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On Being Stereoblind in an Era of 3D Movies

Cynthia Freeland

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Abstract

I happen to have a visual impairment known as strabismus, which means that the information from my eyes is not successfully fused in my brain, so I lack stereoscopic vision. Hence I was surprised to find I could see some depth effects of recent 3D films such as Wim Wenders's *Pina*. This experience has prompted me to explore both further information about binocular vision and various disputes about the aesthetic merits of 3D films. My paper takes up the following topics: (1) a review of information about binocular vision and the problem of strabismus; (2) a summary of 3D film history and techniques; (3) a discussion of the aesthetic merits and deficits of some "best cases" of contemporary 3D films, concluding with (4) assessments of the meaning of claims about 3D cinema's alleged superior "realism." I consider three proposals about the superior realism of 3D movies with the aim of summarizing what the latest ventures in this mode mean to those of us who lack normal binocular vision.

Prologue: Being Stereoblind

I knew as a child I had problems with my eyes. I wore glasses in first grade. I also had what was called a "lazy eye:" at times when I was tired, my left eye drifted upward on its own, which was apparently disturbing for my parents and teachers to look at. After visits to the eye doctor, I was directed to wear a patch every evening over my right eye, which was dominant. I don't believe this corrected anything, but it was supposed to make my left eye work harder and strengthen its muscles.¹ I was an avid reader from an early age and found it difficult trying to read while using only my left eye. The experiment was given up after some time. Other indications that something was "off" were there, although I understand them better now than I did at the time. I was reasonably good at things like running,

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climbing, and tumbling, but horrible at ball sports. I could never hit a baseball with a bat. I had no idea where the ball was coming from and just swung blindly. Similarly, I had a nearly impossible time trying to thread a needle when my mom was teaching me how to sew. I kept missing that eye-hole by a mile. (Even now I can't do it unless I use a really big needle.) I could not see anything 3D in the old-fashioned comic books that came with red and green-lensed glasses. Nor could I share the experience others seemed to enjoy when looking through View Masters at pictures of wonderful scenery like the Grand Canyon or Niagara Falls. Instead of experiencing a landscape with magical depth, I saw two separate images, one with each eye. I never fused them together but switched back and forth. And more recently I have never been able to see any of the depth in the "Magic Eye" illustrations.

I didn't learn the technical term for my vision problem, "strabismus," until I was a tenured professor at the University of Houston and visited its excellent optometry school for their free annual eye check-up for faculty members. Since they are training graduate students there, the testing is thorough and extensive. During my exam, Dr. Dennis Levi brought in more and more students to observe me. It seems I was quite a good guinea pig as I lack binocular vision and cannot pass any of the standard tests, such as looking at a page that shows the wings of a fly that will supposedly rise up into the air. Dr. Levi explained that I have strabismus and am what is called a "rapid alternator," switching attention from the input of one eye to the other so as constantly to refresh my view of the world. Not only this, but I also have a vertical misalignment between my two eyes. I was aware of some of this. I normally use my right eye, the dominant one, except for distance viewing, such as watching scenes on stage at the opera (my seats are way back in the balcony), when I use my left eye, which has better distance vision. (Needless to say, this sometimes results in eye strain.)

During the most recent 3D movie phase signaled especially by the huge success of James Cameron's *Avatar*, I simply avoided seeing such films in 3D, assuming I would be unable to see them and might get some weird blurring besides. I only went by accident to see the 3D movie, *Pina*, directed by Wim Wenders. When I tried on the special glasses, amazingly, I saw a clear picture. Further, to my surprise, I actually could perceive some instances of 3D depth effects. I would not claim to see any specially increased depth or "full-worldedness," but in several instances I experienced the "pop-out" effect. For example, once some overhead trolleys shot directly toward us from the center of the screen, and I practically jumped out of my seat.

This experience left me wondering about the aesthetic possibilities (whether good or bad) of the new 3D cinema. Many film-goers have expressed doubt about whether 3D in its current incarnation (which is just one of many periodic revivals in the history of the medium) is

here to stay or just another fad. No less an authority than movie critic Roger Ebert placed himself on the skeptical side when, in January of 2011 he ran a column on his popular blog titled, “Why 3D doesn’t work and never will. Case closed.”² Apparently, however, the case was not closed because the piece has to date generated nearly 700 responses, including some detailed ones from participants in the cinematic medium, vision specialists, and of course, ordinary viewers.

My article will proceed to consider the aesthetic potentials of 3D films by taking up the following topics: (1) a review of information about binocular vision and the problem of strabismus; (2) a quick summary of 3D film history and techniques; and (3) a discussion of the aesthetic merits and deficits of contemporary 3D films, surveying treatments of some of the presumed best cases. I conclude that assessments of the merits of 3D often come down to claims about its alleged superior “realism.” And so in the final section, part (4), I will discuss three proposals about the superior realism of 3D movies. My hope is along the way to consider as well what the latest ventures in this mode mean to those of us who are, for now at least, missing out on most of the fun.

(1) Stereoscopic Vision

Stereoblindness is estimated to affect 3 to 15 percent of the population, mostly due to poor binocular vision. “It means that one in 30 persons will not see 3D at all, and one in six has some sort of stereoscopic vision impairment” (Mendiburu, 24). The most common cause of stereoblindness is strabismus, a problem often called “crossed eyes” in which the two eyes do not look the same way or at the same object at the same time, probably due to muscle problems.

Six different muscles surround the eyes and work “as a team” so that both eyes can focus on the same object. In someone with strabismus, these muscles do not work together. As a result, one eye looks at one object, while the other eye turns in a different direction and is focused on another object. When this occurs, two different images are sent to the brain -- one from each eye. This confuses the brain, and the brain may learn to ignore the image from the weaker eye. (“Strabismus,” PubMedHealth 2010)

Strabismus is often related to—either the result or cause of—amblyopia or a lazy eye.³ If the messages from the two eyes remain separate, then the young child will typically fail to develop binocular vision. This is explained by Bruno Breitmeyer in his 2010 book *Blindspots: The Many Ways We Cannot See*. He writes,

Binocular neurons... (a) are quite plentiful at or shortly after birth and (b) lose their binocularity when highly discordant images are projected on the two retinae after birth. To compensate for this problem, the neural connections from the healthy eye to the immature binocular neurons compete during critical postbirth periods of development with the connections from the defective eye. The winner turns out to be the connections from the healthy eye, with input from the unhealthy eye being suppressed, having little effect on the now ‘rewired’ monocularly driven cortical neurons.” (Breitmeyer, 43)

Fortunately, people like me do not have to get by without *any* visual mapping of depth in space. Other cues are derived from perspective and relative size, texture gradient, occlusion, atmosphere blur and color shift, cast shadows and highlights, in addition to motion-based cues involving parallaxes (Mendiburu, 11-16; Breitmeyer 45). The world has never looked “flat” to me (whatever that might mean). I can see that things have diverse shapes, textures, and relationships to one another in space.

