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Introduction: Stereoscopic Illusions

Maurice Merleau Ponty has said that 'to see is to have at a distance' (1964: 166). Vivian Sobchack quotes this in order to make the point that to hear, by contrast, is to be enveloped and surrounded (2012: 30). Although Sobchack frequently discusses audio-visual media that conflate this distinction between the senses (1992, 2004), long-standing artistic practices and theories posit sight as the colder, yet more intellectually engaged, disembodied receiver of phenomena. Consequently, artistic works, particularly those created in the Western world over the last few hundred years, are often constructed to maintain this division (Crary, 1992; Marks, 2000). What, then, of optical illusions that rely on a sense of proximity in order to function? In particular, I am interested in stereoscopy as a mode of visioning that has an almost 200-year history based upon deceiving the eyes' understanding of distance, depth and solidity.[1] While stereoscopic images, be they from the stereoscope, cinema screen, television set or computer monitor, do not fully envelop or surround their viewer, by no means are they at a distance in the same way that flat (2D) images are. I do not use the term 'flat' to suggest that these latter images are without significant depth cues (perspective, shading, motion parallax), but they do perceptively operate on a planar surface. They do not contain the negative parallax (in the auditorium) and positive parallax (receding depth) qualities unique to stereoscopic imagery, which can only be realised when binocular vision is activated. I shall return to these technical considerations shortly, but, needless to say, stereoscopic images disturb the traditional concept of disembodied vision.[2] They present optical illusions in which objects

are frequently extremely close but simultaneously not quite there, forcing into play an embodied engagement with a thick, tactile visual field. Although one could argue that stereoscopic moving images do no more than replicate our natural viewing process whereby sight displaces objects, the illusion at the heart of stereoscopy makes seemingly stable boundaries permeable and the stability of the self in distinct space is diminished, far more so than the radical reconfigurations of the self in space that occur during edited sequences in flat moving images. When dust motes in *Hugo* (2011) appear to gently swarm around the auditorium and when luminescent seeds in *Avatar* (2009) seem to be within touching distance of one's fingertips, the body is positioned in a sensory arena that is material and immaterial at the same time.

The mechanisms for producing stereoscopic imaging have been in place since the late 1830s, and, while under-studied, their effects on audiences should not be underestimated. There have been a number of landmark moments that offer new technological manifestations but nonetheless retain the same aim of displaying binocular depth. Stereoscopy was first showcased in 1838 when Sir Charles Wheatstone presented hand-drawn images in a reflecting stereoscope in order to demonstrate his theories of binocular vision (Darrah, 1977; Schiavo, 2003; Zone, 2007; Pietrobruno, 2011). His device was able to combine two separate images into a single, depth-rich view and was later updated to display stereoscopic photography, particularly when commercialised by Sir David Brewster's lenticular stereoscope in the 1850s. The stereoscope then moved from a parlour object to a mobile imaging device when Oliver Wendell Holmes modified Brewster's box-type stereoscope into a hand-held version, which (unpatented) became especially successful in the US. At the height of its success, stereoscopic photography was more common in the home than flat photography, and millions of stereographic images were produced worldwide throughout the nineteenth and twentieth centuries (Fowles, 1994; Babbits, 2004). From its early days there was interest in producing stereoscopic moving images: experiments in the mid- to late nineteenth century led inventors such as Antoine Claudet, Jules Duboscq, William Thomas Shaw, Henry Cook, Gaetano Bonelli, and Emile Reynaud to work on stereo-versions of moving-image devices such as the Phenakistoscope and Magic Lantern Slides (Zone, 2007). While many of their attempts to animate photographic

images stereoscopically were unsuccessful, large numbers of patents were filed and there was a clear desire to match the visual potential of the stereoscope with early cinema (Kerbel, 1980; Mannoni, 2000; Lumière, 2011).

