scholarly resources that really grapple with the theoretical implications of collage and the strategies used to create them. In 1975, art critic Harold Rosenberg (1989) lodged this complaint, and unfortunately little has changed in the 40 years since. In both educational settings and in too many fine art environments, collage is taken to be simply the combination of different elements on a page (Garoian & Gaudelius, 2008). A notable example of the debasement of this word includes a Groupon advertisement called “A Collage Of Our Best Deals: This Collage Is Crafted With Care,” which was simply a web page grid of links to merchants (sent via email September 12, 2013). This confusion over collage is extensive and often begins in public schools. According to the authors Charles Garoian and Yvonne Gaudelius (2008) in their book *Spectacle Pedagogy, Art, Politics and Visual Culture*,

*A visit to a public school would give us a learning environment replete with social studies collages, arithmetic collages, language collages, health collages, and even physical education collages, in addition to using this genre in art classes. Such ubiquity notwithstanding, we find little evidence that the aesthetic dimension and disjunctive narrative of collage is understood at any depth in schools (Garoian & Gaudelius, 2008, p. 4).*

This chapter is an effort toward resolving some of these shortcomings. Digital tools in particular have made the creation of collage easier and more affordable than ever before – well within the reach of most students. The downside of such ease of use is that students (and others) can easily fail to recognize the strategic and cognitive possibilities inherent in recombining various components. “Left to a ‘cut-and-paste’ mentality, the conceptual profundity of its [collage] narrative is easily misunderstood as a pastiche of essentialized images and ideas” (Garoian & Gaudelius, 2008, p. 68).

One of the challenges facing educators and students today is the gulf between the necessary expertise in visual communication and familiarity with technical content (Ursyn, 1997; Kosera, 2007). In spite of resources such as the series of books by Edward R. Tufte (1983, 1990, 1997) on design methods for knowledge visualization, it is rare to find people with skills in design, graphic software, and deep understanding of specific scientific concepts. At the commercial professional level it usually takes a team of at least two people to craft a visual experience, irrespective of media, that can accurately communicate the details of some aspect of scientific research. Furthermore, there is often a minimization of the skills or values of one group by the other. Of course, there are exceptions on both sides of the so-called two cultures divide as originally described by C. P. Snow (1993) in 1959. In spite of numerous reports as to how much artists and scientists have in common, it is critical to remember that there are fundamental differences between the goals and methodologies of scientists and those of artists. Science is about facts and falsifiability; art is about everything else.

Additionally, there are fundamental differences between the goals and methodologies of the quite distinct fields of “commercial arts” and “fine arts.” Although there is obvious overlap between visual judgment skill sets, the pedagogy and intention of both is significantly different (Kosera, 2007). In a typical university setting shared courses between students in both disciplines might include color theory and

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basic drawing. After those freshmen level courses the two cohorts will split out into courses with names such as “Typography” or “Intro to Visual Communication” for graphic designers; and “Mark Making” or “Intro to Painting” for fine artists. Although it is likely that the global lessons of good composition or visual psychology will be taught to both cohorts, the context of delivery is certain to be entirely different. This includes the required history classes, which for the former would be “History of Modern Design” and for the latter “Contemporary Art History.” The design student *may* be given a specific project to visualize a scientific concept. It is highly unlikely the same would be given to a fine arts student.

It will be posited in this chapter, however, that the fine arts *can* support knowledge visualization, assuming that one is willing to consider alternatives to the typical commercial demands of unambiguous intelligibility. Additionally, as acceptable and appropriate content in a fine arts project can be more inclusive, concepts from science can be connected to larger domains of knowledge, psychology, and emotion. Collage in particular has a long and interesting history within the arts. Collage strategies can be uniquely productive for knowledge visualization. Furthermore, this approach can be useful in a number of educational environments for students of any age. The prevalence of commonly used digital software creation tools has made this simpler than it might have been in the past. The necessary skills are: how to do research; how to capture salient aspects; how to translate them into compelling visual components; and how to combine them into a compelling visual experience. This is not to say that any of these skills are necessarily easily taught, learned, or assessed. However, for some percentage of people, learning from this process will be more enjoyable and retainable than other traditional methods (Ursyn, 1997, 2015; Ursyn & Sung, 2007).

This chapter will be divided in two sections. The first, *Theory* will review the history of collage strategies in a variety of visual media from painting to cinema to artists’ books. These strategies will be defined taxonomically and their theoretical implications explored, in order to lay a foundation for the second section. That section, *Practice* will begin by describing and analyzing three contemporary works of art using the approaches described in the first section, and conclude with the pedagogical implications of collage and methods for manifesting different types of scientific knowledge. Throughout this section different aspects of using digital software will be addressed.

## BACKGROUND

Some preliminary definitions must be introduced. This author has developed a *collage taxonomy* that systematically and consistently identifies categorical characteristics that can be determined within collage and mixed media artworks. This taxonomy is created by four different sets obtained by the combination of two terms.

There have been several authors that have suggested different defining characteristics of collage; they are overly simplistic, ambiguous, or incomplete (Janis & Blesh, 1967; Wescher, 1971; Wolfram, 1975; Waldman, 1992). For something that everyone can identify in a moment, why has it been so difficult to come up with a consistent descriptive theory? And for a creative strategy that extends through multiple media in addition to the visual arts, including but not limited to literature and music, there is relatively little scholarship (Garoian & Gaudelius, 2008). Surprisingly, for an art that hasn’t always been taken very seriously, there is much more written about cinematic montage, which can be quite useful in this context, but nonetheless, is a subset of collage.

By far the most common term applied in discussions of collage is “juxtaposition” (by everyone, perhaps popularized originally in 1961 by Shattuck, 1992, p. 126). Although this term is necessary, it is by no means sufficient, and on further inspection it really says nothing at all about the complex inter-relationships between elements within a collaged structure. More subtlety is required and can be found within these two taxonomical terms: *gap* and *seam*. Gap has been used by some writers on this topic (Shattuck, 1992 and many others). Seam has received little attention. Here are dictionary definitions (American Heritage Dictionary, 1969):

*Gap: 3. A suspension of continuity; interval; hiatus. 4. A conspicuous difference; disparity. 5. Electricity. A space traversed by an electric spark: a spark gap (p. 542).*

*Seam: 1. a. A line of junction formed by sewing together two pieces of material along their margins. b. A similar line, ridge, or groove made by fitting, joining, or lapping together two sections along their edges. d. A scar (p. 1170).*

The literary theorist Brian McHale (1991, p. 13) uses an expression “ontological discontinuity” in describing the distance between the real and the fictional within a narrative. The phrase can capture some of the sense of the word gap. In addition to the perception of discontinuity what is interesting is that this space is filled with one’s imagination.

Bert M-P. Leefmans (1983) is a writer who describes the gap quite well: “Let us say that collage is the art of the *space between* or of *crossing boundaries* ... the *open* space left, upon which our imaginations may work” (p. 220). When comparing poetry to collage he wrote,

*It is the leaps across the gaps that constitute the action, the dynamic, of the poem. These gaps, these bondings transform the elements they link but at the same time become autonomous and significant in themselves – and they are gratuitous in that they are neither caused nor limited by any laws but those of the imagination as it is affected by associations. It is thus the “content” of the gap that becomes the source and power of the new, and it is also upon it that selection is free to work as poetry itself evolves (Leefmans, 1983, p.193).*

There are often literal seams in collages, but here it is also used metaphorically. Note too, the idea of seam as a scar. This is evidence of history and a kind of stitching together.

Another term needs to be introduced. It is not part of the taxonomy, but it is a critical concept. It is *contested space*. Building on the idea of the gap’s content as described above, when two elements either in time or space are juxtaposed there is a conflict as the first one to be perceived influences one’s psychological anticipation of meaning, which is then altered by the influence of subsequently perceived elements.

Although most histories of collage begin with Georges Braque and Pablo Picasso near the beginning of the 20<sup>th</sup> century, there are some sources that refer to collage-like structures beginning in the mid-19<sup>th</sup> century (Seitz, 1961) particularly with reference to photography (Fineman, 2012) and even earlier. The use of cutting and pasting different photographic elements and mixing them with paint was a common

## Collage Strategy

procedure in order to achieve aesthetic and interpretive goals. Because of the overlap between this and the creative and conceptual processes involved in crafting digital work, this topic will be postponed until the end of the *Theory* section. This section, by necessity, leaves out art movements, genres, and numerous practitioners who advanced collage in exciting ways. It focuses on styles that can be seen as taxonomic exemplars, along with some practices that are included for their relevance to the themes of this chapter.

## 1. THEORY

### 1.1. Cubism and Collage

There is some controversy over whether or not the first “fine art” collage was *Fruit Dish and Glass*, 1912 (Figure 1) by Georges Braque (likely to be the case according to Wolfram, 1975, p. 16 and others), or *Still Life with Chair Caning*, 1912 (Figure 2) by Pablo Picasso.

Both artists by this time had created numerous cubist works where they explored abstractions of space and time in decidedly non-illusionistic paintings and drawings. In the case of the Braque charcoal and gouache drawing, the artist has pasted pieces of wood patterned wallpaper; in the case of the Picasso oil painting the artist has added a piece of wallpaper with a chair caning pattern, along with a length of rope as a “frame.” Below is a quote from Picasso (as cited in Gilot & Lake, 1964) that provides a good introduction to understanding their motivation:

*The purpose of the papier collé was to give the idea that different textures can enter into a composition to become the reality in the painting that competes with the reality in nature. We tried to get rid of “trompe l’oeil” to find a “tromp l’esprit” ... If a piece of newspaper can become a bottle, that gives us something to think about in connections with both newspapers and bottles, too. This displaced object has entered a universe for which it was not made and where it retains, in a measure, its strangeness. And this strangeness was what we wanted to make people think about because we were quite aware that the world was becoming very strange and not exactly reassuring (Gilot & Lake, 1964, p. 70).*

Picasso explains several things here. The first is that not only is there a conflict, as there had always been between the reality of a painting and the reality of the world outside of painting, but that it can be exhibited within the painting itself. That is, one object can now represent two realities. The second is that when two things are conflated, for example a bottle made of newspaper, a dialogue is created between those two entities as concepts. But additionally a dialogue is created between these two entities as formal visual and material elements – one illusory and one real: that is, the representation of a bottle and the reality of newspaper. Finally, that injecting a real element into an illusionistic world independently of any content is in itself an act that carries meaning. These dialogues are created within the gaps by the spectator. For example, within the contested space between the chair caning and the painted elements, one’s thoughts go to the conflict between the two physical materials; the conflict between different modes of representation; and the conflict between different realities and histories.

To follow up on the formal aspects of collage, art historian Christine Poggi (1992) describes *Glass and Bottle of Bass*, 1914 this way:

Figure 1. George Braque, *Fruit Dish and Glass*. (1912)  
(© 2015 Artists Rights Society).



Figure 2. Pablo Picasso, *Still Life with Chair Caning* (1912)  
(© 2015 Estate of Pablo Picasso/Artists Rights Society).



## Collage Strategy

*Picasso created a mock frame by pasting a wallpaper border to the four sides of his picture. But this frame fails to function convincingly because the paper has been crudely cut and glued (scissor marks and overlapping are visible), the orientation of the pattern alternates around the four edges, and most crucially, a section is missing from the upper right corner. Picasso filled this gap with a frame drawn in pencil directly onto the cardboard ground, without, however, making any attempt to imitate the wallpaper pattern. Further emphasizing the difference of this hand-drawn section from the wallpaper frame, Picasso made it cast an illusionistic shadow to the right, as if only the drawn frame had volumetric presence. Yet, because of its isolated and fragmentary character, the shadow cannot be confused with a real shadow and thus calls attention to itself as an illusion. The function of the frame as an enclosing border is also negated by the extension of the cardboard ground beyond the perimeter marked by the (inner) frame, causing the literal and framed edges of the collage to diverge. The wallpaper border thus appears as a (badly rendered) picture of a frame. The small bit of paper bearing Picasso's name is similarly paradoxical. It functions in relation to this picture both as a literal nameplate of the type (if not the material) frequently found in museums and as an ironic imitation of such identifying labels (Poggi, 1992, p. 82).*

The conclusions that can be drawn from this are as follows: although the cubist painters, irrespective of collage, often played with space and perception of space, collage lends itself to an extra layer of complexity that can not be achieved in paint alone. Unfortunately, this quite interesting aspect of collage has rarely been examined with the same complexity and subtlety as had Picasso. Note too, that this picture is filled with seams both literal and metaphorical.

The final consideration is Picasso's use of newspaper text as content. Most of the critical writing on cubist collage considers the use of newsprint as simply a formal issue of pattern and reference. But at least for Picasso, from the beginning, collage was a method to bring text and its associated content into art, thus initiating a long tradition. Art historian Patricia Leighton (1985, p. 653) describes in convincing detail how the newspaper clippings of the collages from 1912-14 not only were included for specific political content, but that as they are reviewed chronologically a significant number of them document the evolution of the Balkan War prior to World War I.

It can be seen then, that both gaps and seams are important carriers of meaning within cubist collage.

## 1.2. Futurism and Collage

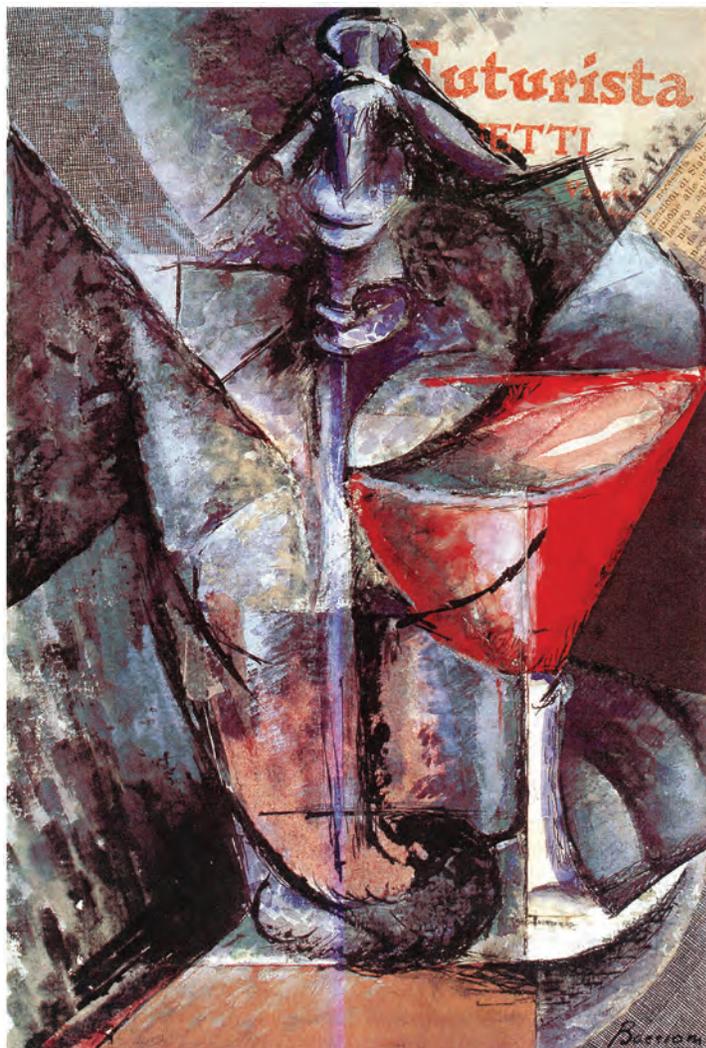
Collage created by futurists tends to get very little coverage in the scholarship. For example, Brandon Taylor's (2004) otherwise excellent book on the history of collage ignores them entirely. The futurists stand in sharp contrast to both the cubists and the surrealists from which the two major threads of collage through the 20<sup>th</sup> century are developed. Additionally, it will be noted that this underappreciated futurist collage thread is consistent with feminist approaches to constructing collage.

William Seitz (1961) in the catalog for the pivotal exhibition at the New York Museum of Modern Art, *The Art of Assemblage*, puts his finger on a key element of the problem, "futurism's key words are 'interpenetration' and 'synthesis' rather than [the cubist's] 'interval' and 'juxtaposition'" (p. 26). But, perhaps more importantly, futurists noticeably expanded the material possibilities of collage. Picked up by the dadas and becoming especially important after World War II, the futurists explored the use of *any* material to create art. In 1914 futurist Carlo Carrà (as cited in Poggi, 1992) wrote,

*We Futurists also believe that 'painting does not lie in Lefranc tubes.' If an individual possesses a pictorial sense, whatever he creates guided by this sense will always lie with the domain of painting. Wood, paper, cloth, leather, glass, string, oil-cloth, majolica, tin and all metals, colors, glue, etc. etc., will enter as most legitimate materials in our present artistic constructions (Poggi, 1992, p. 165).*

Poggi, one of the few writers to carefully assess futurist collage, discusses how their use of outside materials had an entirely different agenda to that of the cubists. Instead of accentuating contrasts between paint and non-paint realities, their goal was to fuse outside elements into paintings in order to achieve a new kind of dynamism. This minimizes the gaps between different realities, as within cubist painting, although the seam remains. But this seam is a subtler one; it is seam in the sense of scar. The outside elements have healed within the body of futurist painting. For example, Poggi (1992) describes the painting called *Still Life with Glass and Siphon* (Figure 3) by Umberto Boccioni probably created in 1914:

*Figure 3. Umberto Boccioni, Still Life with Glass and Siphon (1912)*  
(Public Domain).