It used to be taken as gospel that stereoscopic vision can only be formed during the earliest years of childhood. (Recall that Breitmeyer said this as recently as 2010.) However, the expert opinion on this has now changed. Susan Barry, a professor of neurobiology at Mt. Holyoke College, is a leader in disseminating information about new techniques of vision therapy, especially through the personal report offered in her fascinating book *Fixing My Gaze: A Scientist’s Journey into Seeing in Three Dimensions* (Barry 2009). As a child, Barry had severely turned eyes and went through three operations before the age of seven to straighten them. But while the operations made her eyes *look* straight, they did not affect the way she *saw*. Later in life in 2002, at almost age 50, she began a course of vision therapy during which she acquired the 3D vision she had always lacked. Vision therapy involves various eye exercises that promote strengthening of the eye muscles and the ability to recover binocular fusion. Barry describes the experience as revelatory and deeply transformative—as if discovering an entire world she never knew existed. She also sees it as offering a compelling new case for neuronal plasticity. Barry’s experience was written about and popularized by neuroscientist Oliver Sacks in an essay titled “Stereoscopic Sue” (Sacks, 2006). Her story has inspired others with strabismus to follow her lead and attempt to acquire stereoscopic vision. Some who have been successful rave, as Barry does, about the new world they have discovered. She writes about the experience as something unique and nearly ineffable:

When I first learned about stereopsis in college, I wondered if I could imagine this way of seeing. Now I had my answer. I could not. Stereopsis provides a distinctive, subjective sensation, a *quale*. ... The sensation provided by stereopsis of empty space and things projecting out or receding into that space is unique. (101)

As an example Barry describes seeing the folds and creases of coats hanging in the family's closet in amazing detail with a clarity like that she had only seen before in paintings—and indeed she had been skeptical then, thinking “no one... really saw the texture of the gown in that kind of depth and detail.” (105)

Others with strabismus have also experienced, as I did, some 3D vision during film viewing. Why is this possible? I have read several different proposals on this. Barry herself suggests a plausible one on Sovoto, an online forum for vision advocacy:

Here's an idea explaining why you can see the 3D in the 3D movies. The glasses that you wear for 3D movies alternate which eye sees the image at a very fast rate. Then your brain must fuse the images seen at slightly different times by both eyes. Under normal circumstances, you suppress the image from one or the other eye, but suppression may take time to build up, and the glasses may switch the image from eye to eye so fast that suppression doesn't have time to kick in. If your eyes are aligned well enough for some fusion, then you may be able to fuse the two eyes' images and see the 3D.

Also movie theaters are dark, and suppression may be greatest under normal daylight conditions (when if you have misaligned eyes, you need suppression most to avoid double vision). So the movie theater presents a viewing situation in which your normal strabismic adaptations may be less activated. Perhaps, you might be able to see 3D in real life if you start by looking, let's say, at tree branches at night under a street lamp. This is just a guess but I did notice that tree branches illuminated at night by street lamps gave me a wonderful 3D view.⁴

Another explanation was offered by my colleague Dr. Janice Wensveen in the University of Houston's College of Optometry. She wrote,

It is interesting that you did get a sense of depth from the movie you saw and I think that people like yourself who have no clinically measurable stereopsis do get a sense of depth from 3D movies because the screen is so big that it involves peripheral vision, where there may be some gross binocular cooperation.⁵

(2) Basics of 3D film history

The creation of a vivid three-dimensional film experience has long been a goal of movie makers. It has roots going back at least to the stereoscopic photography pioneered in the 19th century by Sir Charles Wheatstone as early as 1833. The stereoscopic camera works by taking two photographs of a scene at slightly different angles. The resulting image pairs can be viewed with an appropriate device enabling (most) people to experience the depicted scene with an unusual degree of realism and depth. Such images and devices were affordable and became smaller and almost toy-like during the mid-twentieth century in the form of the well-known “View Master” box and cards of my childhood. Like the stereoscope, View Master cards had to be looked at through a device that sent the two images to each eye individually. These would produce a result for people (unlike me) whose brains could fuse the two to create a depth effect. A similar framework was employed in the early days of 3D comic books and films employing the infamous red-green glasses. This anaglyph technique employs differently shot red and green images projected to each eye separately and then, typically, fused into a 3D result when a viewer dons the colored glasses.

3D films were shown as early as 1922 using this red-green anaglyph format and two projectors. A different process using polarized light and special silver-coated screens was introduced in the 1930s. There was a 3D film craze in the 1950s with a variety being produced in diverse genres including horror, sci-fi, and the Western. These films used the polarizing system and required specially treated screens and well-synchronized dual projectors. Often-cited as a superior example was Alfred Hitchcock’s *Dial M for Murder*, which employed 3D to great effect when the heroine (Grace Kelly) about to be strangled grabbed a pair of scissors and first thrust them out toward the audience and then back at her attacker to kill him.

3D films were made throughout the 1970s and ’80s. Again, these often were features in the horror and science fiction genres. Other processes competed with 3D, including Cinerama in the 1960s, a wide-screen technology that required simultaneous shooting by three cameras, as well as projection from three different booths in a specially equipped theater. The three curved screens created a surround-the-audience effect but also showed seams that could be disruptive to the movie experience. IMAX, which premiered in 1970, uses greater magnification and a special kind of film frame. Theaters are also specially constructed to put audiences in steep rows but within film screen height, again enhancing the filmic experience.

The latest phase in the 3D film history is, as I mentioned earlier, was signaled particularly by the success of James Cameron's *Avatar* (2009/10). 3D today is distinctive as a technology because it is typically accompanied by digitization (Mendiburu 7). There are significant differences in films actually shot with stereoscopic cameras and those altered in post-production, as also between films using real actors vs. those using CGI-generated characters. 3D movies produced with two cameras have interaxial disparity which must be adjusted in accordance with object distance and camera focal length, to produce a roundness effect (103-4). For many, 3D is the obvious future of cinema. Bernard Mendiburu writes,

Eventually, 3D will make its way into mainstream cinema the way color and sound did ... it will be unavoidable and ubiquitous, to the point that the very mention of "3D" will disappear from posters. At some point in the near future, you will go to see a 'flattie' for nostalgia's sake, just as you sometimes watch black-and-white movies on TV today. (Mendiburu, 2)

However, not everyone agrees. As mentioned in my introduction, Roger Ebert's 2011 column titled, "Why 3D doesn't work and never will. Case closed" generated an unusual amount of commentary. Ebert had previously been outspoken in his criticism of 3D with other articles such as "D-minus for 3-D" in August 2008. There he complained,

There seems to be a belief that 3-D films are not getting their money's worth unless they hurtle objects or body parts at the audience. Every time that happens, it creates a fatal break in the illusion of the film. The idea of a movie, even an animated one, is to convince us, halfway at least, that that we're seeing on the screen is sort of really happening. Images leaping off the screen destroy that illusion. (Ebert 2008)

Ebert argues that such movement is neither realistic nor consistent with the purposes of motion detection our species evolved for.