The development of anaglyph systems, whereby two images produced in different colours (most often red and cyan) are filtered through coloured lenses, made possible displays of stereoscopic visuality in cinema's first decades. Although critics have suggested that an anaglyph version of the Lumières' *L'arrivée d'un train en gare de La Ciotat* (1895) was shown around 1903, the stereoscopic version was not screened until the 1930s (Sammons, 1992; Lumière, 2011). Nonetheless, various experiments took place, leading to Edwin S. Porter's presentation of anaglyph moving images in New York on 10 June 1915 (Denig, 1915) and further demonstrations that cumulated in the first feature in 1922, *The Power of Love* (The Billboard, 1922). A significant change to display options occurred in the 1930s when Edwin Land's polarisation system was used to present different images for each eye without the need for colour filters (McElheny, 1998), a system that is still used in many contemporary 3D television and cinema screens today.

Stereoscopy's appearance in US movie-theatres drew vast public attention, particularly the short-lived but commercially lucrative period in the US between 1952 and 1954 that introduced box-office successes such as *Bwana Devil* (1952) and *House of Wax* (1953); the unexpected success of soft-core features in the 1960s and 70s such as *The Stewardesses* (1969); the revival of the format in the 1980s with high-profile releases such as *Comin' at Ya!* (1981), *Jaws 3-D* (1983), and *Amityville 3-D* (1983); and its return to cinema in the digital era with record-breaking films such as *Avatar* (2009) and *The Avengers* (2012) that have been released concurrently with a new emphasis on 3D television and gaming (Hayes, 1989; Mitchell, 2004; Zone, 2007, 2012). Although US 3D cinema box office success has led many to presume that 3D cinema's major developments have occurred in the North American market, innovation and technical breakthroughs have occurred in a number of global locations. Examples include the production of polarised 3D shorts in 1930s Germany, including Nazi propaganda footage of the 1936 Olympiad; Russian filmmaker Semyon Ivanov's development of an autostereoscopic (glasses-free) system in the 1940s; the London exhibition of Canadian and British

short films at the Telecinema event in London in 1951; Italy's 3D feature film production in the 1950s; and the transnational effort to revitalise 3D in 1981 when a Spanish, German, and Italian crew produced *Comin' at Ya!* (1981) (Hayes, 1989; Zone, 2007; Gurevitch and Ross, 2013).

Throughout its history, stereoscopic imaging has attracted many hyperbolic claims, such as Oliver Wendell Holmes' decree in the 1850s that by viewing the stereoscope

> the mind feels its way into the very depths of the picture. The scraggy branches of a tree in the foreground run out at us as if they would scratch our eyes out. The elbow of a figure stands forth so as to make us almost uncomfortable. Then there is such a frightful amount of detail, that we have the same sense of infinite complexity which Nature gives us. (1859)

In 1949, Sergei Eisenstein claimed 'to doubt that tomorrow belongs to stereocinema is just as naïve as it is to doubt the very coming of tomorrow!' (Eisenstein, 2013: 20). More recently, in 2012, James Cameron stated that 'it's absolutely inevitable that eventually, all or at least most of our entertainment will be in 3D' (Ho, 2012). Equally, stereoscopy has provoked numerous critiques, such as nineteenth-century concerns with the proliferation of pornography in stereoscopic images (Colligan, 2008) and twenty-first-century reactions against increased prices for 3D content and loss of light levels due to polarised glasses (Ebert, 2010). With cinema in particular, stereoscopy has often divided critics into two factions. One camp proposes that its potential has never been fully realised and that we are still in the nascent stages of a technological breakthrough that will eventually reach maturation and surpass the flat format, in the same way that black and white surpassed colour and synchronised sound surpassed 'silent' cinema. The other camp suggests that 3D cinema can never be more than a passing fad and, by insinuation, suggests that it is somehow not true cinema. This study is not concerned with trying to rescue stereoscopy from its naysayers or uncover its shortfalls. Rather, I am interested in the way that stereoscopy, in its various historical manifestations, operates as a visual format that has its own governing principle and is distinct from other visual processes.