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*Unlike Picasso and Braque, Boccioni did not tend to assert the identity of each pasted element by allowing its boundaries to remain visible. In Still Life, for example, he covered almost the entire surface of his canvas with various kinds of paper and cardboard, so that the glass and siphon seem embedded within a textured ground. Because Boccioni painted over the layered materials glued to his canvases, Herta Wescher was led to claim that these materials served no particular expressive purpose. This is patently mistaken: they provided Boccioni with a plastic means of suggesting the 'molecular' interpretation of the depicted object and its environment. Just as Boccioni had once rejected a too rigorous application of separate strokes of pure color, he now rejected a collage technique based on the play of clearly defined edges and on the relations between distinct elements (Poggi, 1992, p. 181).*

*Thus Boccioni found in collage an ideal means of allowing the expressive properties of different materials to suggest the dynamism of all things, including inorganic substances (Poggi, p. 11).*

Conclusions to be drawn from the futurists are that collaged elements may be continuous with the overall visual field. The distinctions between real elements and illusory painted ones create their own dynamics, but some juxtapositions are palimpsestic which will be discussed in greater detail further on. Their work was not about creating conceptual gaps between entities, and the seams present are seams that are knitted together, but conceptually potent.

### 1.3. Dada and Collage

Dada is included here, not because it leads to one of the taxonomic categories, but because of its subsequent influence across media and genre. Following somewhat on futurist strategies of incorporating a wide range of non-traditional media into painting, the dadaists wanted to integrate lived lives in all their turmoil and uncertainty. This led to new kinds of multi-media performance events. Dadaist Richard Huelsenbeck (1981) wrote in 1920,

*The word Dada symbolizes the most primitive relation to the reality of the environment; with Dadaism a new reality comes into its own. Life appears as a simultaneous muddle of noises, colors and spiritual rhythms, which is taken unmodified into Dadaist art, with all the sensational screams and fevers of its reckless everyday psyche and its brutal reality (Huelsenbeck, 1981, p. 244).*

Writer and founder of surrealism, André Breton adds:

*[Dada] is the marvelous faculty of attaining two widely separate realities without departing from the realm of our experience, of bringing them together and drawing a spark from their contact; of gathering within reach of our senses abstract figures endowed with the same intensity, the same relief as other figures; and of disorienting us in our own memory by depriving us of a frame of reference reality (Huelsenbeck, 1981, p. 15).*

Dada artist Kurt Schwitters is known for two separate types of work that he created throughout his career, and which influenced subsequent generations each in their own way (Figure 4). The first of these were his small collages made of paper and other items literally picked up off the streets, with paint added as necessary. The second were the mixed media sculptural structures that were built into the rooms of his houses.

Figure 4. Kurt Schwitters, *doremifasolasido* (1930)  
(© 2015 Artists Rights Society).



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So unlike the previously mentioned artists, Schwitters' starting point was with the outside elements – in itself a significant change of methodology and emphasis. His work illustrates another direction of abstract art that collage can take. However, Schwitters can be contradictory in his own statements. He claimed explicitly that items were not included for their semantic signification but for formal reasons only (Schulz, 2010). Nonetheless, the signification remains and is meaningful. There is a difference between a painted blue square and a blue bus ticket. As Isabel Schulz (2010) explains,

*In the context of the work, the “chunks of everyday refuse” that Schwitters applied to his collages surrender their original function to be sure, but not all their semantic meaning. As used objects, discarded materials distinctly relate to the social reality of their time, and as vestiges of modern civilization, they become metaphors of a society increasingly shaped by industrial production and consumerism, advertising, and the media. The unresolved discrepancy that emerges between their “literary” content, rooted in time, and their abstract form places a limit on Schwitters’s endeavor to exclude all manner of symbolism (often by way of overpainting) in favor of a work’s absolute autonomy (Schulz, 2010, p. 52).*

In contradiction to Schwitters' claims against semantic content, and that his art was meant to be self-enclosed, he also said that his motto was to “create connections if possible between everything in the world” (as cited in Schulz, 2010, p. 61).

Several dada artists were instrumental in popularizing photomontage – collages created by pasting clipped fragments of photographs into single, often quite complex compositions. In contrast to the almost entirely abstract collages of Schwitters, Hannah Höch (Figure 5) created collages filled with specific referential content. One example created in 1919-1920 is *Cut with the Kitchen Knife Dada through the last Weimar Beer-Belly Cultural Epoch of Germany*.

Visual studies professor, Maria Makela (1996) explains this work:

*This large and complex photomontage unites representatives of the former Empire, the military, and the new moderate government of the Republic in the “anti-Dada” corner at the upper right, while grouping Communists and other radicals together with the Dadaists at the lower right. These mostly male figures are paired with photographic fragments of active, energetic women – dancers, athletes, actresses, and artists –who animate the work both formally and conceptually. The newspaper fragment at the lower right identifies the European countries in which women could or would soon be able to vote, including Germany, which granted women suffrage in its 1919 constitution. By placing the clipping in the corner she normally reserved for her signature and including a small self-portrait head at the upper-left edge of the map, Höch identified herself with the political empowerment of women, who, she envisioned, would soon “cut” through the male “beer-belly” culture of early Weimar Germany (Makela, 1996, p. 25).*

Owing to the fact that dada was more of an attitude than a coherent art style, numerous dada artists created collages in widely differing methods and forms. Thus, dada as a movement does not fit into any of the taxonomic categories. However, as seen in the next section, Max Ernst, originally a dada artist, helps to define one of the categories.

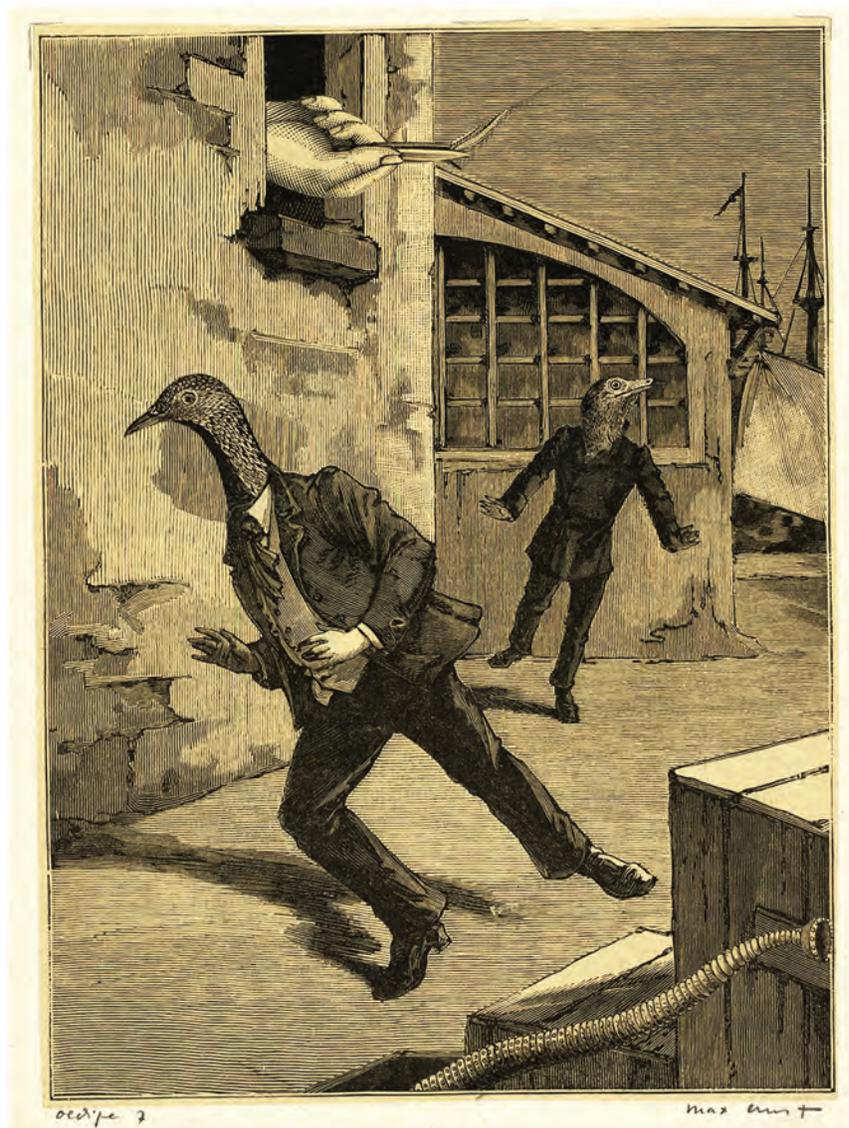
Figure 5. Hannah Höch, *Cut with the Kitchen Knife Dada through the last Weimar Beer-Belly Cultural Epoch of Germany* (1919-1920)  
(© 2015 Artists Rights Society).



## 1.4. Surrealism and Collage

Surrealism introduces the third thread of collage typology. Indeed, this is where juxtaposition is strongest. But surrealism also exposes a paradox that some have called the *collage aesthetic* in order to distinguish it from a collage of differing materials. As has been suggested earlier, and will become explicit subsequently, it is more appropriate to simply extend the meaning of the word collage. Max Ernst (Figure 6) began as a dadaist, and without really changing his style became a surrealist. His categorization had more to do with the art politics of the time than anything else. Consider the technical craft of Ernst's collages. As Waldman (1992) tells us,

Figure 6. Max Ernst, image from the book *Une semaine de bonté* ("A Week of Kindness"). (1934)  
(© 2015 Artists Rights Society).



*Ernst took the process of collage one step further than anyone had previously. Rather than disposing the paper fragments as separate elements upon the picture plane, as had the Cubists, or exploiting the shock value of their social and political content, as had the Futurists, the Russians, and other fellow Dadaists, Ernst created from them a seamless image and identified them as a single entity on the picture plane. ... The psychological ramifications of this procedure were enhanced by Ernst's skillful technique of manipulating his material so subtly that it became difficult to discern whether the work was, in fact, a collage. In accordance with this fastidious method, he cut and pasted as little as possible. Eventually he improved on his technique by reproducing his images photographically, so that the cut edges were no longer visible. It was this invention that constituted his major contribution to Dada collage (Waldman, 1992, p. 124).*

Critic Werner Spies (1982) supplies more insight into the images themselves,

*The conflict between the overall image and the constantly interfering interpretation of its units, gives rise to the strange mood that pervades our encounter with Max Ernst's work –elements that are comprehensible in detail turn ambivalent on the level of composition.*

*This ambivalence is disturbing. In order to escape it, our mind attempts to analyze each detail and to fashion an image, as it were synthetically, from this knowledge. Yet the image is not simply the sum of its details – it is like a force field in constant flux, irreducible and disquieting. The image as a whole resists logical solution (Spies, 1982, p. 95).*

This disturbing ambivalence has much to do with one's expectations when reviewing the "scene" of an artwork. One is surprised by juxtaposed elements when they don't correspond with either what is expected in artwork, or expected in the real world. This is fundamental, but not necessarily unique, to collage. It allows for the special frisson that occurs between the collage itself and the world to which it references.

When reading the two quotes through the gap and seam filter, it is clear that the work may be seamless, but the gap can be enormous. This applies to surrealism in general, and as shall be seen is especially relevant within digital environments where "cut and paste" are only metaphors, and all seams – visible or not – are illusory. In fact, looking next to the paintings of Salvador Dali (Figure 7) the defect in a too literal definition of collage can be driven home.

What's at issue here is the pure technical virtuosity of Dali. Since he could paint anything and make it illusionistically indistinguishable from a cutout image reproduction he can easily create a collage effect in paint alone. For example, compare two paintings. The first called *The Accommodations of Desire* done in 1929 is a collage in the strictest sense.

The lion head is taken from a book of advertising illustrations. The second called *Partial Hallucination. Six Apparitions of Lenin on a Grand Piano*, 1931 (Figure 8) could certainly be a collage, but according to the strict definition, is not.

Anyone who insists on seeing a difference between the two is simply being obstinate, contentious, or missing the point. As early as 1948 Margaret Miller (2007, as cited in Fergonzi) recognized this point, and in the press release for a MOMA collage exhibition wrote,

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*Figure 7. Salvador Dali, The Accommodations of Desire (1929).  
(© 2015 Artists Rights Society).*



*Figure 8. Salvador Dali, Partial Hallucination. Six Apparitions of Lenin on a Grand Piano (1931)  
(© 2015 Artists Rights Society).*



*Collage cannot be defined adequately as merely a technique of cutting and pasting, for its significance lies not in its technical eccentricity but in its relevance to two basic questions which have been raised by 20th century art: the nature of reality and the nature of painting itself (Fergonzi, 2007, p. 332).*

### 1.5. First Review

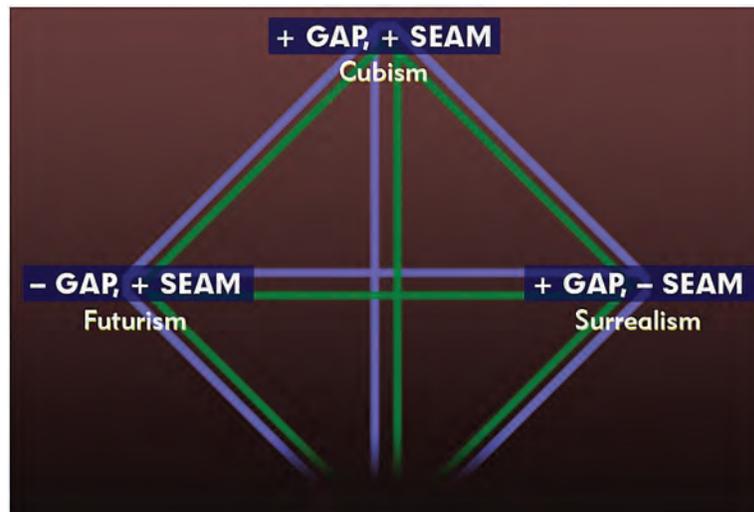
At this point three major threads of collage typologies can be reviewed (Figure 9). Cubism supports the first one, where both the gap and the seam are observed. Futurism, the second, where the seam is more salient than the gap. Surrealism, the third, where the gap is more salient than the seam. It is important to note that in spite of their historical origins these threads have nothing to do with content, they are solely a heuristic designed to categorize the structure of collages. It must be stressed, as the lines on this chart indicate, that each of these typologies exists on a continuum, one to the other. The previously referenced artists are exemplars of each typology – other artists can and have blurred these distinctions.

### 1.6. Collage since 1950

Everything changed after World War II. Collage began taking on entirely new physical forms, and within only 20 years became one of the major creative strategies for artists, and within 40 years became *the* major creative strategy for artists. Taylor (2004) writes that,

*The story of collage tells us that the real tension within modern art of the post-war period was between the procedural licenses of Surrealism (chance, and the strangeness of the image) and the formal inheritance of Cubism (surface articulation, material construction, even abstraction). (Taylor, 2004, p. 133).*

Figure 9. Dennis Summers, *Collage Taxonomy I*  
(© 2013, D. Summers. Used with permission).



## Collage Strategy

To which, as seen, the third source of tension is the less recognized legacy of futurism (healing, synthesis, interpenetration). At this point one of the best known collages in the history of art will be explored. Its troublesome nature has implications for digitally created collage.

### 1.7. Richard Hamilton

In 1956 the English artist Richard Hamilton created a small traditional collage made of images cut out of magazines. It was called *Just What Is It That Makes Today's Homes So Different, So Appealing* (Figure 10).

Many people point to it as a progenitor of pop art. But there is something else as interesting. Look closely at the image. It has almost nothing in common with preceding collages and much with succeeding ones. There is no confusion of the picture plane; little ambiguity of space and perspective; no abstract combination of elements picked up off the street; no combination of separate realities of media; no unusu-

Figure 10. Richard Hamilton, *Just What Is It That Makes Today's Homes So Different, So Appealing* (1956) (© 2015 Artists Rights Society).



ally surprising juxtapositions; no dreamlike imagery. It is nothing like collage up to that point aside from the fact that it is glued paper elements taken from different sources. It is mostly a photomontage, but one entirely different than the disturbing and visually complex photomontages of dada artist Hannah Höch from a generation earlier. With only a couple of exceptions, Hamilton's collage could have been set up as a photo-shoot and look quite similar. This artwork reveals that collage can on the one hand be a much simpler visual experience, and on the other hand can *mirror* – not just include elements of – the actual world. In some ways this turns collage on its head. It is a return to a more or less illusionistic image but not in paint. This also exposes the importance to collage of *expectations*. Yes, it may be unusual to see a muscle man holding an oversized tootsie-pop, but not as disturbing or mysterious as the juxtapositions seen in an Ernst collage. For the most part there is not much in the gaps between its constitutive elements. The seams are obviously there, but not really in a disjunctive way. This piece can be problematic to fit within the schematic, but would lie somewhere along the continuum between futurism and surrealism.