Film scholar Kristin Thompson appeared to echo these reservations with several blog posts on the theme, "Has 3-D already failed?" In the first, from August 2009, Thompson began by citing James Cameron's pronouncements that 3D was the future of cinema, commenting,

This year, coverage of *Avatar* has been considerable and has mostly echoed his prediction that this is the future of cinema. Geeks who tend to love special-effects-heavy sci-fi and fantasy films also tend to long for all of those films to be 3-D. *Star Wars* and *The Lord of the Rings* cannot be converted into 3-D fast enough for them. They run websites to express their fervor and to report every new technical

innovation and every rumor about a future film perhaps being made in 3-D. (Thompson 2009)

But Thompson notes that other directors are lagging behind Cameron—people as varied and prominent as George Lucas, Steven Spielberg, and Tim Burton.⁶ One problem she notes is that there are as yet simply not enough theaters equipped to screen 3D films. Also she writes that the trendiness effect may wear off: “there’s the potential that 3-D will lose its luster for audiences.” Thompson also examines claims about 3D’s profitability with some skepticism, since making 3D films is costly, and other aspects like the requisite glasses can be expensive for theater owners. Finally, Thompson makes a compelling argument about the negative impact for 3D of a lack of transferability to small screens like iPods, smart phones, etc. She writes, “3-D has the effect of making films that won’t play well on the very devices that studio heads would love to see playing their movies” (Thompson 2009).

In revisiting the topic in January 2011 with the same title plus the addition “The sequel: Real Dlighted” (sic), Thompson reported on the quick growth of 3D-equipped theaters spurred largely by the successes of *Avatar* and *Alice in Wonderland*. However, she was still cautious.

Yet for some the bloom seems to be off the rose. Low-budget exploitation films in 3D, films shot in 2D and converted for 3D release, filmgoer impatience with ticket surcharges and clunky glasses, and a general decline in the novelty value of 3D have all combined to leave its future still in doubt. There is a downward trend in 3D film revenues and sales of 3D televisions have not been as high as expected. (Thompson 2011)

A problem often mentioned is the need for special glasses which can be cumbersome, not to mention smudged. Thompson remarks, “Maybe guys who sit around drinking beer and watching the Super Bowl will get used to seeing each other wearing plastic glasses. Still, I have long been of the opinion that until 3D technology reaches a point where the glasses are unnecessary, the format can’t be universally viable” (Thompson 2011).

The 2011 column by Roger Ebert showcased a letter sent to Ebert by acclaimed film editor Walter Murch (whose numerous Oscars were listed at the start) to the effect that perceiving 3D in films is unnatural for our brains. 3D films cause our visual system problems in achieving convergence, depth perception, and immersion. Murch alleged that 3D requires our brains to do so much work that many people get headaches after watching these movies for a mere 20 minutes. These problems are exacerbated by fast editing, which can produce blurred edges; and in general the films also simply have too much darkness. Murch

concluded, “So: dark, small, stroby, headache inducing, alienating. And expensive. The question is: how long will it take people to realize and get fed up?” (Murch in Ebert 2011). Some readers agreed, stating that 3D was just a cyclical fad and gimmick and they were already fed up. A writer identified as “David” posted, “3D is now what CGI rapidly became in the mid- to late-1990s: something flashy the filmmakers can use to distract us from shoddy scripts and wooden acting” (Ebert 2011).

However, many pointed to personal experiences attesting that the films they had seen were brilliant in 3D and did not give them visual problems, implying that Murch and Ebert were just old men showing typical resistance to innovation and change. One reader posted a link to his own blog entry titled ““This isn’t your Grandfather’s 3D”.⁷ In my own experience, some 3D films (*Prometheus*) were dark, but this seemed entirely appropriate given their grim atmosphere; a film like *Pina*, on the other hand, was not dark at all. This may be a matter both of the director’s choices and of the projection devices available at particular theaters.

Various experts replied to Ebert’s column, taking on other technical issues Murch raised, such as motion strobing. Many admitted that the new technology has problems yet to be solved, but they argued this is just a matter of time, and that issues of depth perception can be addressed by editors and directors being better trained at how to use the medium. One expert optometrist wrote,

The problem with 3D is twofold ... one is artistic and the other deals more with vision function. On the artistic side ... if it doesn’t detract from the story but rather adds to your overall experience, I don’t have a problem with it.

On the functional vision side ... most individuals should be able to handle the visual demand ... having said that the AOA found that up to 25 percent of people report symptoms after watching a 3D movie and anywhere from 2-6 percent have eye problems (strabismus & amblyopia) that could make enjoying the 3D experience very difficult. Since you are talking about 310 million people in the USA, that adds up to many consumers who are going to be very disappointed in their 3D content viewing experience.⁸

Other specialists in fields like film editing and digital game design argued that once directors and editors become familiar with the possibilities, limitations, and rules of the new medium, the artistic problems can also be reduced. The problem of darkness can be addressed by using brighter projection systems, for example.

(3) Aesthetics of 3D films

The qualities most generally listed as the key aesthetic effects of 3D are often related to claims about its superior realism. These involve such features as immersiveness, depth behind the screen, “pop-out” effects in front of the screen, and a unique “flow” in certain sorts of movement and action sequences. I turn now to some more detailed studies of sample films often touted as excellent examples of the genre, including *Pina*, *The Cave of Forgotten Dreams*, and *Avatar*, to illustrate how these various aesthetic features apply in the context of particular genres and stories.

Win Wenders’ *Pina* and other Dance Films

First, in “Spectacular Dimensions: 3D Dance Films,” Miriam Ross discusses the special virtues of 3D for presentation of dance sequences in films, including Win Wenders’s *Pina* as well as popular films like *Streetdance 3D* (2010) and *Stepup 3D* (2010).⁹ Ross suggests that 3D adds a strong kinesthetic element to the viewer’s perception of dance in films. “3D film is particularly effective at heightening the physical affect that cinema can create. There are a number of sequences in each film where other muscles and senses in the viewer’s body are called upon.” Even though the more popular dance films often have sketchy narratives they can highlight the spectacle of dancing bodies—of both genders—in ways that acknowledge the viewers in the audience. Or as Ross puts it, the dance scenes work so as to “implicate the viewer’s body within these spatial configurations”. She argues that such films can “rework screen aesthetics.”

More specifically, dance films can use features of both positive and negative parallax to show the physicality of dancers’ bodies. Scenes in both *Pina* and *Streetdance* include images of water or bubbles that appear to float or flow in between dancers and the audience. Other scenes clearly represent some dancers’ bodies as being well back in space (behind the plane of the screen), better capturing their spatial relations to other dancers. In addition, some of the 3D dance films include direct address to the audience in scenes that “provoke an embodied presence that maintains an active stance.” Ross cites parallel examples discussed in Jennifer M. Barker’s book, *The Tactile Eye: Touch and the Cinematic Experience*, of ways in which films evoke audience muscle responses such as tensing, leaning forward, etc. Without having read Barker’s book, I am reminded of my own responses during the movie *Seabiscuit* when I found that I was eagerly sitting up in my seat urging on the horse to win his big match race with War Admiral. In contrast to points Ross and Barker make, this did not involve or seem to require 3D but simply the excitement of a well-constructed movie.