The most dynamic and readily discernible qualities unique to stereoscopic moving images are the use of negative parallax (in the auditorium) and positive parallax (receding depth) space.[3] In the former, there is the sense that images are placed somewhere between the screen and the place where the viewer is located. Use of negative parallax space provokes the greatest interest in popular discussion of 3D cinema and is mythologised through the many accounts of viewers seeing objects (spears, arrows, cannon balls) fly directly at them. Use of positive parallax space, which displays objects existing in deep space, behind the plane where the screen rests, is often less easy to discern as it offers a heightened presentation of the three-dimensional depth effects apparent in flat cinema. Nonetheless, it has the ability to draw attention to depth construction in a way that is not available elsewhere. It is also able to intensify sensory perception of depth so that views into deep caverns or from the top of large buildings produce increased sensations of vertigo and unsteadiness. Flat images, although able to simulate some of these effects, always operate at zero parallax (where objects appear to reside on the screen's plane) and in this way seem more noticeably fixed and stable, with clearly defined borders.

Although the extent to which objects appear in negative or positive parallax space depends on where the viewer is seated in front of the screen (effects are often stronger when the viewer is seated further back and may be distorted if they are too far to the side), most viewers with binocular vision will be able to discern the way in which objects in negative parallax space appear in what is traditionally the auditorium's space.[4] Similarly, although there have been different technologies for producing stereoscopic moving images in place for over 100 years, each of these projects objects in positive and negative parallax space. As mentioned, anaglyph systems were used for initial experiments, and they were often brought back throughout the twentieth century for theatrical, television and video screenings. At times dual-strip polarised technologies, which needed two separate projectors, were implemented, while at other times a single-strip technology was used that could place the different images for each eye above and below or side by side on the same reel. There have also been numerous experiments with autostereoscopic (glasses-free) options and shutter systems whereby the lenses of the glasses are actively shuttered intermittently in order to let

in different images. Even today, with standardised digital packages in place, there are various display systems, including polarisation (IMAX's linear polarisation and RealD's circular polarisation), Dolby's dichroic filter wavelength system, active shutter glasses, and glasses-free technology. These technological differences have an effect on the way in which objects in negative and positive parallax space are experienced and, in doing so, interact with the subjective viewing experience of the viewer, so that no two viewing experiences are alike. However, negative and positive parallax space is never completely diminished, and the above-mentioned variables do not prevent stereoscopy's potential for creating distinct moving-image types that encourage viewing relationships between audience and film that could not otherwise be realised.

While the use of negative and positive parallax space creates distinct effects, I do not wish to suggest that stereoscopy itself is merely an effect that is added to a pre-existing set of moving images. Rather, in line with Thomas Elsaesser's thoughts on this matter, stereoscopy offers a unique type of visuality, 'a different kind of mental image (or "crystal image," to use Giles Deleuze's terminology)' (Elsaesser, 2013: 218). Following on from William Paul's (1993) work on 3D cinema's *aesthetics of emergence*, this study recognises the distinct visual illusions created in 3D moving images and examines how they operate in multifaceted ways.

Although cognisant of the history of stereoscopic imaging across different media, this study is primarily concerned with cinema. On the one hand, this is a matter of focus, due to the impossibility of covering the rich history of stereoscopy in one book. On the other hand, it is also a matter of interest in the way stereoscopy intersects with cinema in specific ways. As Cubitt (2004) notes, cinema has always relied on its illusion for a sense of presence, and this has particular implications for the way stereoscopy is developed. In a manner distinct from other forms of cinema, 3D cinema's sense of presence is acutely called into question at the same time as it is activated, due to the fragility of its illusion of depth. Whenever an object appears to exist in the auditorium space in front of the viewer, a swipe of the hand makes it clear that it is not really there. Similarly, when objects exit the borders of the screen space, their seeming solidity frequently disintegrates. In order to fully develop the implications