Its real importance lies in how easily this image could be created today in Photoshop. In fact, so much digitally collaged imagery resembles *Just What Is It ...* that it can be seen – in a way that cubism, futurism and surrealism cannot – as the prototype for digital collage.

## 1.8. Feminist Collage

Feminist collage was mentioned earlier in the discussion of futurism. The idea of fusing elements in order to create synthesis as opposed to juxtaposition is a shared ideology. This is not to suggest that more recent artists considered futurist collage as an influence on their own creative strategies (not that they would have been ignorant of futurism). But, their respective content is quite different. As early as 1987 the critic Lucy Lippard (1995) wrote that: “The feminist ‘collage aesthetic’ – putting things together without divesting them of their own identities – is a metaphor for cultural democracy” (p. 209). And Collage is born of interruption and the healing instinct to use political consciousness as a glue with which to get the pieces into some sort of new order” (p. 168). As has already been seen, the first quote isn't unique to a feminist collage aesthetic. And the second quote is not applicable to all collage. However, the shift of emphasis toward this particular metaphoric use is significant. Note the use of the word healing, and recall the scar definition of seam. In 1998 Gwen Raaberg (1998) developed this premise:

*Works of feminist collage created during the 1990s continue to deconstruct cultural representations and discourses but also seek to expand their concerns to include, along with gender issues, a full range of social, political, and cultural concerns. In many works, we may find a reconstructive impulse based not on a totalizing perspective but on a collage strategy that utilizes fragmentation, discontinuity, and dialectical opposition to stage multiple, fluid relationships. Moving beyond a postmodern emphasis on fragmentation that results in a pastiche of ‘distinct and unrelated signifiers’ these feminist collages provide a mediating site that suggests new ways of connecting multiple open identities and perspective in a multitude of possible relationships. ... Although we cannot conclude that collage is particularly feminist, we may speak of ‘feminist collage,’ mindful that this body of work includes as number of theories and practices in various media arising from different historical and social contexts, which have been guided by and have furthered feminist goals (Raaberg, 1998, p. 169).*

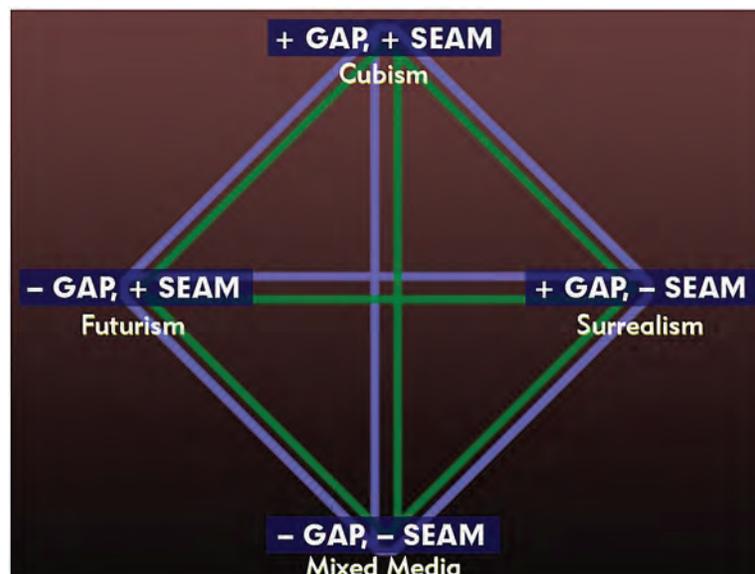
## 1.9. Mixed Media

The careful reader will note that the fourth category within the collage taxonomy has yet to be addressed (Figure 11). Briefly this refers to what is called mixed media. Although too casually and problematically included in surveys of collage (to take one example, Waldman, 1992), some mixed media artwork does not participate in the collage strategies that have here been delineated. As the 20<sup>th</sup> century progressed, artists no longer felt that they need be constrained by reductionist attitudes toward appropriate use of media. Alternatively, although collage historically was often mixed media, this is no longer the case – especially in the domain of digital collage. Nonetheless, thinking that all mixed media is collage is a serious error in analysis. In such work, there is no gap and no seam. For example, perceptual work, like the installations of Robert Irwin, although made of multiple materials, have nothing to do with collage. Additionally, – GAP, – SEAM would refer to any standard illusionistic representation in painting, photography, or film. That is, artwork that is not collage.

## 1.10. Second Review

Many artists prior to World War 2 were responsible for creating a number of different styles of collage ranging from the representational to the non-representational and the purposeful blurring between the two; from real world elements incorporated into paintings to paint incorporated into real world elements; from 2D to 3D to 4D. Only selected highlights have been discussed here, but the interested reader can find many more especially in *Collage: The Making of Modern Art* (Taylor, 2004). The first major exhibit of sculptural (i.e., 3D) collage, *The Art of Assemblage* (1961) at the Museum of Modern Art, New York, curated by William Seitz in 1961 was controversial, and the tone of the accompanying catalog is somewhat defensive. Shortly after this exhibition, and perhaps influenced by it, mixed media collage

Figure 11. Dennis Summers, Collage Taxonomy  
(© 2013, D. Summers. Used with permission.)



would become commonplace and uncontroversial. This chapter cannot cover the breadth of the many different forms that collage has taken since. However, as will be seen, the four typologies described here remain surprisingly reliable in classifying the full range of collage in many media and disciplines.

### 1.11. Some Other Forms of Collage: Introduction

This review of the history of collage has covered only a few emblematic examples of visual artwork or “static art.” There are two more media, which must be discussed as they extend collage into time and are relevant to the potential pedagogical use of collage for scientific visualization. They are film (or more appropriately to the purposes here – moving pictures – that can be created with video technology, manually, or entirely synthetically), and artist books. Both of these art forms can be especially useful in an educational setting.

The addition of time raises new issues that must be explored and developed. Static imagery is reviewed by its audience iteratively. One grasps the image as a whole quite quickly, and then focuses on details in order to add depth to experience, subsequently connecting those details to one another in order to recreate the complete image. Although it can be possible to do this with time-based media, such as film, typically understanding is gained sequentially and retrospectively over durational time. This allows collage to take on different forms of presentation with different implications. Generally, this is the same approach taken with literature, such as novels, although poetry might be more atomized. Like poetry, artists’ books fall into a grey zone where they are likely to be experienced both iteratively *and* sequentially. Additionally, static imagery requires the viewer to move in space around the object of interest (which has prompted numerous investigations into the relationship between the body and art). Whereas accessing time-based media generally requires the viewer to be static. This distinction identifies a key difference between a collage created in Photoshop and one in After Effects.

Writing in the 1950s and 60s, early film theoretician Jean Mitry (1997) echoes this: In a painting “spatial relationships are immediately perceptible within the organic structure of the *whole*. Now, a film, like a symphony, is not an *immediate* entity, but a series of relationships, which gradually take shape. Moreover, relationships of time . . . are not perceptible to our eyes as they are to our ears” (p. 149). Film-maker Vsevolod Pudovkin adds, “When we linger over an image in life, we have to make an effort and spend some time, moving from the general to the particular, concentrating more and more until we begin to notice and appreciate the details. Film saves us this effort through editing” (as cited in Mitry, p. 132).

As mentioned at the beginning of this chapter the word collage is used to stand in for numerous other closely related terms including “montage.” Montage is traditionally the term used in describing a film editing method. Loosely speaking it describes different film clips or scenes cut together. Thus, they are images that are combined sequentially over time. These cuts can be more or less apparent to the viewer. Practically speaking, film *is* montage. However, montage has a secondary meaning describing a less frequently used technique. This is the combination of different still or moving images – either juxtaposed or superimposed – within a single segment of film.

### 1.12. Cinematic Film and Montage

Every time there is a “cut” between two strips of film then a montage has occurred. The nature of this montage, and where it falls along a continuum from “seamless,” “continuous,” or “invisible,” to “dis-junctive,” or “discontinuous” can and will differ amongst individual films or even within a single film.

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The style of montage employed usually depends on that of the film's director. Different editing styles can be categorized and will loosely parallel that of the collage taxonomy classified here.

Theorizing on this topic may not have begun with filmmaker Sergei Eisenstein, but throughout his career he wrote extensively about montage. In 1929 he wrote,

*in my view montage is not an idea composed of successive shots stuck together but an idea that DERIVES from the collision between two shots that are independent of one another (the "dramatic" principle). ("Epic" and "dramatic" in relation to the methodology of form and not content or plot!!) As in Japanese hieroglyphics in which two independent ideographic characters ("shots") are juxtaposed and explode into a concept (Eisenstein, 2004, p. 26).*

*The incongruity in contour between the first picture that has been imprinted on the mind and the subsequently perceived second picture – the conflict between the two – gives birth to the sensation of movement, the idea that movement has taken place.*

*The degree of incongruity determines the intensity of impression, determines the tension that in combination with what follows, will become the real element of authentic rhythm (Eisenstein, 2004, p. 27).*

Eisenstein uses the term "a leap" to describe the "collision" or juxtaposition of clips in montage (as cited in Bogue, 2003, p. 51). Leaps, of course, imply gaps. Additionally, these "conflicts between the two" should echo what was written earlier regarding contested space. Eisenstein (1949) also created taxonomy of different types of montage, that is to say different psychological effects of cutting various film images together. He sets a pattern here that continues in subsequent critical writing on cinema.

One of the first writers to take cinema seriously as deserving philosophical attention was the critic Andre Bazin. Writing in the 1940s and 50s, Bazin (2004) was no fan of montage, but he does define its implications. He writes that montage creates

*a sense of meaning not proper to the image themselves but derived exclusively from their juxtaposition. The well-known experiment of Kuleshov with the shot of Mozhukin in which a smile was seen to change its significance according to the image that preceded it, sums up perfectly the properties of montage (Bazin, 2004, p. 26).*

Montage suggests "an idea by means of a metaphor or by an association of ideas" (p. 26). As can be seen, these comments are entirely consistent with those regarding static image collage.

It is Mitry, however, whose four types of montage most closely approximate the system described within this chapter. They are "narrative," "lyrical," "constructional," and "intellectual." Each of these has an analog in the taxonomy of collage.

According to Mitry (1997), the only purpose of narrative montage is to "ensure the continuity of action. ... It can be said to be invisible for the reason that it never violates the logic of the concrete" (p. 129, 130). This is montage that is subsumed to simply storytelling. This would be equivalent to the - GAP, - SEAM quadrant. An example would be the movies of Howard Hawks, described here by Sam Rohdie (2006): "The fragments, characters, looks, movements, expressions, voices, actions, all belong to different registers, but all so perfectly linked and harmonized, so naturally motivated, that the fragments are effaced for the unity that they constitute and to which they belong and which they return" (p. 87).

Of course, any montage could be said to have seams. Unless the film consists entirely of one camera shot for its entire duration, it will have cuts. But as these quotes point out, the intention is clearly that the viewer's impression of those cuts be so negligible as to be "invisible."

Lyrical montage, Mitry (1997) writes, ensures

*narrative or descriptive continuity, exploits the continuity in order to express ideas or sentiments which transcend the drama. ... Its purpose is to inform but also and more especially to sublimate and magnify. The most significant scenes are broken down into a series of extreme closeups, in such a way that the editing can present the scene from every angle (Mitry, 1997, p. 130).*

This is employed by directors such as Pudovkin in the movie *Mother*, and would be equivalent to – GAP, + SEAM.

Constructional montage is about editing clips together at the expense of traditional storytelling. The director Dziga Vertov, well known for the film *Man With A Movie Camera*, would be the exemplar of this type. Vertov

*used his art above all to order selected documents and assemble them in such a way that a new idea should spring up from several objective and independently interrelated facts. ... The editor juxtaposes facts which are clearly authentic but have no signification other than that which they verify. An idea thus expressed –but one which obviously does not exist except through this relationship (Mitry, 1997, p. 133).*

Rohdie (2006) actually uses the word gap in describing Vertov's film in this quote, "one shot does not 'answer' another ... but instead functions to highlight the gap and interval between them. ... This gap or interval is the center and source of movement and interest and energy in the film" (p. 81). Rohdie uses the word gap in just the same way as it is used by this author. This would be equivalent to + GAP, + SEAM.

Lastly, intellectual montage according to Mitry (1997) is "less concerned with ensuring the continuity of narrative than with constructing it and less with expressing ideas than with *determining* them dialectically" (p. 129). It is "concerned with expressing and signifying through image relationships rather than a purely cumulative continuity" (p. 135). A good example of this is the cut in the Eisenstein movie *Strike* from an ox being slaughtered to the workers being shot down by police. Rohdie tells us,

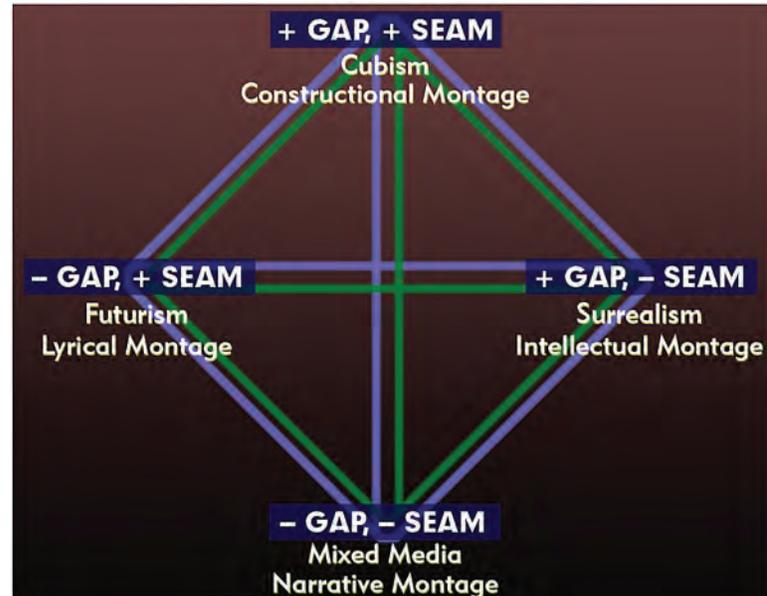
*Nearly every image in Strike, certainly every sequence, brings together unharmonious, contradictory forms that correspond to no reality or at least no coherent continuous one. ... The central montage strategy of Eisenstein is a montage of correspondences whereby elements distant in time and space and from different realities are brought together... (Rohdie, 2006, p. 36).*

Although entirely different in intent, one can see that in construction this is not dissimilar to Surrealism. This is equivalent to + GAP, – SEAM.

These parallels should not be overstated. The aims of Mitry are quite different than the ones here. However, they are relevant to any artist creating moving picture collage. These differing strategies, more or less, comprise the options available when crafting a movie. As with the visual arts described above, this system is a heuristic, and individual films and videos can fall along a continuum between these categories. Or different categories can be applied within the same movie for creative effect (see Figure 12).

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Figure 12. Dennis Summers, *Collage Taxonomy with Montage*  
(© 2013, D. Summers. Used with permission).



The key point is that narrative montage is similar to perceiving events as if they are continuous and traditionally novelistic. This is the construction for most film and television that comes out of Hollywood. In response to Mitry’s categories, it is clear that there *are* alternatives – narrative is not the only option. For creative projects, even or especially those created for knowledge visualization, other choices are likely to be useful. As author William Burroughs (as cited in Miles, 2012) has said: “Life is a cut-up. As soon as you walk down the street your consciousness is being cut by random factors. The cut-up is closer to the facts of human perception than linear narrative” (p. 32). “Cut-up” is the word Burroughs used for collage. The bricolage of lived experience can also be constructed lyrically, constructionally, or intellectually. Recognizing this and acting upon it completely transforms perception, ontology, and understanding.

Montage in cinematic film by no means exhausts the possibilities of moving pictures. Video has a distinct aesthetic of its own, and many artists have created a wide range of collage work in this media. Perhaps the best known might be the couple Steina and Woody Vasulka who have been “abusing” video since the late 1960s. Interested readers can also check out the excellent book of essays edited by Doug Hall and Sally Jo Fifer (1990) called *Illuminating Video: An Essential Guide to Video Art*. Regardless of whether the capture format is video, digital video or film, in the past 20 years or so it has become commonplace to see “artists’ cinema” in museums. These artists’ work can range from that which is similar to traditional film to that which deconstructs traditional film. A good reference for this is *The Place of Artists’ Cinema: Space, Site and Screen*, by Maeve Connolly (2009).