A second strength of the 3D dance film, in Ross's view, is somewhat surprising and even paradoxical. She argues that the stereoscopic medium can "re-make the close-up."

The close-up enhances the multiple and simultaneously minute movements in their features while the detailed exploration of the face is enhanced by the hyper-real quality that stereoscopic images produce. Furthermore, the rounded form of the face, as with all spherical objects, is an effective surface for the stereoscopic effect that both suggests three-dimensional depth and alludes to the weightless nature of the optical illusion. (Ross 2011)

Use of the close-up in film is, as Ross sees things, often "enigmatic." It is not natural for us to see people's faces magnified to the scale of height of a full screen. This effect of closeness is strengthened in 3D by our sense of being right there with the person yet at the same time physically separated. She asks, "At what point can we stop at or push through and beyond the close-up when it is simultaneously in our space and not there at all?"

Both strengths singled out by Ross in discussing 3D dance films—engagement with audience bodies and enigmatic close-ups—are described by her using the term "oscillation." It is worth getting clearer on what she means by this term: "that there is no stable viewing position on offer but rather a constant reinvention of the relationship between audience and filmed body." I am skeptical about how attractive such oscillation actually is, as well as about how conscious of it various film audiences actually are, especially for the more popular dance films. On the one hand it seems plausible that 3D dance films can "produce alternative methods for stimulating our perceptive senses." However, an oscillation that includes acknowledgment of our separation from bodies or faces shown on screen might appear *unappealing* since it works against the very feature often claimed as 3D's primary strength—its immersiveness. I did not feel Ross ever successfully explained why our inability to share space with dancers we appear to see right in front of us should be something positive. Also, the enormous popularity of 3D concert films (movies of live performances by stars like Miley Cyrus) suggests that their appeal lies mainly in the sense of "almost being there," and not in any recognized vacillation between presence and absence of the performer on the screen. I shall return to this issue in my conclusion below.

Cave of Forgotten Dreams

Another film that has been praised by critics for its use of 3D is Werner Herzog's *Cave of Forgotten Dreams* (2011). In her article on this film, "Cave of Forgotten Dreams:

Meditations on 3D,” Barbara Klinger examines various strategies used by the director in depicting the ancient cave paintings in the famous Chauvet Cave in France.¹⁰ Strikingly, Herzog employs the latest in film technologies to record some of the earliest artistic efforts of human beings on earth. Klinger argues that Herzog means to highlight this irony or paradox in part by making his film itself is a meditation on its own uses of 3D and other technologies. 3D is effective in depicting the depth and surface areas of the cave in relation to the paintings upon these surfaces—especially so given the filmmakers’ extremely restricted access to areas of the cave. “When Herzog and crew film the paintings, the camera and the light from handheld panels trace the walls’ contours, bringing out the undulating surfaces that give the pictured animals additional dimensionality and life” (Klinger, 40).

Another way in which Herzog makes self-conscious use of cutting-age technology in exploring one of the most ancient of human artistic creations is by employing dynamic and aerial shots done by a specially designed “Skybot” camera to convey a sense of the landscape and geography of the region around the cave. This choice also foregrounds the very technology of cinema that Herzog is using to create his own artistic representation. The film emphasizes not only the continuity between standard techniques of documentary and fiction film but similarly brings out parallels between science and art in Herzog’s interviews with the various scientists exploring the cave by showing how they use drawings, models, and so on in their work. He compares their working lights to the Paleolithic artists’ torches. As Klinger explains, the film

... meditates impressively upon issues that are continually negotiated in 3D filmmaking today: its competing capacities to enhance cinema’s verisimilitude and tendency toward spectacle; its use in both documentaries and fantasy-oriented films; its complicated existence as a scientific, technological, and artistic instrument; and its dependence for subject matter and style on interactions with old media and their conventions.

Klinger concludes, “Herzog’s film plays a fascinating game with the 3D optic, as *Cave* advances on and recedes dramatically from this horizon, exploring what can be seen, what is difficult to see, and what remains beyond technology’s ability to reveal” (43). In the case of a director as sophisticated as Herzog, this claim seems convincing—that is, the idea that the film would be reflective about some of its own representational strategies. I find this more plausible than Ross’s idea that even popular dance films can make audiences reflect upon the tension between the “there/not there” of the dancers’ bodies represented so vividly on (or in front of or behind) the screen. Unfortunately, I have not seen Herzog’s movie

myself, although some interesting trailers and shorts about its making can be found online.¹¹ This makes some of Klinger's other claims hard to evaluate.

James Cameron's *Avatar*

Avatar is one of several movies, also including *Pina*, discussed by Barbara Flueckiger in a major article from *Projections* Summer 2012 titled "The Aesthetics of Stereoscopic Cinema." Flueckiger uses the term "aesthetics" in her title to describe "features of a film ... that address the senses, regardless of whether they were intentionally arranged by an artistic agency...or...are highly informed by technological possibilities and limitations." In this informative article Flueckiger describes various technical aspects of 3D, including ones that can impose limitations on either filmic depictions or viewer perceptions, beginning with the example of Wim Wenders' *Pina*. She quotes the director as claiming the film was only possible given the advances in stereoscopic filming.

He expressed his belief that only this technique can convey the concept of space and the corporeality of the dancers, both of which are central to this art form: "Die Körperlichkeit von Pinas Tänzern gibt es nur im Raum, die gibt es nicht als Abbild, nicht als Foto, nicht als Film" (The corporeality of Pina's dancers exists only in space. It does not exist as a representation, nor as a photo nor as a film. [*Translation by the author.*]) (Wenders 2011a: 25). (104)

Despite Wenders's strong claim here and his usual technological savvy, Flueckiger faults *Pina* for committing some "textbook errors" of the 3D medium. These include ghosting of images, a lack of background depth, strobing of fast motions, dwarfing and gigantism (distortions in size perception due to an unfavorable ratio of object and interaxial distance), and interferences in the depiction of reflections. Flueckiger argues that some of these limitations can be addressed by the film director and are not inherent in the 3D medium. Further, the problems listed here all involve live action films and would not arise for computer animated films.

The major aesthetic impact of 3D films involves techniques film directors have evolved to use and depict depth. A variety of factors affect the observer's perception of the placement of objects as existing in space either behind, on, or in front of the screen. These variations are due to various kinds of parallax. With negative parallax objects appear in front of the screen; positive seems to place them behind the screen because "the corresponding points' position on the screen are placed with a difference such that the lines of sight meet behind the screen thus generating the in-screen effect." And finally, with zero screen parallax

objects appear to be positioned on the screen plane (103). But such techniques are not always salutary. Films shot entirely in deep focus can produce a sterile and cardboard effect: “A specific form of flattening occurs in wide shots of open landscapes when the background looks like a matte painting” (111). A 3D film can create vision problems, including distorted spatial perception or headaches, if viewers are asked to converge both on foreground and background features of a scene. Again, such problems can be overcome if directors make particular choices about, say, the angle of vision. And she also explains that some movies like *Avatar* work around this problem by the use of fog or haze in the background.