that this false yet simultaneously tangible sense of presence has for our relationship with screen content, it is important to pay attention to the way audiences accept films as living bodies that are both optical illusions and representations of a reality manifested by the film. In order to do so, I will be taking into account Vivian Sobchack's call to understand 'cinema as life expressing life, as experience expressing experience' (1992: 5). By considering the expressive qualities of cinema and grounding them within the particular depth illusions of stereoscopic imaging, I hope to be able to demonstrate 3D cinema's unique qualities while also drawing attention to the contingent relationship between viewer and film necessary for the film's expression to be developed and received. As such, I will be exploring the way in which stereoscopic films display extensive depth markers in a way that allows the mutual '*perception of expression* and the *expression of perception*' that viewer and film participate in (Sobchack, 1992: 5).[5] Rather than directly replicating 'realworld' visual processes, stereoscopic depth techniques allow films to mutually perceive and express complex visual fields while delivering audiences a sense of their illusion as well as a tangible experience in which they can invest.

In one of the first scholarly articles to address 3D cinema's unique potential, Michael Kerbel noted in 1980 that 'images in depth raise questions about realism vs. expressionism, mise en scene vs. montage, and the audience's relationship to the screen – in short about the very nature of the film medium' (12). The presentation of a number of twentieth-century 3D films at the World 3-D Expo in Los Angeles in 2003 allowed scholars to examine, once more, the unique way in which stereoscopic moving images operate, including notable articles from William Paul (2004) and Sheldon Hall (2004). With the resurgence of 3D cinema following the release of *The Polar Express* (2004) and *Chicken Little* (2005), there has been renewed critical attention to 3D cinema,[6] but fundamental questions remain to be asked about the way stereoscopy operates as an imaging format with its own unique visual regime.[7] This study aims to answer three major questions in this respect: where is the film in stereoscopy's optical illusion; where is the viewer's body; and how do these factors come into play in the development of experimental and conservative modes of imaging in 3D cinema?

Where is the film in stereoscopy's optical illusion?

Stereoscopic cinema's optical illusions ask us to consider the screen and, most importantly, whether that screen is there at all. By implication, we can then ask: where is the film? The screen as surface for reflecting the light that constitutes the film's visual illusion may continue to exist, and its borders are clearly in sight, but the use of negative and positive parallax space to explode any singular plane of action destabilises the place of the film. One of the difficulties in understanding how the film is constituted in this space is that the primacy of the screen is rarely left behind in discussion of stereoscopy.

Most often, we are accustomed to describing use of negative parallax space as a process whereby objects 'pop out' or emerge into the auditorium. This, in turn, posits the question: out from where? Is there a prior place where the film resides? Is there still an imagined screen which objects are on, in front of or behind? As posters for *House of Wax* (1953) advertised, action 'comes off the screen right at you.' Scholarship in this field has thus far presented similar terminology, such as 'off-the-screen-effects/shots' (Hayes, 1989), objects that 'thrust their way off the screen' (Johnston, 2008), 'pop out of the screen' (Paul, 1993), and 'pierce the screen' (Higgins, 2012), all of which suggests that the screen remains. This aspect is well known to stereographers, who calculate and configure their cinematography on the basis of a screen plane (Lipton, 1982; Devernay and Beardsley, 2010). Yet where does this leave the immersive viewing experience, in which the fourth wall is supposedly dismantled and the screen eliminated (Mizuta Lippit, 1999)? Stereoscopy's optical illusions suggest that objects operate in a shared auditorium space with the viewer and are no longer confined to one plane, but we remain aware of the physical material, which, in the case of theatrical screenings, reflects, or, in the case of home viewing screens, projects the film's substance. Regardless of the difficulty of constituting the way in which stereoscopic screen space is constructed, it becomes clear that the film has more permeable boundaries than those that exist in flat cinema. In this way, stereoscopic images expand Giuliana Bruno's notion of the 'field screen,' a 'habitable geographic space' that extends tactile viewing and incorporates the embodied participation of the viewer (2002: 250).