In order to draw out the implications of montage consider the film *Last Year at Marienbad* directed by Alain Resnais from a screenplay by Alain Robbe-Grillet. Note that this film would fall in the + GAP - SEAM quadrant, which when compared to Eisenstein gives an idea of just how robust these categories can be. From a visually constructed standpoint it appears to be like most other traditional movies. But

creating a continuous and coherent narrative across scenes is not only challenging but actually *not* possible. *Last Year at Marienbad* makes the retrospective nature of cinema explicit. There are characters remembering and perhaps creating a past within the movie. Aside from beauty and mystery, what makes the movie valuable is that there are at least 2 and possibly 3 incommensurate realities presented within the movie – the behavior and memories of each of three characters. This is one of the things that make collage so philosophically useful. Remember from Picasso and Braque: collage is capable of representing multiple realities within the same place. This is in contrast to most styles of illusionistic painting, and Hollywood film making, which can be considered “Cartesian” in their rationalized structure. Robbe-Grillet (1962) addressed this distinction in reference to the movie:

*Two attitudes are then possible: either the spectator will try to reconstitute some ‘Cartesian’ scheme – the most linear, the most rational he can devise – and this spectator will certainly find the film difficult if not incomprehensible; or else the spectator will let himself be carried along by the extraordinary images in front of him ... and to this spectator, the film will seem the easiest he has ever seen: a film addressed exclusively to his sensibility, to his faculties of sight, hearing, feeling (Robbe-Grillet, 1962, pp. 17–18).*

If the word incommensurate reminds the reader of Thomas Kuhn (1970) and *The Structure of Scientific Revolutions*, this is intentional. One can see collage in the numerous culture clashes throughout the twentieth century. As mentioned earlier, incommensurate realities can be productively generative when collaged together. Such combinations of realities have creative and pedagogical implications.

### 1.12a. Montage of Superimposition/Palimpsest

Philosopher Gilles Deleuze (2013) wrote extensively on film. One topic is particularly relevant. He is one of the few people to address in any detail *montage of superimposition*. His thoughts are also consonant with static image collage and digital media.

In referring to the use of montage by director Abel Gance, in the film *Napoleon*, Deleuze wrote,

*By superimposing a very large number of superimpositions (sixteen at times), ... the imagination is, as it were surpassed, saturated, quickly reaching its limit. But Gance relies on [this effect] which presents to the soul the idea of a whole as the feeling of measurelessness and immensity. ... In short, with Gance the French school invents a cinema of the sublime. The composition of movement-images always presents the image of time in its two aspects: time as interval and time as whole; time as variable present and time as immensity of past and future (Deleuze, p. 47, 48).*

The take-away is this: there is something sublime in superimposition. Superimposition is a special type of collage and not just in cinema. For example, it can be seen in some of the art of Robert Rauschenberg, where paint is combined with silk-screened images. More specifically a superimposition is a palimpsest. A palimpsest, in turn, is “A written document, typically on vellum or parchment, that has been written upon several times, often with the remnants of earlier, imperfectly erased writing still visible, remnants of this kind being a major source for the recovery of lost literary works of classical antiquity” (American Heritage Dictionary, 1969, p. 944). Thus a palimpsest collapses history, that is time, within itself. Perhaps this ought to be the lens with which to understand Deleuze’s comment on the image of time in

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its two aspects. Unlike other forms of collage, which *connect* concepts across spatial and/or temporal gaps, a palimpsest *aggregates* concepts across spatial and/or temporal gaps.

There is a history of painters creating palimpsests. For example, many of the painting by Cy Twombly demonstrate this attribute. However, constructing palimpsests digitally in either Photoshop or After Effects are so much easier to do than in other prior media. Via the (often overused) function of blending “layers,” this technique has perhaps become the hallmark of digital collage. These blended elements occur via levels of transparency and specific algorithms for color mixing. These algorithms offer possibilities previously unavailable. A Google image search for “Photoshop collage art” will reveal that roughly one half of the image results display this feature.

### 1.13. Artists’ Books

Artists’ books, of course, by definition *are* books. They may expand and challenge what is thought of as a book along a continuum from something that is almost indistinguishable from a standard book to something that might casually be considered sculpture, or with advances in digital technology might even resemble a movie. This fluid character puts artists’ books at the heart of this analysis. A good place to begin is with a quote from Fluxus artist Dick Higgins (1996),

*A book in its purest form, is a phenomenon of space and time and dimensionality that is unique unto itself. Every time we turn the page, the previous page passes into our past and we are confronted by a new world. ... The only time a text exists in a solid block of time is when we are no longer reading it, unlike for example, a single painting which is all present before us when we consider its presence physically. In this way a book is like music, which is only experienced moment by moment until it, too, is past and remembered as a whole (Higgins, 1996, p. 103).*

And, in this way, a book is like film.

Artist and writer Johanna Drucker (1995) confirms: “the codex form is described as a continuity with continual interruptions. This is quite similar to film, where the viewing experience is in relation to those breaks whether they are emphasized or repressed beneath the illusion of a continuous image” (p. 131). This critical point has already been noted in the theory of film. It should be clear that these “interruptions” are analogous to the term seam. Drucker, referring to books, discusses this in more detail, but it can be extended to collage in general,

*This use of the edge of the page to manipulate the tension between continuity and discontinuity is so fundamental to the book form that it shows up in many works. In every book a decision has to be made about how to either emphasize, ignore, or overcome the fact that the openings are discreet units, separate spaces, each from the next and yet part of a continuous whole (Drucker, 1995, p. 175).*

One artists’ book that pushes the form was created by artist Isidore Isou in 1960 and titled *Le Grande Désordre*. As described by Drucker,

*The envelope contains more than the cover for the book – it also contains its content. These are elements which spill forth as so much trash and debris: matches, cigarette butts, theater tickets, canceled stamps, [and much more]. ... The text of the “novel” is to be constructed from this mass of disorganized mate-*

*rial. There is no set sequence. There is no structure, order or framework. And yet the empty cover of the codex form serves as the major object according to which the rest of the elements gain their identity (Drucker, 1995, p. 126).*

This artwork draws attention to the performative aspect of artists' books, which like static visual art, multimedia installation, and some new media; but unlike literature and traditional cinema, can be a corporeal experience actively created by the reader in collaboration with the artist. Engaging with Isou's book, by extension, makes us aware of our performance within – and engagement with – all of the elements of the world. Reading this one should think both of the dada artists, and of contested space.

A final quote by Clive Phillpot (1987) to confirm the concordance between artists' books and both static image and durational collage,

*Reading sequences of pages in book works sometimes has an affinity with the way in which one reads a painting or a photograph, rather than a novel, in that it is a non-linear, quasi-random process. Reading page by page might be likened to traversing the surface of a collage or montage in which the eye experiences disjunctions between discrete sections of the work. It can also be likened to one's experience of a movie, in that the visual images are sometimes juxtaposed in time instead of space and cumulatively create an experience (Phillpot, 1987, p. 129).*

Artists' books then, can be an ideal way for students to create projects of knowledge visualization. The convenient mix of text and imagery can help those who find it difficult to think solely in images. Additionally, text sometimes can capture a concept "just right." Finally, in spite of the virtual world experienced by today's students, the viable integration of digital and traditional media into a single tangible object can be quite satisfying.

## 1.15. Digital Collage or Compositing

In 2002 *The Language of New Media* was published. This highly influential book written by Lev Manovich examined montage in detail. Unfortunately, what he wrote on this topic is both internally inconsistent and unsupported by other scholarship including the information presented in this chapter. For this reason, and because of the importance of digital media to the practice of both collage and within educational settings, these misconceptions must be addressed. Manovich (2002) writes,

*In computer culture, montage is no longer the dominant aesthetic, as it was throughout the twentieth century, from the avant-garde of the 1920s up until the postmodernism of the 1980s. Digital compositing, in which different spaces are combined into a single seamless virtual space, is a good example of the alternative aesthetics of continuity; moreover, compositing in general can be understood as a counterpart to montage aesthetics. Montage aims to create visual, stylistic, semantic, and emotional dissonance between different elements. In contrast, compositing aims to blend them into a seamless whole, a single gestalt (Manovich, 2002, p. 144).*

This quote will be unpacked piece by piece. For the moment, accept *his* definition of montage. Manovich offers no support, here or elsewhere, for the claim that either montage was the dominant aesthetic "from the avant-garde of the 1920s," or that it ended with postmodernism in the 1980s. Or

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even that postmodernism has ended. By montage does he mean that which is specifically cinematic, or more broadly that which has been referred to as collage in multiple other media. This is unclear because throughout his book he sees all cultural artifacts through the lens of cinema. And yet, certainly here, the implication is that the word is being used in the broader sense, as the huge majority of films made (especially in Hollywood, the global engine of film) during this period would clearly fall into the category of narrative montage, which does *not* aim to create dissonance between elements. Assume then, that he is using the word in a broader sense to include for example the tradition of the visual arts as described earlier in this chapter. Montage (collage) was neither as monolithic a presence as he claimed during this period, nor did it end in the 1980s. A quick review through any art history book will expose numerous other art movements during this period, and show that montage (collage) remains a viable force today.

The word “compositing” is currently the word used by digital artists and editors to refer to combining different visual elements into a single image or film sequence. By “different spaces” I believe he means visual elements that may have originated from different capture media sources or may have been constructed synthetically, i.e. 3D animated models and scenes. Compositing, digital or otherwise, can be traced to the earliest decades of photography from the 1850s onward. Manovich discounts these photographs out of hand, but numerous others do not (Fineman, 2012). Additionally, compositing can be seamless, but is not technically obligated to be so. In most Hollywood movies it *is* seamless, but this is by no means determined by post-production software. It is determined by the aesthetics of continuity editing. Manovich asserts a distinction between physically manipulated photographs from the 19th century, and digitally manipulated imagery from today. Digital manipulation of photographs is fundamentally no different than physical manipulation. As Professor Tom Gunning (2004) wrote, “No question digital processes can perform these alterations more quickly and more seamlessly, but the difference between digital and film-based photography cannot be described as absolute” (p. 41). Furthermore, artist Mark Alice Durant (2002) makes clear that seamlessness is not a unique characteristic of digital media compositing: “[Using Photoshop] we can recreate our visual past without the violent telltale tears or cuts from an old pair of scissors. Our collage is seamless with edges softened, airbrushed, and blended-in with the new background” (Durant, 2002, p. 26).

Return now to Manovich’s definition of montage, which cannot be supported by most scholarship. Certainly at one extreme there exists a montage of dissonance. But it should be clear that montage and collage include a wide range of approaches and results. A standard definition of montage might be this one by Rohdie (2006): “Montage simply is the joining together of different elements of film in a variety of ways, between shots, within them, between sequences, within these” (p. 1). As Rohdie and other writers on this topic explain, montage can emphasize or minimize discontinuities between film clips. It’s a question of style and intent.

As mentioned, continuity editing refers to filmmakers who minimize psychological or perceptual disjunction by the viewer. The aesthetics of continuity can certainly be created via digital compositing, but this is by no means something new. It has been seen that the collages of Ernst were produced to just the same aesthetic of seamlessness. And should anyone argue that in the case of Ernst there is a psychological dissonance between elements, even if it’s visually seamless; it is suggested that an image of dinosaurs and human beings in the same place is just as psychologically dissonant. And, in fact that certainly was the point of the composited scenes of *Jurassic Park*, which Manovich (2002, p. 142) refers to as an example of the perfect blending of digital compositing.

Manovich (2002) makes the startling claim that “Computer multimedia also does not use any montage” (p. 143). He explains that,

*it follows the principle of simple addition. Elements in different media are placed next to each other without any attempt to establish contrast, complementarity, or dissonance between them. This is best illustrated by Web sites of the 1990s that typically contain JPEG images, QuickTime clips, audio files, and other media elements, side by side (Manovich, 2002, p. 143).*

As Manovich certainly knew the composition that he described here is a limitation of technology, not of aesthetics. Furthermore, even if such a web site construction is accepted, there's no reason at all to assume that images and clips side by side are incapable of establishing contrast or dissonance. In fact they are more likely to do so than not.

But even more surprising, later on in the book he completely contradicts this earlier statement. There he favorably defines his own new terms of "spatial montage" and "temporal montage" without the "postmodern" connotation. Contrast the previous quote to this:

*In general, spatial montage could involve a number of images, potentially of different sizes and proportions, appearing on the screen at the same time. This juxtaposition by itself does not result in montage; it is up to the filmmaker to construct a logic that determines which images appear together, when they appear, and what kind of relationships they enter into with one other (Manovich, 2002, p. 322).*

(His definition of spatial montage is simply the same one that has been used for collage throughout this chapter. His use of the term temporal montage describes the same structure for which most others simply use the word montage).

Finally, this last quote from Manovich,

*Digital compositing exemplifies a more general operation of computer culture –assembling together a number of elements to create a single seamless object. ... As a general operation, compositing is a counterpart of selection. Since a typical new media object is put together from elements that come from different sources, these elements need to be coordinated and adjusted to fit together. Although the logic of these two operations –selection and compositing – may suggest that they always follow one another (first selection, then compositing) in practice their relationship is more interactive. Once an object is partially assembled, new elements may need to be added; existing elements may need to be reworked (Manovich, 2002, p. 139).*

Can this be more stunningly obtuse? Every artist in every media works precisely the same way, especially collage artists.

## 1.16. Digital Collage or New Media

"New Media" can be notoriously difficult and controversial to define. As I use it, new media is likely to include at least two of the following: it is digital; it is interactive; it is virtual, or simulated; it is multi-, i.e. it incorporates more than one component of what would be considered old media. Additionally, it almost certainly takes advantage of some sort of programming code.

It is worth noting, that the word collage has been utterly debased via software apps found on the internet that allow users to combine their own photos and imagery according to different simplistic templates. I'm not exactly sure how or why this particular word appears to have lost its meaning, but the internet

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clearly has something to do with it. Collage that for the Dadaists was a pointed gun has become a tool for “Dummies.” I think that one reason for the misuse of the word collage in these sorts of examples is that people have latched on to one rudimentary characteristic of collage, and that is “making connections.” The fact that these connections are unsophisticated at every level is apparently beside the point. And making connections is something that digital applications do very well. At the heart of this are hyperlinks.

### 1.17. Hypertext and Hyperlinks

Writer and computer guru Ted Nelson coined the words hypertext and hyperlink in the mid-sixties. Although his full intentions for this technology were lost in the creation of the World Wide Web, for most of us the Web has defined these terms. Nelson himself envisioned a much more robust use of linking. Nonetheless, hypertext links, such as they are, have permeated our experience of virtual data for the past 25 years. George Landow (1999), a writer on digital culture, has made the case that hypertext is a kind of “digital collage-writing.” He writes,

*[I] am more interested in helping us understand this new kind of hypertext writing as a mode that both emphasizes and bridges gaps, and that thereby inevitably becomes an art of assemblage in which appropriation and catachresis rule. This is a new writing that brings with it implications for our conceptions of texts as well as of reader and author. It is a text in which new kinds of connections have become possible” (Landow, 1999, p. 170).*

Two conclusions can be drawn here. The first is that web and standalone hyperlinked projects are definitely collage and their interactive nature offers possibilities that are difficult if not impossible in other media. The second is that the distinction between art as created by the author and art as created by the participant is blurred. This resonates with some of my previous comments regarding the way that collage has a way of expanding outward from itself to then incorporate other foreign elements. It should be pointed out that not all hypertext projects are collagic. The act of simply linking texts is not enough, there needs to be some sort of gap and/or seam, and contested space, otherwise the reading experience is simply unusually robust but relatively linear.

Of course hyperlink constructions are not limited to hypertext novels. These can include websites such as [cameronsworld.net](http://cameronsworld.net), which includes a myriad of words, images and gif animations taken from archived webpages on Geocities, a web hosting service that closed in 2009. These elements in turn are links that open new windows. Scrolling down through the main page is an experience like the rings of Dante’s Inferno. The top “level” consists of outer space and lower levels include a “fantasy realm,” an ocean filled with fish, a hell level and several more. The site reveals a wide range of amateur design and personal content created between 1994 and 2009. It also exposes the often ephemeral nature of such art. Searching for net-art on the internet can be an exercise in frustration, as many sites depend on out of date plugins and lost links.

Net-art can include static-image collages that change over time, or links where the participant creates a durational montage effect similar to film and video. This is one example by Jim Gilmore called *Black Cloud* {Gilmore, [uncertainmachine.com](http://uncertainmachine.com)} where the participant clicks on a button to expose short texts that tell a story as strange creatures float across an image of typical suburbia. An extraordinary interactive net-art piece that participates in both types of collage, and one that explores possibilities unimagined by Lev Manovich, was completed by David Clark in 2008 and is titled *88 Constellations for*

*Wittgenstein (to be played with the Left Hand)*, (<http://88constellations.net/>). This project was created using Flash which offers possibilities unavailable in standard HTML. The following quote is taken from the Electronic Literature Collection website with no attribution.