Some choices of techniques that have become standard in 2D films will not work as well or in the same way in 3D. An example is certain shifts in depth of field (“rack focus”) to direct the viewer’s attention from a foreground element to a background one, or vice versa. Flueckiger notes that in 3D these shifts can be more uncomfortable or difficult because a blurry foreground appears very unnatural, “because then we tend to converge at these objects” (113). Still, the standard rules can be broken for certain aesthetic effects; she says this was done deliberately by James Cameron in *Avatar*.

In his interview with Ray Zone (2005: 144), James Cameron talks about how he established a set of rules by analyzing stereoscopic movies, but then decided to break these rules to broaden his cinematic vocabulary. Even if, on inspection, certain shots in *Avatar* obviously violate some common rules, the unquestionably positive impact of this film’s handling of stereoscopy by far exceeds the negatives mentioned here. Surely the most important asset of *Avatar* for its successful exploitation of stereoscopy lies in the dense and marvelous environment of Pandora whereby the stereoscopic rendition greatly enhanced the viewer’s sense of presence in the fantastic world. (115)

A final aesthetic issue that is crucial for 3D films involves treatment of edges or “windows” of the cinematic frame, including features that may not be seen by both eyes, or the treatment of objects that extend beyond the frame. This is related to the representation of motion which can occur in a variety of ways. Flueckiger comments,

In S3D in general, the viewers’ perception of the cinematic space is highly changed by movements, either movements in the diegetic space or camera movements and also movements from shot to shot through montage. In addition to stereopsis, motion parallax is the most important depth cue. If both are present as in stereoscopic cinema, they enhance each other, sometimes even to the point where they exceed the viewers’ capability to process the overwhelming wealth of stimuli. (118)

Lateral movements can create strobing artifacts, whereas pull-backs can create pop-ups. The most effective movements appear to be forward movements, which are “best suited to creating a strong kinesthetic effect by taking full advantage of heightened depth cues in S3D. They are a key factor in delivering a pleasing and gripping cinema experience with stereoscopic formats...” (118-119). Such movements might be illustrated by some of the scenes in *Avatar* that show the hero and heroine flying on the backs of the planet’s large bird-like creatures.

In her summary, Flueckiger describes two opposed approaches or attitudes toward stereo films: one claiming that S3D should not apply gimmicks but should first and foremost serve the story, the other claiming that S3D should enhance the viewers’ experience in the cinema, sometimes even to the point of becoming an end in itself. She thinks another option is to “add ironic distance to this exposition of style, especially in the moments of greatest tension” as illustrated in *Dial M for Murder*, “in which the scissors in Grace Kelly’s hand extend far into the theater.” (119-120) As to the big question of whether stereoscopic cinema has a future, Flueckiger’s answer is yes, but only within a somewhat limited range of genres. “With regard to the future development of S3D we can assume that stereoscopic cinema will survive in some genres, especially computer-animation and action-adventure including immersive science fiction movies and other body genres such as porn films.” (120)

(4) The vexed issue of realism

For many viewers as well as critics, the special appeal of 3D seems to reside in its alleged superior realism in comparison to 2D films. For example, in his book *3D Movie Making*, Bernard Mendiburu writes,

Because 3D is our natural way of seeing, it brings a feeling of realism to the audience. With 3D, we no longer have to rebuild the volume of objects in the scene we are looking at, because we get them directly from our visual system. *By reducing the effort involved in the suspension of disbelief, we significantly increase the immersion experience.* (Mendiburu, 3, emphasis in original)

But there are others for whom the case *against* 3D is equally clear. I turn again to Roger Ebert.

There is a mistaken belief that 3-D is “realistic.” Not at all. In real life we perceive in three dimensions, yes, but we do not perceive parts of our vision dislodging themselves from the rest and leaping at us. Nor do such things, such as arrows, cannonballs or fists, move so slowly that we can perceive them actually in motion. If a cannonball approached that slowly, it would be rolling on the ground.¹²

These kinds of comparison, invidious or not, should give us pause as philosophers. Realism in discussions of art and film can denote a number of different things. Just to mention a few likely candidates, it could be about creating an illusion of three-dimensionality on a flat surface. It could be about re-creating our usual modes of seeing within the restricted context of a museum or theater. Finally, in discussions of 3D among filmmakers, as well as video game designers and consumers, realism often seems to be equated with an experience of lively reality that is generally labeled “immersiveness.” I will examine each of these proposals in turn.

Seeing Three-Dimensionality on a Flat Screen

Some of the ongoing debates about realism in 3D film echo similar debates concerning non-moving pictures. But philosophical and art historical treatments of realism in painting, for example, cover a lot of ground with a lengthy, complex history. An art historian like Ernst Gombrich argues that increasing standards of realism in western art history reflected both natural ways of seeing and improved conventions that painters both acquire and improve upon in their experiments with depicting a three-dimensional world on a two-dimensional surface. In contrast there are extreme positions such as that of Nelson Goodman in *Languages of Art* to the effect that realism in art is entirely a matter of familiarity with relevant conventions, involving no element of visual resemblance to the real world. The consensus now is largely against Goodman, and points about the similarity between natural or real-world seeing and cinematic seeing (my next topic) tend to weigh against his extreme conventionalism.¹³ But this does not mean that realism has any accepted definition or standard explanation.

It is something of a side issue but one I find intriguing to note that some vision scientists, notably Margaret Livingstone, have proposed that artists with vision problems like mine, with impaired stereoscopic vision, have an inherent advantage in their fundamental task precisely because of how they “naturally” see the world (presumably, as somehow more ‘flat’ than those with normal binocular vision). Such a proposal has been advanced in particular concerning Rembrandt. Livingstone diagnoses the artist with strabismus based on an analysis of how his eyes appear (exotropic) in a number of self-portraits. Her medical

journal article was given popular coverage in articles with headlines such as “Did Walleye Make Rembrandt a Master?” or “Imperfect sight helped Rembrandt’s art” (BBC News). The implication is that Rembrandt’s visual handicap furthered his art by making it somehow easier to transform contents of normal visual experience into the two dimensional planar space of a canvas.

An article entitled “Was Rembrandt stereoblind?,” outlining research by Professor Margaret Livingstone and colleagues, was published in the September 14, 2004, issue of *New England Journal of Medicine*. After studying 36 of Rembrandt’s self-portraits, and noting that the left eye showed exotropia in all but one of them, researchers concluded that this may have contributed to his ability to translate a 3-dimensional world to a 2-dimensional canvas.¹⁴

Livingstone explains why in the artist’s case this visual handicap may have been an asset. “When you learn how to draw, you have to learn how to flatten the world onto a canvas,” Livingstone said. “That’s a skill, and it’s easier if you have poor stereo vision.”¹⁵

One wonders about how much depth artists can ever achieve and how much is optimal. In some cases it seems that depth in visual art is a goal in its own right—as, for example, in trompe l’oeil paintings—yet such work does not necessarily garner great respect among art audiences but is regarded as more of a clever trick. In addition, it is obvious that we can appreciate art from periods or cultures that do not share or had not yet developed skills at illusionistic 3D rendering of reality.