Where is the viewer's body?

In this field screen, there is no longer a viewing body opposite a flat film but a shared screen space in which action is discernibly close but always in danger of disintegrating under one's touch. Operating broadly under the umbrella of film phenomenology, a number of scholars in recent years, particularly Vivian Sobchack (1992), Steven Shaviro (1993), Laura U. Marks (2000), Jennifer M. Barker (2009), Thomas Elsaesser and Malte Hagener (2010), have paid attention to the way flat cinema is able to produce embodied, tactile relationships between viewer and film that incorporate and make use of all the senses. They examine the affective modes that films use in order to elicit bodily reactions and demonstrate how cinema produces moments that defy narrative comprehension and explanation.

This study will refer to and expand the work conducted by film phenomenology, with particular emphasis on the way stereoscopy has unique modes for incorporating the embodied and synesthetic nature of perception, so that both film and viewer are physically present in the production of meaning. In the context of 3D cinema, close analysis is used to understand how stereoscopic optical illusions rearrange and decentre audience positions as viewers engage with the film and its various depth planes. It will involve examination of the way sensory engagement is heightened through the use of positive and negative parallax space while also paying attention to the way stereoscopy encourages specific viewing relationships.

How do these factors come into play in the development of experimental and conservative modes of imaging in 3D cinema?

Particularly important to this study is the work of scholars such as Steven Shaviro (1993), Laura U. Marks (2000), and Jennifer M. Barker (2009), who recognise that some forms of cinema are more inclined to invite bodily engagement than others. Many of the narrative-based cinemas that provide the foundations for 3D cinema emphasise a distance-based contemplation of film content and in this way prioritise ocular viewing processes (Gunning 1995a; Marks 2000). Because I see a latent potential for 3D cinema to introduce affective modes and tactile engagement that destabilise the traditional

primacy of ocular vision, I am chiefly interested in examining the way in which some films do this, while others do not. For this reason, I will examine how 3D cinema's affective modes, on the one hand, have incorporated a unique register based in new visuality, embodiment and the spectacular and, on the other hand, have attempted to enhance a more traditional audio-visual register based in mimesis, wholeness, and realism.

To address these questions, I have chosen to undertake close analysis of two films in each chapter so that I can tease out reoccurring trends and divergent practice. The use of only two films allows more substantial analysis than a broad survey of 3D films, but it does mean that many films that I would like to have written about in more detail have not been included. In recent years there have been a number of 3D films that have been considered ground-breaking in their use of stereoscopic technology, such as *The Hobbit Trilogy* (2012–2014) and *Gravity* (2013), or exceptional in their visual exploration of stereoscopic fields, such as *Dredd* (2012) and *Coraline* (2009). While these films are as worthy of inclusion as the films that I have written about, for various reasons they have not been the most suitable films to use in order to address the central concerns of each chapter. Similarly, although this book has attempted to provide a range of historical contexts, older films have often been selected because of practical concerns, mainly that they are available on Blu-ray for repeat viewing. I hope, then, that it becomes obvious that the films chosen do not attempt to present a canon of 3D cinema but, instead, provide telling examples of the different ways in which stereoscopic visuality functions. In this way, each chapter postulates pathways for thinking about the ways in which 3D cinema operates, so that future analysis of a wider range of stereoscopic films can take place.

The first chapter, 'Hyper-haptic Visuality,' provides the framework for understanding 3D cinema's affective visual modes. It is concerned with the potential for embodied and tactile engagement in the spectatorship of 3D cinema. Taking forward Laura U. Marks' (2000) account of intercultural cinema that invites haptic and sensory viewing relationships between audience and film, this chapter demonstrates how 3D films' stereoscopic affect moves the haptic quality found in many flat moving images into a realm of hyper-haptic visuality. The distinct optical illusions created by use of negative and positive parallax space provide qualities of to-be-touchedness that

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Note: Locators followed by the letter 'n' refer to notes.