*Exquisitely designed with a confident, understated visual vocabulary relying on icons and degraded images, 88 Constellations at times can feel like a really well-made independent documentary, but one which swerves from seemingly normative biographical reportage into visual puns, fantastic associations, and quirky digressions. Infused with the paradox, playfulness and occasional paranoia of the philosopher's life, this is a massive work with circles-within-circles logic that would take several hours to exhaust. ... 88 Constellations is a tour-de-force interactive, multimedia essay ... ([http://collection.eliterature.org/2/works/clark\\_wittgenstein.html](http://collection.eliterature.org/2/works/clark_wittgenstein.html))*

This piece is carefully designed to make connections between the content of each constellation. However, the order of selection can subtly determine one's interpretation of that content. Although this exists to a slight extent in static-image collage, it does not exist at all in cinema where our viewing order is predetermined. Interactive collage is durational, yet not pre-determined. This gives such new media collages –when done well which is often not the case– *variable* gaps, seams and contested spaces which can be quite powerful.

## 1.16. Conclusion to Section 1

Taxonomy of collage can be created and summarized here, using the concepts of the gap and the seam. To reiterate: within these categories the gap is entirely metaphoric, but the seam can either be literal or metaphoric.

1. Cubist type collages and their descendants. Imagery that concentrates on formal visual complexity, spatial configuration, and ambiguity; on illusion versus reality; and on the inclusion of outside elements for purposes of visual and conceptual juxtaposition. Art that draws attention to the gaps between materials, images and concepts; and art that makes both the metaphoric and the literal seams of the collage explicit as part of its visual strategy. This would also include constructional montage as described by Mitry. These would be + GAP and + SEAM artworks.
2. Futurist type collages and other entirely different, sometimes feminist collages, where outside elements are used in such a way that the contrast between them and the rest of the structure is minimized, synthesized or unified, both visual and conceptually. That is the gap between elements is minimized in order to communicate transcendent or socio-political harmony. However, each element retains its identity, and thus the seams – either metaphoric or literal – can be seen. This would also include lyrical montage in film as described by Mitry. These would be – GAP and + SEAM artworks.
3. Surrealist type collages and their descendants. This imagery may or may not consist of actual outside elements, as the focus is on the conceptual disjunction of components, and surprising and unpredictable combinations. The gaps between these components may or may not reflect material differences, but always reflect conceptual ones. However, in many cases the seams between ele-

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ments are minimized or completely absent in order to create an overall formal visual unity. This would also include intellectual montage in film as described by Mitry. These would be + GAP and – SEAM artworks.

4. Mixed media structures where the goal is formal and conceptual unity. Attention is not drawn to the variety of sources, elements, materials or their relationships to the outside world, or their juxtapositions with one another. Even if the elements are, strictly speaking, from different cognitive realms they are put together in such a way that the context reflects external and/or internal coherence, and juxtapositions yield no surprises. There's no discontinuity, ontologically or formally. This would also include narrative montage in film as described by Mitry. These would be – GAP and – SEAM artworks.
5. Collage is transferred into the realm of time with artists' books and cinema. It becomes durational instead of static. Regardless of media, the collage taxonomy remains applicable. Superimposition or the palimpsest is a formal strategy in both moving pictures and static ones. It becomes perhaps the major strategy in digital media.
6. Static image collage always *implies* movement across time and space. This is evident in cubist collage with its attention to different perspective. Static image collage requires the perceiver to move within time and space in order to fully apprehend it. Thus, we perform the art. In contrast, in regards to moving pictures, the perceiver is generally static; the movement occurs within the media itself, and thus the art is performed for us. In addition to the iterative/sequential binary there is a corporeal/ephemeral one.

## 2. PRACTICE

### 2.1. Introduction

Most of my own artwork has been inspired by scientific concepts; about linking these ideas to others from distant intellectual domains; and crafting a visual environment where this may be understood more or less intuitively depending on the background of the participant. The first digital artwork I produced was called *Crosslinked Genome: Or Data Fugue* (1996) an interactive CD created in Oracle Media Objects. This was a collage somewhat similar to the artists' book *Le Grande Désordre*. Selecting one of three interfaces, the user picked texts and images via titles that then popped into different windows on the screen. Extremely primitive by today's standards, it is mentioned here because in some way every digital collage I've created since, in any presentation format has been ever more sophisticated approaches to the same essential aesthetic challenge: How to create a rich visual environment that includes images and texts, and addresses a wide range of content allowing the participant to make their own connections between data elements. The project that will be outlined here is not interactive – it is a series of digitally created videos – yet is impelled by the same motivation.

The project is called *Slow Light Shadow Matter (SLSM)*. Following a project description, the theory portrayed in the first section of this chapter will be used to analyze the work. Following this, the work of two other artists will be described and analyzed. The section will conclude with implications and suggestions for adapting these approaches to an educational setting.

## 2.2. Project Description

*Slow Light Shadow Matter* is a long-term project comprising 13 short digitally created animated videos: twelve chapters and a prologue. The title itself refers to two concepts from physics. In 1999 scientists “used a new state of matter called a Bose-Einstein condensate ... to bring light down to the speed of a bicycle and then later to a dead halt” (Perkowitz, 2011, p. 8). This is called slow light. Shadow matter refers to a hypothetical material “that interacts with ordinary matter, only by gravity, which means hardly at all” (Thomsen, 1985, p. 296). The imagery in *SLSM* consists of complex motion collages, combining modified representational and non-representational elements, text, music and voice. Most visual elements are synthetic, that is created entirely via software. Each chapter is inspired by an artist-scientist dyad; each of these pairs includes an artist and a scientist who were approximate contemporaries. The chapters are united by multiple themes. For example, one narrative thread is based on the Greek god Hermes. The physical nature and history of light (or more generally electromagnetism), that of force and fields, and by extension technologies of communication or information transfer are investigated. I am weaving into the chapters a cross-referential structure of systems that include alchemy and biology in order to draw out related conceptual connections. In addition to a free-improv soundtrack, there is a voice-over recounting the biography of a musician based on jazz saxophonist Ornette Coleman.

The scientist/artist pairs are listed here:

- Prologue (El Greco)
- Isaac Newton/Jan Vermeer
- Michael Faraday/William Turner
- James Clerk Maxwell/Claude Monet
- Rosalind Franklin/Ana Mendieta
- Ernest Rutherford/Paul Cezanne
- Niels Bohr/Wassily Kandinsky
- David Bohm/Sol Lewitt
- Albert Hofmann/Pierre Soulages
- John S Bell/Jasper Johns
- Murray Gell-Mann/not yet determined
- John Archibald Wheeler/Agnes Martin
- James Lovelock/Richard Long

The scientists are almost all physicists who have worked with some aspect of electromagnetic or quantum theory. There are three dissimilar scientists who represent a sub-theme of biology. The work of the artists usually relate to light and/or color. Here too, divergent members are included in order to develop diverse ideas. The connections drawn between the artists and scientists are of course entirely aesthetic and based on my own intuition. The resulting video is exceedingly dense with superimposed imagery and texts. It may take viewers some time to parse out all the components and their relationships.

Each chapter is a roughly 3-minute video with components that move, scale, rotate, and fade in and out. Thus the aspect of motion will be compromised by the inclusion here of only still images. But enough can be represented to give the reader some sense of how information is visualized and aesthetically combined.

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*SLSM: Chapter 2*, the one inspired by Turner and Faraday, will be examined. This high definition video is projected on 3 separate screens, two narrower ones to the right and left, and a square one in the center. There is a small gap between each screen. This is represented here by two vertical black lines, as seen in Figure 13.

This video was composited in Adobe After Effects (AE), and included elements were either created in AE, Autodesk 3ds Max, Adobe Photoshop or E-on Vue. The video opens with digitally created ocean waves covered by an orange fog of clouds. Superimposed on the top of all components throughout the video are vertical colored bars, which the viewer might recognize as the emission spectrum of Helium. There is a pattern of small light blue dots, which represent the constellation Taurus. This slowly rotates 360 degrees on the z axis throughout the duration of the video. Also seen is a pattern of embossed “spots”. Each of these is actually a 2D representation of a 3D model of a radiolarian called *Heliosphaera actinota* based on an illustration by 19<sup>th</sup> century scientist Ernst Haeckel. These spots randomly pop on and off throughout the video. Soon several elements begin to appear, as seen in Figure 14. These include two bodies of texts or text fragments, and a third reveals at about 1.5 minutes. Each of these is taken from the writings of Michael Faraday, and they slide across the screen in different directions.

A “blobby” pattern representing that seen in electrical filings around a magnet appears and is seen throughout the video. At about 15 seconds, emerging from the center and slowly moving toward the viewer, is a model of the Egyptian sun-god Ra as represented by the sun atop a solar barge of a serpent with reflective wings, as seen in Figure 15.

As this leaves the screen a close-up view of a neutrino detector appears (Figure 16), fading off about 20 seconds later.

*Figure 13. Dennis Summers, Slow Light Shadow Matter, Frame 0000*  
(© 2015, D. Summers. Used with permission).

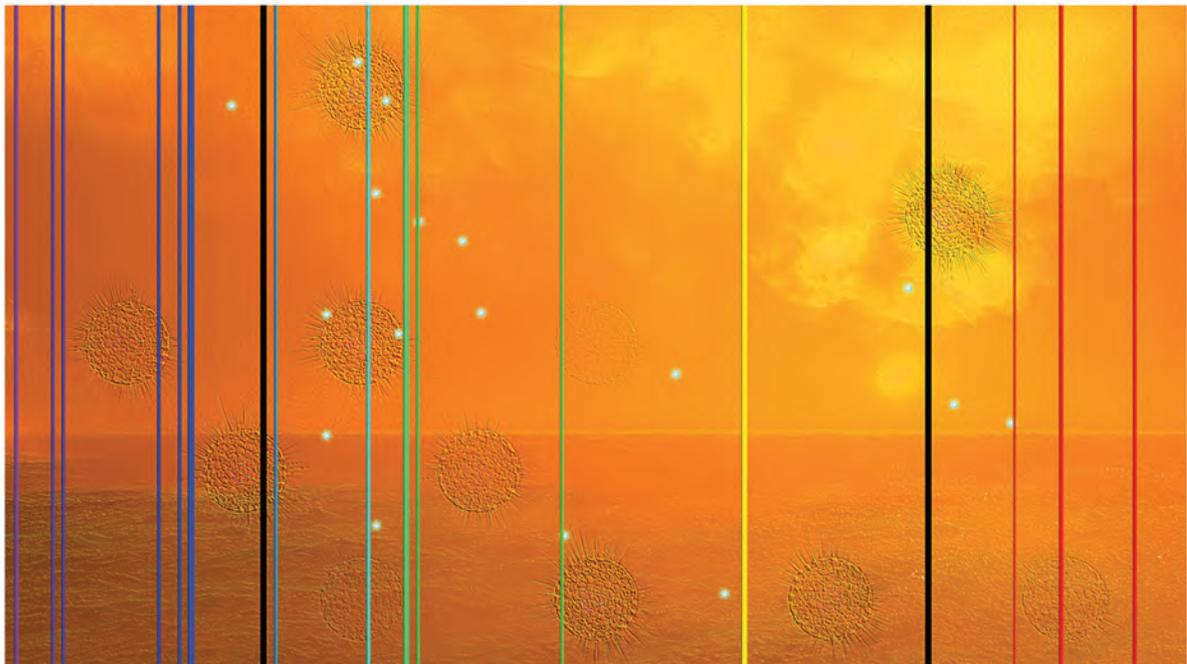


Figure 14. Dennis Summers, *Slow Light Shadow Matter*, Frame 0500  
(© 2015, D. Summers. Used with permission).

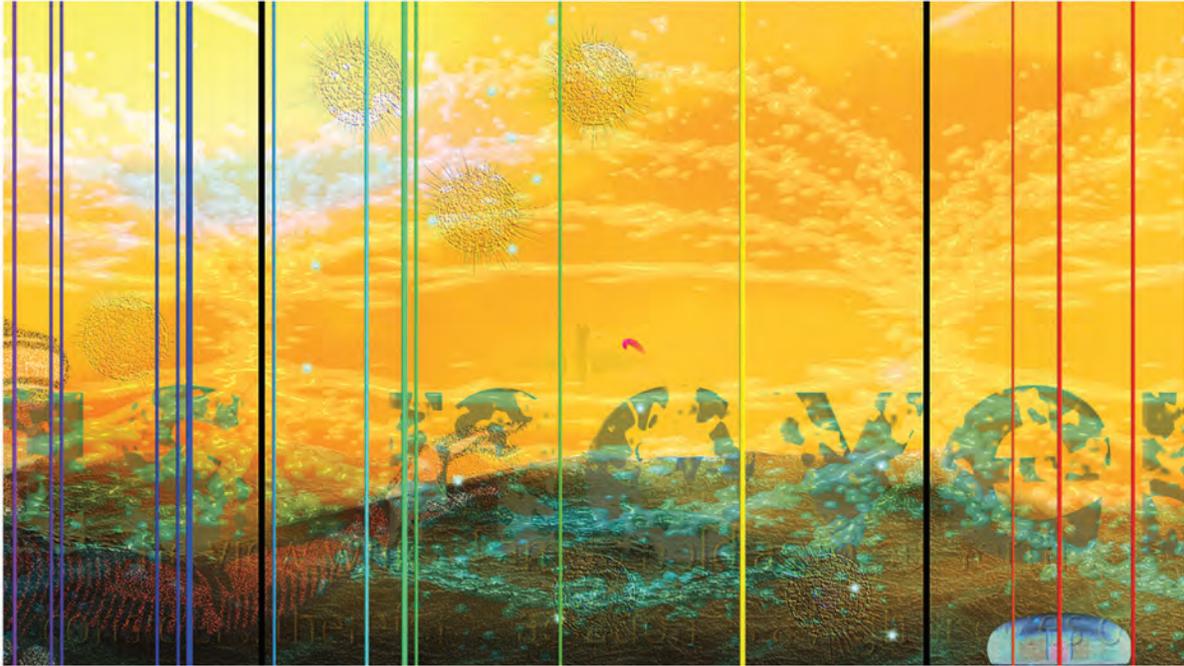
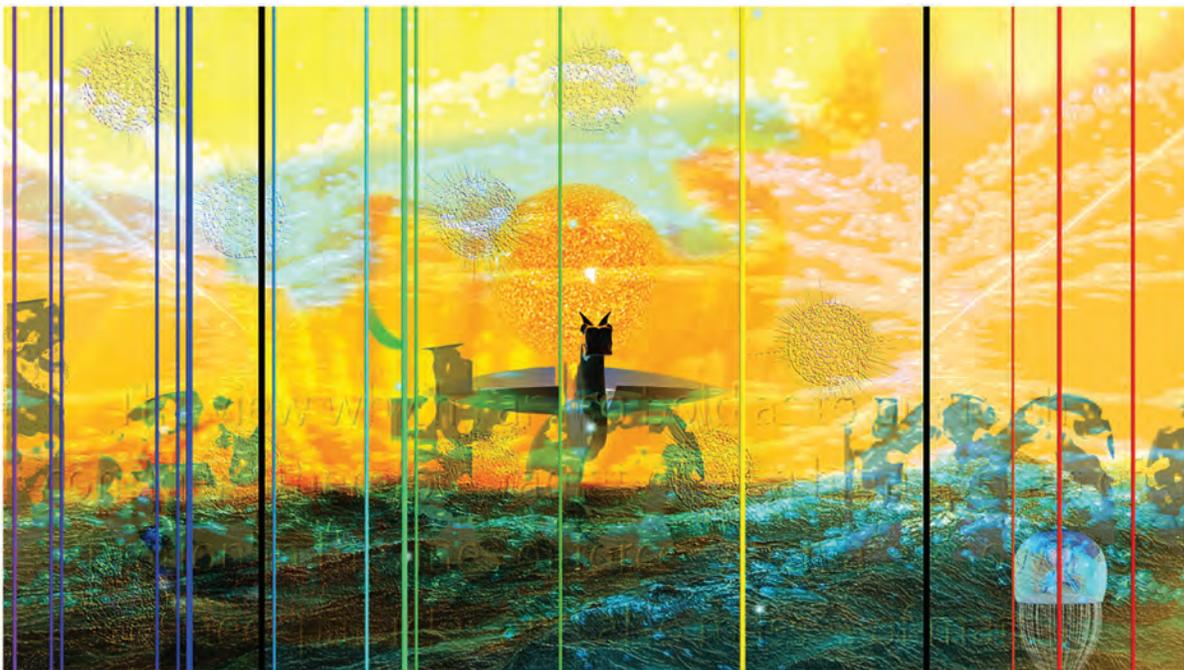
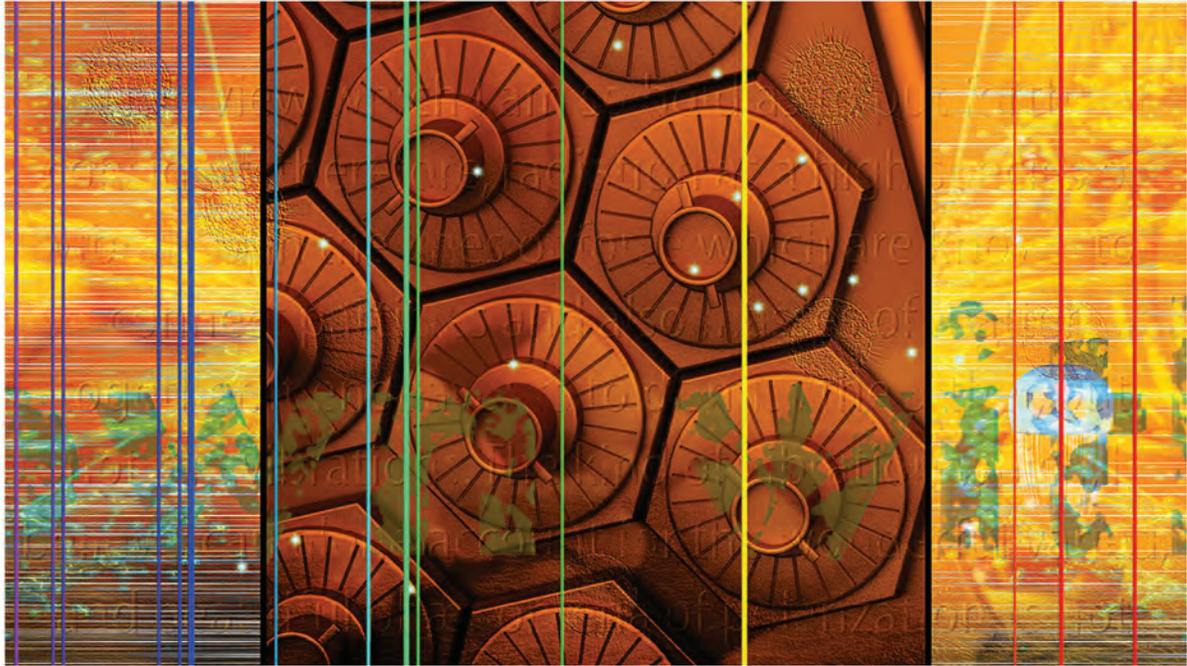