Cinematic seeing and “normal” seeing

Taking a different approach to the question of how to construe realism, some discussions of cinema have focused on whether, and to what extent, cinematic seeing is the same as, or at least quite similar to, real-life seeing. The debates on this issue go back to some of the earliest practitioners and theorists of the medium. An issue often considered is whether, for example, we perceive things like recognizable objects or action sequences in the same way both on screen and in real life. As Stephen Prince outlines, Gregory Currie has proposed a sensible, naturalistic-based account in his book *Image and Mind*. Prince explains:

Currie argues—correctly, I believe—that viewers understand the depictive content of cinematic images by using their visual capacities for object recognition. Employed routinely in the real world, these are reliably transferable to photographic images. Thus, seeing a horse on screen is a matter not of illusion, but of recognizing the

familiar pictured object. Currie is right to stress this characteristic because film theory has grossly underestimated the power and appeal of cinema's recognition-based mode of visual communication. In this area Currie locates the medium's realist basis: it replicates on screen the same kind of spatial information about a three-dimensional world that a viewer encounters, and proficiently interprets, outside the theater.

A more nuanced account of the medium's perceptually based realist components would situate these alongside the medium's transformational abilities. A comprehensive account of cinema should recognize both. (Prince 1997)

The "transformative abilities" of cinema might include features such as focus shifts, editing strategies, and so on. For example, psychologist Tim Smith has argued that the fundamental principles of continuity editing in cinema derive from psychological facts or givens about the cueing of visual attention in everyday life. Smith presented the results of complex eye-tracking studies, along with his own "attentional theory of cinematic continuity" in a symposium in the Summer 2012 issue of *Projections*.¹⁶ This issue also contained comments from six other film scholars, including myself. My criticism mentioned what I take to be a very significant difference between real world and cinematic seeing: the former is typically action-directed.¹⁷ We are able to move our heads or turn our eyes in order to prepare to do things such as grasp a coffee mug or signal before changing lanes on the highway. For more information on this important distinction, and on the different neural correlates of the two vision systems, I pointed readers to Mohan Matthen's very useful 2005 book *Seeing, Doing, and Knowing*.

In another comment from the same *Projections* round-table, Malcolm Turvey offers a different criticism of Smith. Turvey notes that questions about the similarity between perception of a film and of reality "is one of the fundamental questions of film theory," but then he argues that it is also "one of the major dead ends of film theory."¹⁸

The same stylistic technique will be construed as like human vision by some theorists and unlike it by others depending on the feature of seeing being addressed.... The point here is not that comparing our perception of reality with film is necessarily mistaken. Rather, it is that both are complex phenomena with multiple features, some of which are alike in some ways, others of which are not. (55)

Cross-modal perception is another factor that influences real-world vision as well as cinematic seeing. In other words, we can experience various qualities of intensity or directed attention depending upon non-visual factors such as sound. It has also been shown

that visual images can evoke responses in other non-visual sensory areas of the brain, such as the tactile and kinesthetic. Realism in certain genres such as films and video games can involve techniques that “simulate optic flow” (Barry, 84), thus encouraging viewers to simulate certain types of motion seen on screen. There are even areas of the brain that can perform dual or multiple perceptual functions. Barry reports that “the responses of some neurons in the visual cortex are modulated by sounds” (163); citing four different studies from 2005-2008 (234). However, cross-modal perception can be a double-edged sword: it might engage us in a film world but also distract us from it. Barry, for example, notes that our emotional states can have a negative effect on the realism or three-dimensionality of seeing. Even after acquiring stereopsis, she sometimes reverted to her old ways of seeing under conditions of stress. Thus she remarks,

My experiences with vision therapy had already taught me that we can't understand vision without making connections between sight, spatial orientation, and movement. Now I discovered that we can't understand how we perceive the world without considering the whole person—the thinking, moving, feeling person. (156)

What we might best conclude concerning this second proposal about realism in cinematic seeing is that such seeing is both similar to and distinct from real life seeing. This point applies to 3D film seeing perhaps even more than to normal film viewing, since, as Flueckiger reminds us, there are a number of special challenges to vision that can arise during 3D films, including convergence problems or effects of the various kinds of screen parallax (103).

Immersiveness

Many discussions of 3D cinema highlight a feature often called “immersiveness” as its most special virtue and key to its realism. Just what this is, however, is hard to pin down. There are actual institutes devoted to what is called “immersive media” or “immersion studies.” These tend to involve elaborate camera set-ups and projection systems that go well beyond the technologies of stereoscopic cinema. An example is the Immersive Media group, a commercial enterprise based in Calgary, Alberta, Canada. It is described on its website as follows:

Immersive Media is the pioneer and leading world provider of 360°, full motion, interactive videos. What started with the popular “street views” found on leading search engines has become a phenomenon of advanced, experiential media.

The phenomenon described here involves examples like Google Earth maps, which most people are already familiar with. Such maps allow a viewer to select a location and then click so as to gain a photographic rendering which can then be rotated to see in context of its surroundings.

An example of an “immersive media studies” program is the ArtsLab at the University of New Mexico.¹⁹ This group has done a variety of experimental projects involving projection into unusual environments such as a dome. Their projects move well beyond what is now being done in 3D film, with an aim,

to make it possible to use fulldome and other multi-projector installations as interactive, multisurface environments that help people visualize, simulate, or experientially comprehend a wide range of information, from educational and artistic material to evaluating scientific data and complex systems. The goal of this research is to enable scientists, artists, performers, and educators to have an accessible and versatile means to make use of immersive systems. (Artslab New Mexico)

We might note that the key features both in this case and in that of Immersive Media is *interactivity*. This is a feature more characteristic, at present, of the video game 3D environment or of multi-user game systems than that of any cinema seen so far.²⁰

So what then *does* seem to be meant by proponents of 3D film who highlight its “immersiveness?” Among others, James Cameron has made such claims, as reported by writer Xan Brooks:

He shot large portions of *Avatar* on a “virtual camera,” a handheld monitor that allowed him to move through a 3D terrain, in effect editing this existing, computer-generated universe. The result, he boasts, turns cinema into “the ultimate immersive media.” If true, Cameron has hit upon the holy grail that has eluded film-makers for generations, fulfilling the quest to manufacture a truly visceral, immersive film-going experience. (Brooks 2009)

Notice that Brooks’s explanation links the immersiveness of 3D to its being “visceral.” This word choice provides an important clue. It does seem that 3D cinema can supply a stronger sense than 2D of the surrogate presence of an audience member’s own body within a depicted scene. Similar comments were made both by Ross discussing the kinesthetic effect of dance films in 3D and by Klinger talking about the haptic sense of the curved, rocky real surfaces provided by Herzog’s *Cave* film. I can attest to something similar from my own experience of the IMAX film *Tornado Alley*, where the dual effects of sound and vision

created a very involving and frightening feeling of the imminent arrival of a tornado: it literally gave me goose bumps. Again, the feeling of bodily presence within a scene can be greatly enhanced by certain choices of movement and flow depicted in movies like *Avatar*, with its numerous scenes of the hero becoming acquainted with his new body and environment on Pandora by running across tree roots, flying upon colorful bird-like creatures, or swooping like a monkey through trailing vines. Friends also raved to me about certain scenes in *Hugo* seen in 3D (I saw it only in 2D), such as a beautiful depiction of falling snow that appeared to drift down over Paris and right into the theater over the audience.²¹

Perhaps the best explication of this notion of immersiveness is by Miriam Ross in her essay on 3D dance films. She describes the medium's special strengths as follows:

... the curvature of the body and its intense movement through space interact with a moving-image format that dismisses the flat surface of the screen. The variety of spatial planes available in 3D cinema, along with the ability to position action in negative and positive parallax space, explode the determining plane of the fourth wall. (Ross 2011)

If well-used, 3D film can represent the actual flow of a dance, and the result looks different from the simple record of an actual performance in 3D.