Figure 15. Dennis Summers, *Slow Light Shadow Matter*, Frame 1000  
(© 2015, D. Summers. Used with permission).



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Figure 16. Dennis Summers, *Slow Light Shadow Matter*, Frame 2000  
(© 2015, D. Summers. Used with permission).



While all this is occurring, on the right panel a self-illuminating jellyfish is slowly moving vertically upward. At about 1.5 minutes a figure can be seen climbing a stylized representation of the DNA double helix (Figure 17). On closer examination it can be seen that the figure is a half-man/half-woman hermaphrodite wearing a crown like the similar symbol within the visual history of alchemy.

During this period dragonflies can be seen flying across the top of all 3 screens. As this ends a spinning earth with glowing green loops in the pattern of the earth's magnetic field fades on, as birds fly across all screens from bottom right to top left (Figure 18).

Subsequently moving vertically downward on each side panel is a close-up shot of a rotating jade figure of the Minoan Snake goddess (Figure 19).

The video ends with a fade up of a stylized representation of the Greek god Hermes (his hat, staff, and boots) along with the tortoise shell lyre that he made and subsequently gave to Apollo (Figure 20).

There are several more visual components present within this video that will not be described in order to keep this relatively manageable. From the still images and this description one should be able to get a sense of the visual density along with the depth of layering of superimposed images.

### 2.2a Exposition

One of the aesthetic goals is to create a manifold visual space similar (in form, not content) to paintings like those by Robert Rauschenberg, Anselm Kiefer, and many others. Yet adding motion into the experience further complicates the effort to keep the total imagery coherent for both the artist and the

Figure 17. Dennis Summers, *Slow Light Shadow Matter*, Frame 3571  
(© 2015, D. Summers. Used with permission).

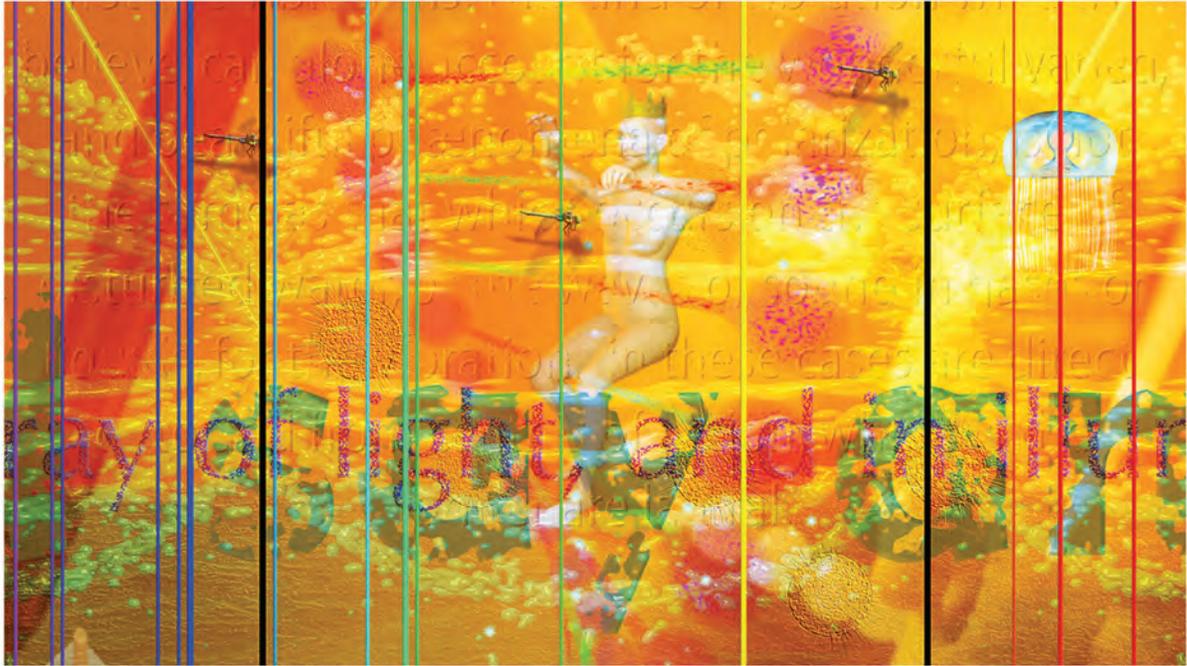
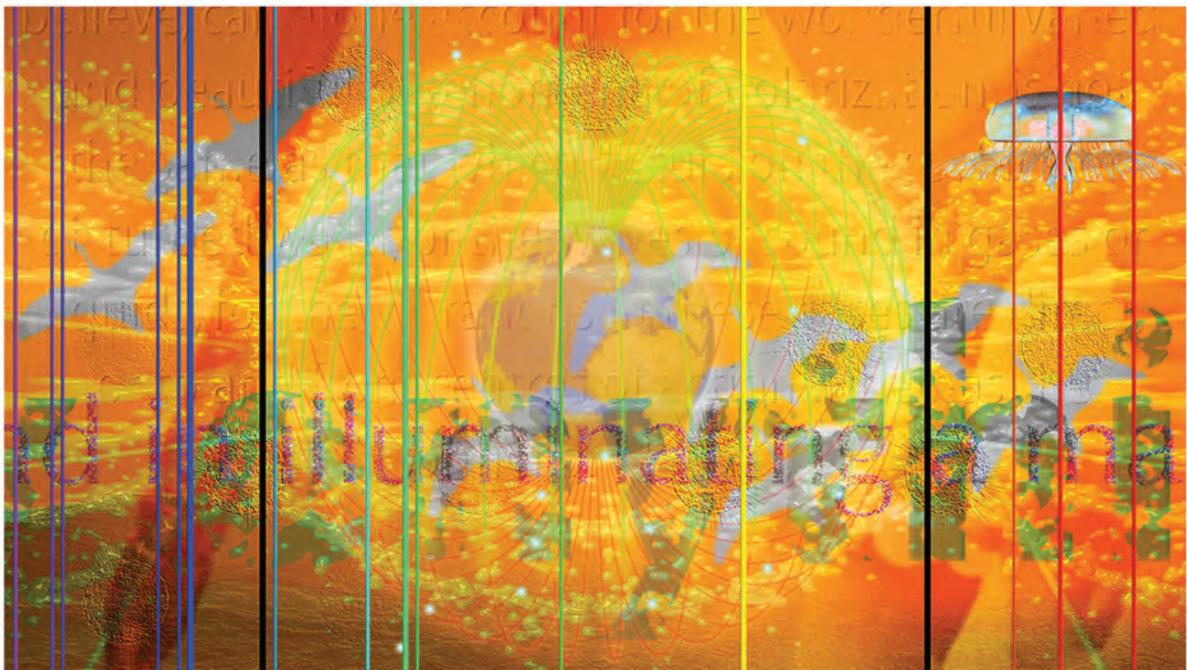
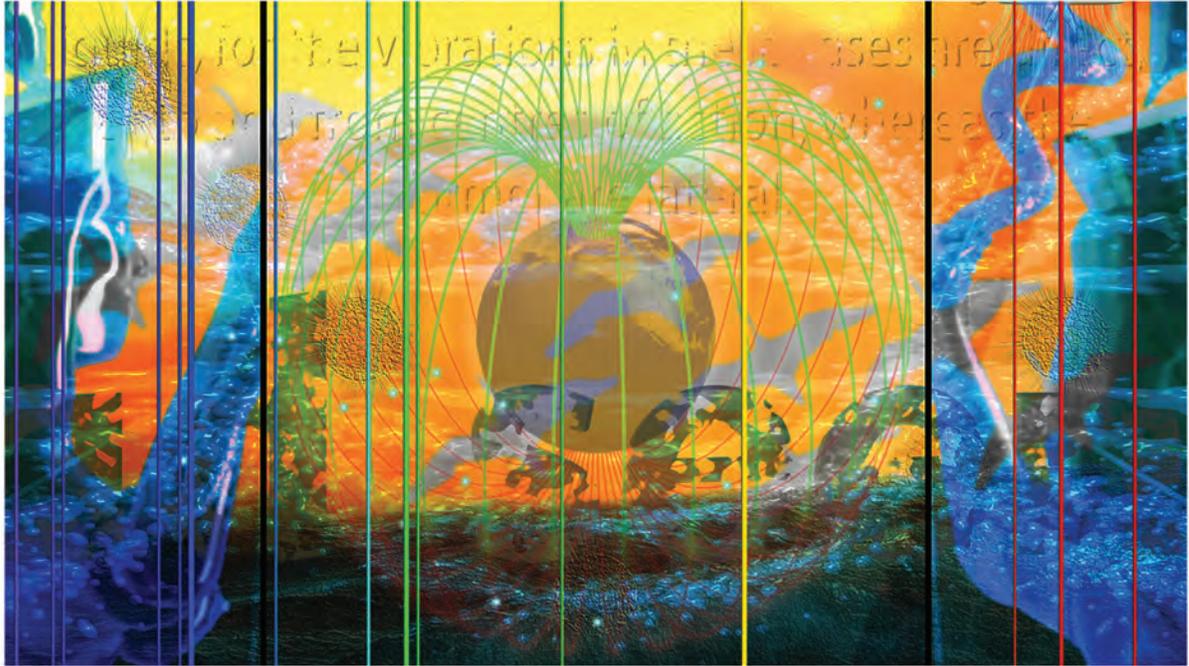


Figure 18. Dennis Summers, *Slow Light Shadow Matter*, Frame 3750  
(© 2015, D. Summers. Used with permission).

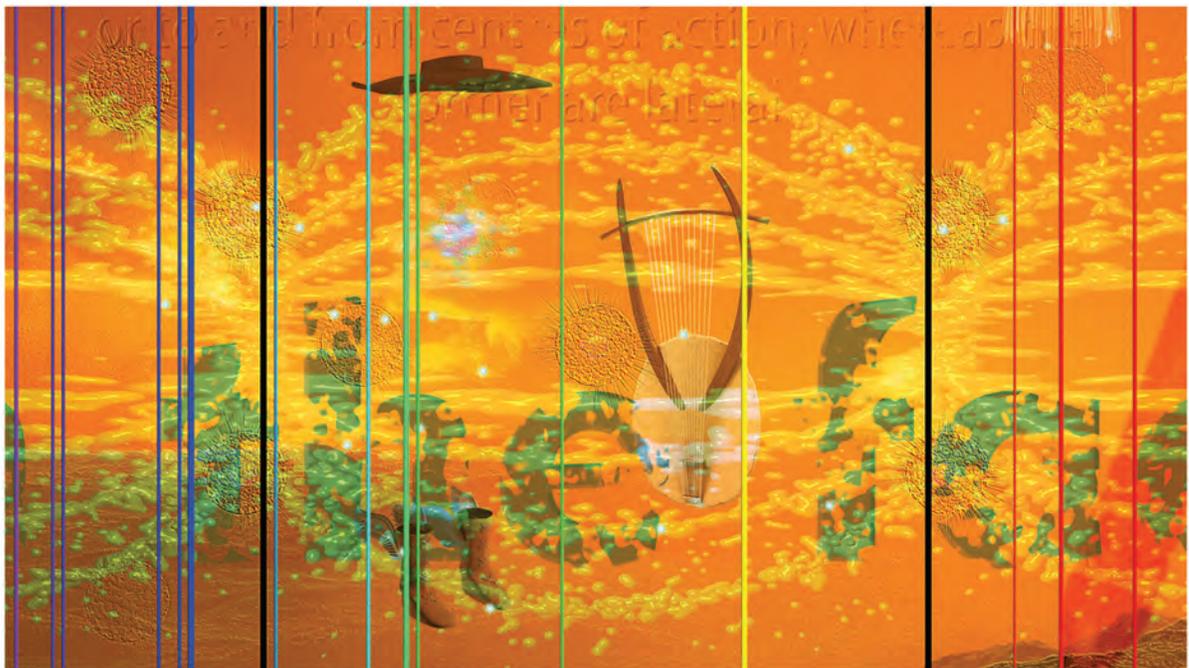


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*Figure 19. Dennis Summers, Slow Light Shadow Matter, Frame 4600*  
(© 2015, D. Summers. Used with permission).



*Figure 20. Dennis Summers, Slow Light Shadow Matter, Frame 4922*  
(© 2015, D. Summers. Used with permission).



viewer. This is meant to require the viewer's iterative and sequential attention as referred to in Section 1. Each chapter is a variation on a theme, much like jazz. Many of the same components are used in each chapter, but in different styles and configurations guided by the respective pairs of individuals. It ought to be clear that this project is all about knowledge visualization but it differs from the objective style as described by Tufte. It is more poetic, evocative. The difference between this sort of knowledge visualization and the more conventionally explicit will be addressed further on.

As an artist I work intuitively, guided by what "feels" right both formally and conceptually. I don't normally have to articulate or explain any of the details, either to myself or others. In some cases I've forgotten information about specific components; sometimes I rediscover connections between them. For the sake of elucidating relationships between this video and collage strategies I will suggest possible signification.

Each chapter includes the emission spectra lines, and the element that they represent matches the number of the chapter. So for example, in this case *SLSM: Chapter 2* shows Helium; *Chapter 3* would show Lithium. Taurus is the second constellation of the zodiac and thus present in the second chapter. These are alternative numbering systems that have arbitrary correspondence. The relevance of the magnetic components to Faraday should be clear, and the ocean and fog speak to the paintings of Turner. A perhaps subtler point is the reference to the birds and the earth's magnetic field. Recent research has suggested that migrating birds orient themselves via magnetically sensitive particles within their heads.

There are numerous connections of commonality, particularly surrounding the concept of light. Turner was famous for painting light and the effects of light – sunsets, skies, reflections on water. Faraday discovered the connection between electricity and magnetism, fusing them into one force: electromagnetism, and made many discoveries about the characteristics of polarized light. Light, of course, is one form of electromagnetism. One of the quotes from Faraday in the video is this fragment: "magnetizing and electrifying a ray of light." Certain species of jellyfish are self-illuminating which in turn connects to the water, the sun, and the stars. However, these are not the interesting parts of this collage. As mentioned earlier, it is the conflicts and contested spaces between juxtaposed elements that make collages interesting.

## 2.2b The Gap

Although there is some overlap between Turner and Faraday there are also differences. Both men were analytical and visual thinkers. Turner was an almost unintelligible public speaker; he communicated with pictures. Faraday was known to be a spellbinding public speaker and cogent writer. Faraday was humble to a fault, not so Turner. But more than simple personality differences, the contrasting goals of an artist compared to a scientist cannot be underestimated. Turner may have wanted to represent the many possible variations of light; Faraday wanted to explain the underlying physical structure of light.

The hermaphrodite in alchemic tradition represents the union of opposites, spirit and matter, and opposing forces, which can be taken as a symbol here for collage itself. The gap between that figure and the double helix on which it climbs could speak to issues such as gender differentiation and identification. There are some species of jellyfish that have both male and female reproductive organs.

The characteristics of Hermes are many, and many are relevant to this project. This allows for a certain flexibility regarding associations both close and distant that can be made between Hermes and other elements within the collage. One attribute is his aspect as the messenger god, swiftly traveling between humans on the earth and the gods who live in the sky. People that believe in astrology believe that forces related to the stars control their lives. Birds occupy a literal space between the earth and the

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sky, and in many cultural traditions occupy a similar mythic space. Hermes is the patron of travelers, and this relates to the migration of birds. What characteristics distinguish humans, gods, and animals? What of the messages carried within DNA? How do these messages compare to literal ones? Neutrinos connect humans to every other point within the whole of the universe. How is this both a metaphor for the video itself, and the relationships of components within it?

These are just a small sampling of potential juxtapositions. Viewers are likely to raise more questions. The richness of their experience depends on their questions and their answers.

### 2.2c The Seam

Digital media has made composing disparate elements in entirely fictional spaces commonplace. This is one such fictional space, in spite of the fairly realistic ocean environment that underlays the video. In fact much like futurist collage these components are thoroughly blended in order to purposely obscure which layers are on top of which. “Blended” here of course has a specific technical meaning within AE. In contrast to typical additive paint mixing, AE offers many different ways of combining color values of pixels from one image with those of another. This range of options allow for robust and complex combinations, many of which are used within this project. Additionally, this blending – as in the painting referred to earlier by Boccioni – is about creating texture and “suggesting the ‘molecular’ interpretation of the depicted object and its environment” (Poggi, 1992, p. 181). Real, that is tangible, texture is of course quite difficult to achieve in digital media, and is a personal frustration in creating these videos.

Ambiguous space is no longer as surprising in contemporary art as it was in Picasso’s time. However, looking closely at Figure 17. The reader will note that the dragonflies not only cast a shadow but they are atop the emission spectrum lines which throughout the video act as a “cage” containing all of the other components. Thus, this shadow “cannot be confused with a real shadow and thus calls attention to itself as an illusion” (Poggi, 1992, p. 82). It paradoxically creates a kind of illusory realism not present in the other elements. The seams between the 3 screens are real, and most components respect the extent of the implied frames, and yet some components, like the birds, stitch the screens together.

Although commonplace now, the use of text as content in artwork, as mentioned earlier, can be traced to the newsprint used in Picasso’s collages. Much like dadaist art, *SLSM: Chapter 2* purposely shows life “as a simultaneous muddle of noises, colors and spiritual rhythms” (Huelsenbeck, 1981, p. 244). As mentioned earlier there is a free-improvisational musical soundtrack, which mimics the density and complexity of the visuals, along with the voice-over, which further tangles the audio experience.

Although not informed by the same psychological concerns as surrealism, the combination of components within *SLSM: Chapter 2* does not conform to any normal illusionistic space. Nor do they conform to any consistent conceptual space. The visual environment includes “elements that are comprehensible in detail [that] turn ambivalent on the level of composition” (Spies, 1982, p. 95).

However, much like feminist collage *SLSM: Chapter 2* moves “beyond a postmodern emphasis on fragmentation ... [and] suggests new ways of connecting multiple open identities and perspective in a multitude of possible relationships” (Raaberg, 1998, p. 169).

It is important to note that in this chapter there are no cinematic cuts, yet there is some overlap with constructional montage. Components are assembled “in such a way that a new idea should spring up from several *objective* and *independently* interrelated facts. ... An idea thus expressed – but one which obviously does not exist except through this relationship” (Mitry, 1997, p. 133). Of course what is most relevant to this chapter and permeates my thinking about this project is that of the superimposition or

palimpsest. Although perhaps difficult to tell from a series of still images, the intention of this video is to present “time as interval and time as whole; time as variable present and time as immensity of past and future” (Deleuze, p. 47, 48).

## 2.3 Nelson Smith and Interactive Collage

Nelson Smith has created art in a variety of media over the past several decades. These include paintings, drawings, installation art, and performance art. Most of this work follows collage strategies. His paintings are a perfect example of a collage with no outside material, just paint. And yet the juxtaposition of constituent items would be recognized as collage. He reorients and reconsiders painting in the multi-media installations will be reviewed here instead.

This project called *Round Tower Cosmic Teacup Network* was created in 2014 and first exhibited in 2015. Smith was participating, as an artist-in-residence producing paintings at the Ballinglen Art Foundation in Ballycastle North Mayo, Ireland. While eating lunch at a local cafe a memorable thing happened. A small group of people sat down at a table and ordered tea. When the cups arrived they each began stirring the liquid. This created a chorus of different sonic patterns, reminding Smith of the music of composer Steve Reich. This striking event led him to record the teacup-stirring patterns for possible inclusion in some as yet undefined artwork.

During this residency he discovered something else. This was a “round tower” site in nearby Killala. He learned that towers like this one have been built by monks throughout Ireland in the sixth and seventh centuries for unknown purposes. He found a book in the Ballinglen library titled *Nature’s Silent Music: A Rucksack Naturalist’s Ireland* written by Dr. Philip Callahan (1992). Callahan’s book explores his experiences in Ireland during World War II and applies his expertise in infrared radiation to the mysteries surrounding the round towers. According to Callahan, the round towers share the same proportions of insect antennae, designed to communicate in the infrared spectrum. In addition, Callahan (1997) aligned the positions of the known round towers in Ireland to the constellations in the night sky above Ireland.

One of the most challenging and provocative books ever written is *Finnegans Wake* by James Joyce. This book is practically a collage of words, sentence fragments and languages, that combines Irish mythology, science, communications, popular art, sociology, and much more into a complex and seemingly endless stream of internal and external references. Smith’s interest in Ireland included pursuing his understanding of *Finnegans Wake* and incorporating that into his own work. He was particularly interested in the process of embedding layers of history and mythology into a cyclic narrative.

### 2.3a Exposition

As these apparently unrelated preoccupations fermented in Smith’s brain, they began to entangle and he started to see the juxtapositions that would become *Round Tower Cosmic Teacup Network*.

As seen in Figure 21, the interactive sculpture consists of a wooden tabletop painted with a layering of diagrams, five teacups each with an embedded speaker, sound module, and motion sensor. The tabletop rests on saw-horse-styled legs fabricated to the same general shapes of the round towers, or insect antennae. Each teacup has a distinct recording of a stirring pattern, which is triggered by someone moving a spoon. Each spoon covers a motion sensor that is hidden inside a teabag on the saucer (Figure 22).

The tabletop painting consists of the superimposition of a diagram indicating the locations of the round towers, and one of matched constellations found in the night sky over Ireland. Also superimposed

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*Figure 21. Nelson Smith, Round Tower Cosmic Teacup Network, installation view  
(© 2015, N. Smith. Used with permission).*



*Figure 22. Nelson Smith, Round Tower Cosmic Teacup Network, detail  
(© 2015, N. Smith. Used with permission).*



is a reformatted version of a diagram of *Finnegans Wake* created by the artist Laszlo Moholy-Nagy. The final layer of information is an interpretive schematic created by Smith that seeks out connectivity between the layers below and the sounds coming from the teacups. The drawings used for the tabletop painting can be seen in Figure 23.

Smith (N. Smith, personal communication, September 28, 2015) writes that:

*Circles and oval forms have three connotations for me – 1) as portals or entry points of some kind; 2) as implied motion like a cyclic or rotating motion; and 3) as container, embracing multiple things. This has been the case for a long time so Joyce’s use of cycles in *Finnegans Wake* fed into something I have been interested in for a long time. As a result, I converted Moholy-Nagy’s *Wake* chart into a kind of bulls-eye format of extending circles. I had no real expectation for how the interaction of the Moholy-Nagy diagram would intersect, but like most of my chance superimpositions I was amazed at how they created unlikely relationships that I would not have thought of otherwise.*

Figure 23. Nelson Smith, *Round Tower Cosmic Teacup Network*, drawings (© 2015, N. Smith. Used with permission).



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Artists in all media and formal structures frequently refer to the role of chance and coincidence in their work. Whether purposely pursued or accidental, such correspondences in collage seem to have special meaning, in part because collage so often causes such unexpected juxtapositions.

Networks, like collages, are about linking components. Smith sees the round towers as a network, not unlike that of television antennae. The interlocking table legs are another kind of network, and a kind of upside-down representation of the towers. The global system of radio telescopes designed to capture information from the stars can be extrapolated to the round towers on the map of Ireland and their correlated constellations. Referring to the teacups as “cosmic” reinforces the idea of a teacup network participating somehow with these other ones. Like bells, all five together sound as if they are signaling. This can be interpreted as a nearby event, like school bells, or farther like African talking drums, or distant – to the outer reaches of space.

All of this in turn resonates with the infrared communication networks of insects. Some insect communication is of course audible, which has additional parallels to the teacup chorus. As Smith writes,

*Since the insects use this communication largely for finding food and forming their communities, it seems a better fit than I might have imagined at first. The use of only five teacups and stirring patterns on a table that echoes the scale of dining, allows for people to make this kind of connection. While my positioning of the teacups is based mostly on aesthetics, they are positioned to be “played.” I have imagined using the piece as an instrument in a performable sound score. The final layer of schematic that I painted onto the table top attempts to speak to the “logic” of the teacups sound design. Some of the configurations appear to be wormhole-like or audio speaker-like; they make a leap from antennae to the audio speakers embedded in the teacups. Much of this configuration is also formal, using my design fundamentals to make a cohesive visual work and unify the underlayers of information as a composition while creating a relationship with the physical teacups sitting on the surface of the painting. (N. Smith, personal communication, September 29, 2015).*

Like all good collage the connections and contrasts between entities radiate outward from the artwork itself into the larger world, and in this case into the rest of the universe. This work can be seen as identifying and representing specific concepts from science. But it also can be seen as creating new scientific structures.

## 2.4 Susan Gold

Susan Gold has produced artwork in a wide range of media over the past several decades. She’s created numerous site specific installations inspired by biology and ecology, one of which is *OBSERVATIONS IN*, created in 2013. This project was located in the Weldon Library of the University of Western Ontario, and created as an extension of her nearby gallery exhibition. One of her objectives in choosing this site was to comment on the relationship between the artwork and texts, animal objects, and systematic classification methods. More specifically, at its heart was a text titled *Systema Naturae*, written in 1758 by Carl Linnaeus, Swedish botanist, physician, zoologist, and father of modern animal taxonomy.

The artwork consisted of three display cases containing a variety of objects paced atop distorted photocopies of the Linnean texts, as seen in Figure 24.

Items in addition to that text included: a variety of preserved horned larks (a species of bird); a manifest of the bird collection; assorted preserved bugs; assorted eggs; some small stones; raku fired

Figure 24. Susan Gold, *OBSERVATIONS IN*, installation view  
(© 2013, B. Lambert. Used with permission).



ceramic objects; and plastic Petri dishes containing transparent photocopies of enlarged portions of the text. One case contained the birds and the Petri dishes; one contained boxes of collected eggs; and the third contained insects, stones, and Petri dishes. Within all of the cases were the sheets of manipulated photocopied text.

These transformed text images were created by manually pulling the originals across the copier plate during its reproductive action. The horned larks, eggs, and insects came from the collection housed in the University's Biology Department. Each bird was tagged with place, date, and a signature of the original collector. Stones collected by the artist came from an area around the municipality Sanikiluaq located on the Belcher Islands in Hudson Bay. Engraved on them are circles that appear to be manually instead of naturally produced. The ceramic pieces were made by the artist in the 1980s, as basic primal shapes designed to represent "almost nothing." Each Petri dish was filled with a text fragment copied on transparent acetate. This combination gave the illusion of a magnifying glass when placed over the larger sheets of paper.

## 2.4a Exposition

This project allowed the artist to place materials affiliated with ideas of classification and knowledge storage into the appropriate context of a library. The library, a place of classification and stored information can also be likened to a book. The installation can be seen as a book presenting its contents physically. Such a book becomes interactive with its space and the viewer. This entanglement of the artwork with the context and content of its location, – always inherent in collage – creates a poetic space where questions, reflections, inspirations, humor, magic, memory, and loss can come into play (Figure 25).

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Figure 25. Susan Gold, *OBSERVATIONS IN*, detail 2  
(© 2013, S. Gold. Used with permission).



The work of Linneaus as both content and methodology are the substructure of this project. The text included a section outlining and explaining his binomial system of classification. Another section described the necessity of including poetics, histories, traditions, and stories that relate to the natural organisms under consideration. Modern systematic scientific practice has eliminated this approach thereby separating arts understanding from scientific understanding.

*OBSERVATIONS IN* can be seen as an effort to redress this partition. Linneaus traveled widely for botanical specimens, and used his original taxonomies for organizing and displaying them in cabinets. At that time, his collection was considered one of the finest in the world. His goal was to create consistent and predictable systems of classification for natural organisms based on specific visual relationships. These relationships of resemblance were aesthetic as much as scientific in a period of history when distinctions between the two were not as explicit as they were to become. In 1754, he said (as cited in Koerner, 1996) that “the earth is then nothing else but a museum of the all-wise creator’s masterpieces, divided into three chambers.” He created a display in his own home that “was a microcosm of that ‘world museum’” (p. 153). The parallels between this, collage in general, and the installation described here should be apparent. Analogously to Linneaus, Gold describes her creative process with the words “Collect. Sort. Align.” (S. Gold, personal communication, September 27, 2015). This, of course, can also be used to describe the process of creating a collage.

The pages of warped text imagery act as a substrate in supporting, reflecting, and refracting the other elements within the display cases. Much as in the collages of Picasso, the text has a dual presence as both content and as image. Gold describes her production method this way:

*Pulling material across the copier plate is a practice of mine to jar loose the content of the material, to see it in a different way. It is a performative act and it harnesses the operations of chance. Chance and error are productive for me in my creative work. Words are smeared to illegibility, but the process exposes*

*embedded alternative meanings. Certain words come forward; the composition of the text is exposed. When pulling back and forth across a digital copier plate very strange mirrored images occur. These can perhaps be deciphered but more likely they are felt experiences. I am startled into an alternative view of the quotidian. Startled into a poetic space. (S. Gold, personal communication, September 27, 2015).*

The insects were chosen for their plainness in order to resemble a mark on the page. An additional possible association here can be to software “bug.” Such programming flaws have a parallel in the text image distortion. Birds eat insects, insects eat paper, and this appears to overlap with the phrase that one “consumes books.” The stones appear to be inscribed with messages from non-human nature, this is juxtaposed with the inscriptions on the various components within the cases, and the books within the library (see Figure 26).

What is it talking to whom? The insects and birds once had mobility: did they carry messages? What does it mean to classify? Classification locks in the range of possible interpretation. Linnean classification was originally based on visual resemblance. Occasionally, DNA sequencing will clarify that an animal

Figure 26. Susan Gold, *OBSERVATIONS IN*, detail 3  
(© 2013, S. Gold. Used with permission).



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was mistakenly included in the wrong group. How does this relate to organizing visual information? Isn't collage about organizing visual (and other sensory) information? What are the distinctions between non-human nature and human culture? What of the contested space between the dead birds and the cases within which they are trapped? (Figure 27).

Gold adds these comments,

*Bird bodies can be anthropomorphized into individualized readings of death or pain or they can appear as a scientific collection revealing their similarities and their objectness, named and labeled; plastic petri dishes contain transformed text on floating transparent acetate, reminding the viewer of the scientific eye and laboratory process. Is text an object for scientific observation? Natural stones or manmade objects confound the viewer as does the morphed text. I brought these objects to the space hoping not so much to create questions with my assembly but to create a state of confoundedness. The objects are meant to speak to each other and confound each other as well as the viewer in their juxtaposition or in the gaze. They are of course mute, as is the relationship of the viewer to object, but their illogic or strangeness breaks down boundaries of linear thought. (S. Gold, personal communication, September 27, 2015).*

Figure 27. Susan Gold, *OBSERVATIONS IN*, detail 1  
(© 2013, S. Gold. Used with permission).



As described earlier in this chapter, collage is inherently irrational. The conflict between the artwork itself and its presentation as a pseudo-scientific classification method creates a contested space that brings into question the differences and commonalities between contemporary and historic art and science.