On the other hand, surely audience engagement with a film neither requires nor is necessarily supplied by special 3D techniques. To become involved in a movie also requires that the film offers up old-fashioned values of character development and an intriguing story. Other traditional features beyond the visual are important as well, such as music and set and sound design. Immersion can happen when characters elicit sympathy or empathy, and an audience will hang on a story even in 2D if it supplies mystery, surprises, romantic obstacles, and so on. (Just look at the intensity of response to a film like *Titanic*—before its conversion to 3D!) Consider too that the beauty of costume and set design of films like *Avatar*, *Hugo*, and *Prometheus* is evident even in 2D still images. I myself only saw *Avatar* this summer on the small screen of an airplane on a trans-Atlantic flight, yet I was fascinated and delighted by the oceanic surrounds of the world of Pandora, replete with floating plant fronds and shimmering colorful creatures. And vice versa, as numerous commentators have said about *Prometheus*, the most well-developed and engaging set design in 3D can fail to satisfy when the plot is full of holes and the characters not well-developed and only present as fodder for routine and predictable scenes of alien extermination.

Conclusion

Is 3D the future of cinema? And if so, where does that leave people like me who are unable to perceive it or assess its putative superior realism? Not surprisingly, James Cameron has claimed that 3D will indeed be the future of cinema.

For his part, Cameron likens the new breed of 3D to the arrival of colour; a tidal wave that could not be ignored. He points out that in the first few years colour cinematography was the preserve of the largest, most expensive productions. Then, as the costs came down and the technology improved, it was rolled out to pretty much everything. The same, he claims, will be true of 3D. (Brooks, 2009)

One wonders if young people who grow up today with constant exposure to 3D animation films, including television versions, will become as unwilling to look at the older 2D movies (“flatties”) as many college students are today about viewing old films in black and white.

On the minus side, there are some (like Ebert) who still seem to regard 3D as a fad or gimmick, with significant limitations as a visual medium. And as Thompson has pointed out, many people dislike the cumbersome glasses required now to see 3D films in theaters; also, it is as yet unclear whether and how 3D movies will support transfer into the smaller-sized screens of iPads, smart phones, etc. Moreover, 3D cinema is limited in comparison to other kinds of visually stimulating presentation such as IMAX, holograms, 360 degree projection surfaces, and so on. If immersiveness is the goal, these other venues or technologies are superior and commercial entertainment products employing them might prove to supplant even 3D cinema.

My own experience of flashes of depth in watching 3D movies have led me to develop a greater interest in seeing more 3D films so as to investigate whether I might have the chance to have more of the mysteries of stereopsis revealed. It turns out that I am not a good candidate for the new vision therapy; circumstances about my own situation as a “rapid alternator” with strabismus make it more likely that I would end up with double vision than with the hoped-for goal of binocular vision, and this risk seems too great to take. If 3D films offer some opportunities for me to get even fleeting experiences of what the world looks like to people with “normal” vision, then I am eager to see more of them. But this does not mean that I will evaluate new movies primarily based on their visual effects. All of the old standards are still relevant, it seems to me: movie engagement is not just about seeing something “cool” or about spectacle, but about the traditional values of intriguing plot, fascinating characters, strong *mis-en-scène*, and good old-fashioned story-telling.²²

Bibliography

ArtsLab New Mexico. <http://artslab.unm.edu/research/pfi>.

Jennifer M. Barker. *The Tactile Eye: Touch and the Cinematic Experience* (Berkeley: University of California Press, 2009).

Susan Barry. *Fixing My Gaze: A Scientist's Journey into Seeing in Three Dimensions*. New York: Basic Books, 2009.

----- . Untitled (on seeing 3D movies). Sovoto: The Vision Advocacy Network. <http://www.sovoto.com/forum/topics/no-stereo-vision-but-i-can-see-the-3d-effect-in-3d-movies>. March 9, 2012 at 5:48pm.

Bruno G. Breitmeyer. *Blindspots: The Many Ways We Cannot See*. Oxford: Oxford University Press, 2010.

Xan Brooks. "Is James Cameron's 3D Movie *Avatar* the Shape of Cinema to Come?" in *The Guardian*, Aug 20 (2009), <http://www.guardian.co.uk/film/2009/aug/20/james-cameron-avatar-3d-film>.

Clyde DeSouza. "This is Not Your Grandfather's 3D." <http://realvision.ae/blog/2011/01/this-isnt-your-grandfathers-3d-a-response-to-the-murch-ebert-critique/>.

"Did Rembrandt Have Strabismus?" (no author listed). *Eyes Apart: Living with Strabismus*, <http://www.eyesapart.com/2005/09/14/rembrandt-strabismus/>. September 14, 2005.

Roger Ebert. "D-minus for 3-D." http://blogs.suntimes.com/ebert/2008/08/dminus_for_3d.html. August 16, 2008.

----- . "Why 3D Doesn't Work and Never Will. Case Closed." http://blogs.suntimes.com/ebert/2011/01/post_4.html. January 23, 2011.

Barbara Flueckiger, "Aesthetics of Stereoscopic Cinema." *Projections: The Journal for Movies and Mind* 2012 6:1 (Summer 2012): 101-122.

Cynthia Freeland. "Continuity, Narrative, and Cross-Modal Cuing of Attention." *Projections: The Journal for Movies and Mind* 6:1 (Summer 2012): 34-42.

Ernst Gombrich. *Art and Illusion: A Study in the Psychology of Pictorial Representation*. London: Phaidon 1960.

Nelson Goodman. *Languages of Art: An Approach to a Theory of Symbols*. Indianapolis: Bobbs-Merrill, 1968. 2nd ed. Indianapolis: Hackett, 1976.

Immersive Media. <http://www.imersa.org/sponsors/item/immersive-media>

Barbara Klinger. "Cave of Forgotten Dreams: Meditations on 3D." *Film Quarterly*, Vol. 65, No. 3 (Spring 2012), pp. 38-43. <http://dx.doi.org/10.1525/FQ.2012.65.3.38>

Margaret S. Livingstone, Ph.D. and Bevil R. Conway, Ph.D. "Was Rembrandt Stereoblind?" *New England Journal of Medicine* 2004; 351:1264-1265; September 16, 2004. <http://dx.doi.org/10.1056/NEJM200409163511224>

Tim Masters. "How the Arts World is Embracing 3D Cinema" in *BBC News*, 31 March (2011). <http://www.bbc.co.uk/news/entertainment-arts-12891882>.