## 2.5 Solutions and Recommendations for Knowledge Visualization

In this section several aspects of the use of collage in pedagogical settings will be addressed. These include the use of software; the importance and value of using collage strategies; assessment of –and suggestions for– student projects. The reader should note that the purpose of this section, and indeed the complete chapter is to create a preliminary framework for a deeper understanding of collage than has been previously available, and for the employment of collage as a creation strategy within and without the classroom. Although some of the following may strike the reader as somewhat under developed, this author hopes that enough information has been presented to allow readers to open it up in directions appropriate to their own individual skill-sets and interests. Collage has always been uniquely expansive, inclusive, flexible, and deeply personal. Take the following as an invitation and a challenge.

### 2.5a Collage and Software

Unlike sophisticated complex scientific visualization requiring advanced software tools, popular and omnipresent software is available to most students. In practical settings one can expect some familiarity with Photoshop, perhaps less with compositing and effects applications, and even less with 3D applications. Engaging collages can be created with fairly minimal software experience. The tools necessary in Photoshop can be as limited as selection, image adjustment options, and the use of filters. Components created in Photoshop can relatively easily be incorporated into an After Effects (AE) comp. Although AE can be a little more challenging, simply learning how create *keyframes*, and using the Transform options: Position, Scale, Rotation and Opacity, can be enough to create moving collages of surprising sophistication. 3D components are by no means necessary, however, the robust and free 3D application Blender is available to anyone. Although not necessarily appropriate for all projects, a wide range of free 3D Blender models can be found on the Internet. In addition to using software to create components, almost everyone today has a phone that can take photographs, and of course the Internet is a vast resource of texts and imagery, which can be incorporated into projects under “fair use” laws. And as noted in the work of Susan Gold, even a photocopier can be expedient.

### 2.5b Pedagogical Implications of Collage

As mentioned at the beginning of this chapter, scholarship on the philosophy of collage is sorely lacking. The one stellar book, *Spectacle Pedagogy, Art, Politics and Visual Culture* (Garoian & Gaudelius, 2008), reviews the principles and implications of collage pedagogical and otherwise. It is limited however, by a narrow definition of collage. Notwithstanding that constraint, it is especially applicable in this section.

*Considering its importance in twentieth century art, why has collage not received the kind of critical pedagogical attention that it deserves in the field of art education? What is the principle of collage? How*

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*is it constructed? What are its cognitive operations? What is the significance of its disjunctive form? What is the epistemology of collage and how does it function pedagogically? (Garoian & Gaudelius, 2008, p. 91).*

But more importantly this is what they have to say about the value of teaching collage:

*Because the postmodern condition is pervasively mediated by visual culture, our awareness of its dominating assumptions and our ability to expose, examine, and critique the spectacle of visual culture make the critical pedagogy of collage, montage, assemblage, installation and performance art all the more imperative. When students understand the critical and paradoxical relationships between their art-making activities and the habitus of institutionalized schooling, between the images and ideas that they create through art and the spectacle pedagogy of visual culture, then a liminal in-between space opens that enables the potential of art-making for transgressive and transformative experiences (Garoian & Gaudelius, 2008, p. 39).*

In order to do this, students need to be within an educational environment that allows for “paradoxical space[s] where an oppositional tension exists” (p. 71).

*For that paradox to exist, the discipline specific content of art should be juxtaposed with the other academic disciplines in schools and the images and ideas of visual culture so that the dialectical tension between them yields multiple critiques, interpretations, understandings, and applications (Garoian & Gaudelius, 2008, p. 71).*

This point goes to the heart of *Knowledge Visualization and Visual Literacy in Science Education*. Despite the very real differences between the arts and the sciences, it is the arts, specifically collage that can capture and explore the complexity and contradictions of what science means for human beings.

*Such boundary-breaking education is transdisciplinary because it enables unlikely creative and intellectual associations. It is transpersonal because it recognizes a diversity of learning abilities and allows for students’ expressions and performances of subjectivity. It is transcultural because students’ memories and cultural histories are recognized as significant content in the classroom and allowed to interplay and intersect with one another as they expose, examine, and critique the commodity fetishism of visual culture and the academic knowledge taught in schools. Hence the critical pedagogy of collage enables students to transgress and transform academic and institutionalized assumptions into new cultural understandings and representations (Garoian & Gaudelius, 2008, p. 72).*

## **2.5c The Difference Between STEM and STEAM**

There are consequential differences between the goals of STEM (science, technology, engineering, and mathematics) and those of STEAM (science, technology, engineering, arts, and mathematics). If the math is wrong then the bridge will fall down. If the art is “wrong” then the bridge will be ugly. These are not trivial distinctions. “Correct” art can transform a bridge from being utilitarian and disregarded

into one that becomes a tourist attraction. These differences are relevant to the use of collage in knowledge visualization insofar as they are recognized as requiring disparate assessment criteria. Aesthetic beauty may be one criterion, but a special kind of “verity” can be another. There is not and should not be an “answer,” much less a correct one. The complexity and stimulating uncertainty of response is the necessary outcome.

*The images and ideas that are radically juxtaposed in these visual art genres constitute a disjunctive collage narrative that is ‘apprehended’ rather than ‘comprehended’ through a fugitive epistemological process in which the interconnectivity of its disparate understandings is indeterminate and resistant to synergy ... In the in-between spaces of the fragments of collage, where knowledge is mutable and undecidable, opportunities exist for creative and political intervention and production—a kind of educational research that exposes, examines, and critiques the academic knowledge of institutionalized schooling (Garoian & Gaudelius, 2008, pp. 91-92).*

For those in disciplines with different expectations this will make assessment problematic. There may not and should not be one rationalized interpretation of students’ work. The assessment should reflect the depth and range of the student’s understanding, and of the questions raised within their work, not the falsifiability of “conclusions” drawn from that work.

## 2.5d Assessment

The method commonly used in the visual arts is the public critique. This can be problematic for other disciplines for at least three reasons. The first is that they are time consuming; the second is that if done well they are difficult; and the third is that there may not be institutional support for potentially atypical assessment methodologies; Ursyn (2015) addresses some of this. Multiple-choice exams are significantly faster, easier, and cheaper to score.

Assuming that the collage project will be critiqued, there are techniques that can encourage success. Too often a visual arts critique devolves into the student supplying a linear narrative: “this means this, which in turn is succeeded by that meaning that.” The professor then responds either with unrelated pontification, or disagrees “that does not mean that,” therefore the student must be mistaken or confused. Aside from the general ineffectiveness of these exercises in learning acquisition, such critiques would be particularly inappropriate for the types of collage projects described here. The objective ought to be the following: can the student articulate the specific meaning of components used, i.e. “this is an example of an electron “s” orbital,” and can the student express the questions arising between juxtapositions found within the work. Looking for answers, which is commonplace in most disciplines would be useless here.

It is important for readers to recognize that incorporating any of the ideas or suggestions presented here in an educational setting require recognition of how easily it can all go wrong. Garoian and Gaudelius list several examples of bad student collage concluding with this:

*Students’ science projects often consist of didactic panels whose compositions are loaded with texts, images, and found materials to illustrate the elemental processes found in nature. ... Mathematics students’ use images and texts from magazines and newspapers to visualize quantification and the logic of*

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*abstract equations. In each of these pedagogical instances, the understanding sought among the fragmented, disparate remnants of collage is a teleological one that conforms and tames its radical aesthetic to naturalized, academic, and logical outcomes. (Garoian & Gaudelius, 2008, p. 90).*

Without an active critical approach on the part of students to the strategies employed in combining components, the full potential of collage will be lost to them. These possibilities include but are not limited to the real world implications of science and technology. For example, a collage on the biology of food production that leaves out genetically modified organisms would be incomplete. It is important to examine closely the complexities and sophisticated possibilities of collage. Otherwise, projects can too easily become haphazard agglomerations of stuff.

### 2.5e Possible Student Projects

As this chapter was being written, there was an article in the New York Times about the assemblage artist Sarah Sze, that captures perfectly the idea of visualizing science in a fine arts context. Sze: “also makes references to science – “You want to have all of the information, then you want to titrate it.” The computer on the desk is connected to the NASA site that measures in real time the distance between Earth and the Voyager 1 spacecraft” (Pogrebin, 2015, p. C1). This is apt as the possibilities for student projects are explored. Keeping in mind the caveats just mentioned, the suggestions listed here must be approached with careful attention to the capacity of collage.

- **Chemistry:** An element from the periodic table could include many visual components: electron orbitals, molecules built from that element, isotopes, chemical reactions, photographs of the natural physical form of the element, different examples of how the element is used in science and technology, historic, artistic and folkloric representations. Additionally, the sociological impacts of the element should be considered: lithium and psychiatric applications; uranium and plutonium as nuclear waste; mercury poisoning in fish. Economic aspects should be recognized, pollution and social disruption from mining; the use of rare earth metals in computers, post-consumer waste. There are political implications to the geographic location of certain elements.
- **Biology of Food:** This can include the biological transition from wild grasses to cultivated grains. Additionally, fungal diseases such as wheat rust can be explored, along with the biology of antibiotic use in farm animals. This topic can range from the origins of domesticating livestock and cultivation of grains to the vast industrial farms of today. The former led to population centers, governments and written languages; the latter to the associated problems of monocultures, poisoned environments, loss of jobs, and patented corporately owned seed. The genetics of breeding plants and animals and genetically modified organisms can be explored. The “green revolution” in farming, which has extended arable land and led to decreases in hunger can be contrasted to improved global economies that have led to an increase in the consumption of meat, which is one cause of climate change.

The methods for visualizing some of these abstract concepts can be quite challenging. This is where the “art” comes in. For example, one could show a tomato with a fish inside of it to communicate the idea

that GMO tomatoes have been created that include fish genes within them. The contested space between these two organisms can be provocative. Of course there are alternative methods of visualizing the same idea. One could include an image of a genome and symbolize the difference between organisms with graphic methods such as color or design styles. I'm sure the reader can imagine even more approaches.

These two examples from quite different realms of science should be enough to suggest the extent of possible uses for collage in science visualization. There are advantages to creating science informed collages by students in the arts *and* by students in technical fields. Those in the arts may discover inspiration that may have gone undeveloped otherwise. Too often young art students really have nothing to say. Their lives aren't all that differentiated or interesting and their artwork can be indistinguishable. However, having to research topics outside of their realm of comfortable expertise is both challenging and engaging. For technical students (and their instructors) the challenge is how to conceptualize hard data that they are comfortable with in totally different forms – some of which they may not even consider to be legitimate. Taking advantage of the inherent nature of collage, students will link concepts from distant epistemological worlds or even opposing tenets. This can teach a flexibility of thought that might be missing in more explicit disciplines. They will learn to critically assess those relationships, which can, and should extend beyond the specific scientific topic into its sociological implications.

As remarked earlier, it should be clear that digital software is an ideal tool nowadays for students to exploit the many visual forms within which such knowledge can be found. They can access still and moving images and texts from the internet, scan images from print resources, draw and paint their own images on a computer, and easily make their own videos of real elements for inclusion in their end product. This end product can take the form of a digital collaged image or video. However, it is worth mentioning that one valuable form their work can take is that of the artists' book. As observed, artists' books are uniquely flexible in that they retain aspects of both static and durational presentation. Additionally, although perhaps seeming somewhat outdated in the virtual world of many students, this author believes that there is something to be gained from crafting a tangible object. Students will experience visual space differently when manipulating objects in physical space. It is easy to print out imagery, text and compositions that have been created digitally, however, artists' books can also include authentic elements taken from the real world. Much of the Theory section of this chapter has explained that such elements retain a quality that refers to reality in a way that is missing from virtual objects.

## **CONCLUSION**

Successful collages must operate at both the visual and the conceptual level. For a student to create a collage based on their studies in, for example, physics or biology, they must not only understand how to visualize a concept, they must understand what connects, *or separates*, two or more realities. This link is not necessarily analogous –collage allows for the juxtaposition of antagonistic concepts. It is not necessarily logical – collage allows for metaphoric poetic relationships. And it is not necessarily linear – collage allows for networks that span time and space. But these associations are no less valid, no less scientific – the history of science is filled with metaphoric leaps that led to significant discoveries and insights.

The implications of understanding relationships in this way are many and can be applied to seemingly distant phenomena. I would suggest that extractive cultures such as industrialized western societies view the world as isolated unrelated components that can be harmlessly removed, taken out of context,

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and recombined as temporary consumer goods destined for the trash. This neglected understanding of the basic truths of ecology obviously results from the adverse view that the lives and materials of the world are isolated –not a coherent collage of elements but an agglomeration of stuff. According to the ecopsychologist Laura Sewall,

*In The Voice of the Earth, Theodore Roszak presents a provocative theory that the roots of our collective [ecological] misbehavior can be found in the historic and conceptual split between ‘in-here’ and ‘out-there.’ This dichotomy manifests as the large and despairing gap we feel between ourselves and nonhuman nature. In response, Deep Ecology and progressive psychology have begun to flesh out a conception of an ecological self, in which the division between inner and outer worlds becomes an arbitrary and historical distinction. In contradiction to an identity in which the mature self is culturally defined as fully individuated and possessing intact, absolute, decisive, and divisive boundaries, the ecological self experiences a permeability and fluidity of boundaries (Sewall, 1995, p. 202).*

One should easily see the parallels between this quote and the description of collage strategies presented here. This fluidity of the border between what is collage and what is not collage, and our perception of it within both art and reality poses interesting questions. When we experience the world with our senses, we are aware of only small bits of the data that is present, and we focus on even less. As we go through our day we may choose to examine something closely, paying attention to ever more levels of detail. Additionally, as we experience the world sequentially our attention may jump from one thing to another; from one sense to another; and our mind retrospectively ties these events together into a seamless experience. We don't generally remember our day as numerous discontinuous jumps of focus. Cinematic montage, which every student is at least subliminally aware of, organizes these jumps of focus. All of these strategies of attention are collage strategies. Becoming aware of this transforms not only the way we understand the world but the way we understand our role within the world.

*If the twentieth century has taught us anything, it is that fragmentation, reassembly, and hybridity are the life forces of a vibrant culture; calls for purity and a return to wholeness are naïve and dangerous. Collage is our natural environment. Once it is understood that we are hybrid culturally, psychologically, esthetically, in our foods, traditions, beliefs, and art, it becomes possible to understand relations as reciprocal. Meaning and identity are constructed vis à vis, in the relationship between things. The impulse toward collage is no longer one of fracture and violence but one of vitality, recognition, and temporary resolution (Durant, 2002, p. 28).*

Collage artists in all media teach us to create realities that wouldn't otherwise exist.

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## **KEY TERMS AND DEFINITIONS**

**Collage:** The gluing of elements historically considered to be outside of the realm of painting, onto paintings or simply onto a flat surface. Assemblage extends this into three dimensions; photomontage consists of multiple images combined in a single photograph, and montage refers to the cuts between film clips in motion pictures. Collage will stand in comprehensively for these and the multitude of other “-ages” that exist, in addition to other words such as cut-up, mashup, etc. In many cases installation art and performance art can also be a collage.

**Collage Taxonomy:** A heuristic method for analyzing artwork via the combinations of two descriptive aspects of collage, the gap and the seam. 1) + GAP and + SEAM, Cubist type collages and their descendants. Imagery that concentrates on formal visual complexity, spatial configuration, and ambiguity; on illusion versus reality; and on the inclusion of outside elements for purposes of visual and conceptual juxtaposition. Art that draws attention to the gaps between materials, images and concepts; and art that makes both the metaphoric and the literal seams of the collage explicit as part of its visual strategy. This would also include constructional montage in film; 2) – GAP and + SEAM, Futurist type collages and other entirely different, sometimes feminist collages, where outside elements are used in such a way that the contrast between them and the rest of the structure is minimized, synthesized or unified, both visual and conceptually. That is the gap between elements is minimized in order to communicate transcendent or socio-political harmony. However, each element retains its identity, and thus the seams – either metaphoric or literal – can be seen. This would also include lyrical montage in film; 3) + GAP and – SEAM, Surrealist type collages and their descendants. This imagery may or may not consist of actual outside elements, as the focus is on the conceptual disjunction of components, and surprising and unpredictable combinations. The gaps between these components may or may not reflect material differences, but always reflect conceptual ones. However, in many cases the seams between elements are minimized or completely absent in order to create an overall formal visual unity. This would also

include intellectual montage in film; and 4) – GAP and – SEAM: Mixed media structures where the goal is formal and conceptual unity. Attention is not drawn to the variety of sources, elements, materials or their relationships to the outside world, or their juxtapositions with one another. Even if the elements are, strictly speaking, from different cognitive realms they are put together in such a way that the context reflects external and/or internal coherence, and juxtapositions yield no surprises. There's no discontinuity, ontologically or formally. This would also include narrative montage in film.

**Compositing:** Combining visual elements from different sources of origin into a single image or film sequence.

**Contested Space:** When two elements either in time or space are juxtaposed there is a conflict as the first one to be perceived influences one's psychological anticipation of meaning, which is then altered by the influence of subsequently perceived elements.