Mohan Matthen. *Seeing, Doing, and Knowing: A Philosophical Theory of Sense Perception*. Oxford: Oxford University Press, 2005.

Bernard Mendiburu. *3D Moviemaking. Stereoscopic Digital Cinema from Script to Screen*. Amsterdam et al: Focal Press, 2009.

William Paul, "Breaking the Fourth Wall: 'Belascoism', Modernism and a 3-D Kiss Me Kate" in *Film History*, 16 (2004): 229-242. <http://dx.doi.org/10.2979/FIL.2004.16.3.229>

----- "The Aesthetics of Emergence". *Film History*, 5:3: 321-355

Mark Prigg. "3D or Not 3D: *Avatar* and *Godfather* Directors Go to War over Technology" in *The Evening Standard*, May 13 (2010). <http://www.thisislondon.co.uk/standard/article-23833677-3d-or-not-3d-avatar-and-godfather-directors-go-to-war-over-technology.do>

Stephen Prince. Review of *Image and Mind: Film, Philosophy and Cognitive Science* by Gregory Currie. *Film Quarterly*, Vol. 51, No. 1 (Autumn, 1997), pp. 50-52. <http://dx.doi.org/10.1525/fq.1997.51.1.04a00130>

Miriam Ross. "Spectacular Dimensions: 3D Dance Films."

<http://sensesofcinema.com/2011/feature. December 19, 2011 articles/spectacular-dimensions-3d-dance-films/>.

Oliver Sacks. "Stereo Sue: Why Two Eyes are Better than One." *The New Yorker*. June 19, 2006.

Tim Smith. "The Attentional Theory of Cinematic Continuity." *Projections: The Journal for Movies and Mind* 6:1 (Summer 2012): 1-27.

Sovoto. The Vision Advocacy Network.

http://www.sovoto.com/?showAddContent=1&xg_source=msg_wel_network

Stereoscopic Media. stereoscopicmedia.org. Victoria University of Wellington, New Zealand.

"Strabismus," PubMedHealth, U.S. National Library of Medicine, (<http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001999/>), 2010.

Kristin Thompson and David Bordwell. "Has 3-D Already Failed?" *Observations on Film Art* (blog). <http://www.davidbordwell.net/blog/2009/08/28/has-3-d-already-failed/>. August 28, 2009.

-----, "Has 3-D Already Failed? The Sequel, Part One: RealDlighted (sic)."

<http://www.davidbordwell.net/blog/2011/01/20/has-3d-already-failed-the-sequel-part-one-realdlighted/>. January 20, 2011

Malcom Turvey. "The Continuity of Narrative Comprehension." *Projections: The Journal for Movies and Mind* 6:1 (Summer 2012): 49-56.

Ray Zone. *Stereoscopic Cinema and the Origins of 3-D Film, 1838-1952*. Lexington: University Press of Kentucky, 2007.

<http://dx.doi.org/10.5810/kentucky/9780813124612.001.0001>

Filmography

James Cameron. *Avatar*. USA, 2009.

Sean Casey. *Tornado Alley 3D*. USA, 2011.

Werner Herzog. *The Cave of Forgotten Dreams*. Ireland, 2011.

Wim Wenders. *Pina*. Germany, 2011.

¹ Barry remarks that now the view is that patching “may have adverse effects on binocularity and stereovision”; Barry 2009, 149.

² Rogert Ebert, “Why 3D doesn’t work and never will. Case closed.” http://blogs.suntimes.com/ebert/2011/01/post_4.html.

³ Amblyopia is “a condition affecting about 2 percent – 4 percent of children and sometimes also called ‘lazy eye,’” <http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001999/>. See also Breitmeyer, p. 42.

⁴ Susan Barry, blog post on Sovoto: The Vision Advocacy Network, <http://www.sovoto.com/forum/topics/no-stereo-vision-but-i-can-see-the-3d-effect-in-3d-movies>, March 9, 2012 at 5:48 p.m.

⁵ Dr. Janice Wensveen, private communication, May 25, 2012.

⁶ Burton at least has since joined the 3D bandwagon.

⁷ Clyde DeSouza, <http://realvision.ae/blog/2011/01/this-isnt-your-grandfathers-3d-a-response-to-the-murch-ebert-critique/>.

⁸ From Dominick M. Maino, OD, MEd, FAAO, FCOVD-A . On Rogert Ebert’s blog, January 25, 2011 4:42 p.m.

⁹ Miriam Ross. “Spectacular Dimensions: 3D Dance Films.” <http://sensesofcinema.com/2011/feature.December.19.2011/articles/spectacular-dimensions-3d-dance-films/>.

¹⁰ Barbara Klinger. “Cave of Forgotten Dreams: Meditations on 3D.” *Film Quarterly*, Vol. 65, No. 3 (Spring 2012), pp. 38-43.

¹¹ See for example, Ben Sherriff, “BTF 3D Rigs and Aerial Photography on Herzog’s ‘Cave of Forgotten Dreams,’” <http://vimeo.com/23967658>.

¹² Ebert, “D-Minus for 3D.”

¹³ See for just one example John Hyman, *The Objective Eye: Color, Form, and Reality in the Theory of Art*. University of Chicago Press, 2006.

¹⁴ “Did Rembrandt Have Strabismus?” (no author listed). Eyes Apart: Living with Strabismus, <http://www.eyesapart.com/2005/09/14/rembrandt-strabismus/>. September 14, 2005.

¹⁵ Quoted in Randy Dotinga, “Did Walleye Make Rembrandt a Master?,” HealingWell.com <http://news.healingwell.com/index.php?p=news1&id=521230>. September 15, 2004.

¹⁶ Tim Smith, “The Attentional Theory of Cinematic Continuity,” *Projections: The Journal for Movies and Mind* 6:1 (Summer 2012): 1-27.

¹⁷ Cynthia Freeland, “Continuity, Narrative, and Cross-Modal Cuing of Attention.” *Projections: The Journal for Movies and Mind* 6:1 (Summer 2012): 34-42.

¹⁸ Malcolm Turvey, “The Continuity of Narrative Comprehension.” *Projections: The Journal for Movies and Mind* 6:1 (Summer 2012): 49-56.

¹⁹ I am grateful to Allison Hagerman for alerting me to this interesting institution.

²⁰ See for example jeeopen.org, a multi-user Swedish role-playing game (thanks to Eva Dadlez for this example).

²¹ Thanks to Joellen Jacobs for the example. Interestingly, Barry cites a vision of falling snow as one of the remarkable examples of perceiving stereoptically after her vision therapy succeeded.

²² I am grateful to Mary Ann Natunewicz, Luis Rocha Antunes, and William P. Seeley for comments on an earlier draft, and to the audience of the Rocky Mountain Society for Aesthetics for suggestions and questions on the version given there as a lecture in July 2012.