STEREOSCOPIC THEATRE: THE IMPACT OF GESTALT PERCEPTUAL ORGANIZATION IN THE STEREOSCOPIC THEATRE ENVIRONMENT

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Abstract

This paper argues that it is essential for live theatre that incorporates stereoscopic imagery to reconceptualise the performance space to facilitate a successful audience experience. While 3D technology greatly increases artistic possibilities, the risks of perceptual confusion exist in live theatre just as in stereoscopic cinema, indeed more so given the co-existence of live performers. This paper argues that Gestalt perceptual organization theory can be valuable in informing how best to employ stereoscopic imagery within a live theater environment, with reference to the artistic works of one of the authors.

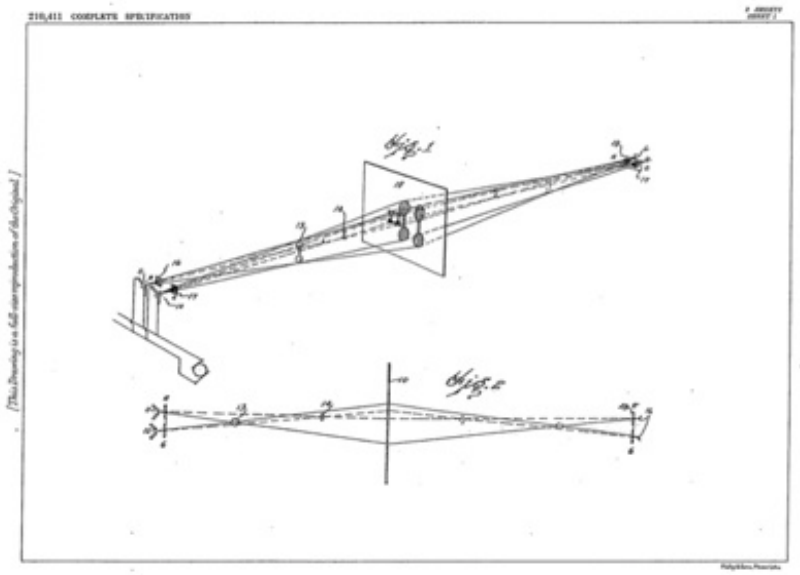
Keywords

3D, stereography, dance technology, digital scenography, choreography, multi-media dance.

Introduction

It is the impressive amount of detail within the stereoscopic image that gives the three dimensional (3D) phenomenon its impact. The stereoscopic picture is perceived as real because the image has volume, depth and texture, and is placed within three-dimensional space. Although originally developed for still pictures, this visual effect has been used within the film industry since its inception. Early examples include the peep-shows of the late1800s and early 1900s. In the twenty-first century, stereoscopic imagery has come to the forefront with popular Hollywood films such as *Avatar*[1] and the *Great Gatsby*[2] and theatre based 3D film productions such as the English National Opera 3D live 3D broadcast of Donizetti's *Lucrezia Borgia* [3] and Wim Wenders' *Pina* [4]. Interestingly, 3D films are also presented with a traditional two-dimensional (2D) viewing option. At least at the present time, the stereoscopic image does not appeal to everyone. This may be a result of the 'visual stress and disorientation' experienced by some viewers [5]. Overcoming these discomforts is central to providing a broadly enjoyable experience for audiences of artistic works.

Fig.1 Hammond's system of stereoscopic shadowgraphs. Described is; no. 16 anaglyph lights, no. 13 & 14 performers, no. 10 screen, no. 18 the audience [6].



While cinema has been the primary focus of 3D attention, the use of the stereoscopic image within live theatre is a development that promises more than just visual effects or skillful lighting. Both authors have created live performances that integrate the stereoscopic illusion and live contemporary dance. This process has made us aware of the problems and possibilities of this unusual combination. This paper addresses these issues from the creative perspective of theatre-makers. We suggest that many of the issues that arise when creating and viewing stereoscopic theatre revolve around the audience's ability to comfortably perceive a theatrical scene that includes both the live body and stereoscopic image. Gestalt theories of visual perception are a practical way to understand the processes of stereoscopic theatre this is because they emphasise wholeness and perceptual cohesion.

In this paper we focus on creating a method to develop a comfortable and unified experience of stereoscopic imagery in live theatre for the audience. This is by no means the only approach that could be adopted. The reverse approach of emphasizing the disjuncture and perceptual alienation stereoscopic imagery can induce is also an artistically valid choice, and one adopted by many visual artists working with stereoscopic imagery. However, we feel that given the perceptual complexity of combining live performance with stereoscopic imagery, it is perhaps prudent to explore less deliberately disruptive territory first. In the case of combining stereoscopic imagery and live dance performance, our experience is that even work designed to be as perceptually cohesive as possible still generates significant challenges for audiences. In the use of stereoscopic imagery, even in the absence of live performance there is also the risk of visual fatigue which can induce asthenopic symptoms such as headaches, tiredness and visual discomfort, [7] and this also influences our choice to consider the potential benefits of creating a more cohesive perceptual experience.

Background

Fig. 2. Through proximity the animated figure and performer almost appear as one (© Megan Beckwith.)

Stereoscopic theatre is live performance that incorporates stereoscopic images as an integral part of the scenography. The theatre and stereographic combination creates a multi-layered performance experience that optically redefines theatre space. The stereographic technical system controls the horizontal separation of two video projection streams, each of which is visible only to the audience's right and left eye. The resulting effect "exists only to the observer" looking directly at the image or projection surface [8]. The stereographic process relies on the audience's ability to fuse the right and left eye images to form a 3D depth image.

The stereoscopic image is not a new phenomenon. It was developed in the 1830s by Charles Wheatstone and became an entertainment marvel of the time [9]. The stereoscopic images of the 1830s provided a novel approach to image creation for entertainment events, and were extremely popular. Initially, the imagery of the stereoscope was so innovative that the mechanism of the stereograph was often misunderstood. Oliver Wendell Holmes Senior wrote: "Many persons suppose that they are looking on miniatures of the objects represented, when they see them in the stereoscope. They will be surprised to be told that they see most objects as large as they appear in Nature"[10].

Stereoscopic images were described further by Holmes as "frightful" because they contained so much information. The images looked as if "they would scratch ones eyes out"[11]. Holmes was describing not only the detail contained within the imagery but also the emotional and visceral reaction to the 3D image that seemed hyper-real.

Stereoscopic theatre was pioneered in the 1920s. Laurens Hammond, who is commonly known for the Hammond organ, invented the Stereoscopic Shadow Scope for use in theatre in the 1920s [12]. The Shadow Scope was a lighting affect using the anaglyph stereoscopic method. Two colored lights in red and cyan were used to back light a scrim and the performers, placed between the lights and the scrim. The audience viewed the shadows of the performers with corresponding red and cyan glasses (See Fig. 1). This effect was picked up by Florenz Ziegfeld and was used extensively in the 1920s, particular within his 1927 review called Padlocks, where it was used in both dance numbers and comedy acts [13].

Fig. 3. The petals appear on different planes behind, in front and directly to either side of the performer, giving the illusion of the animation and performer within the same space. (© Megan Beckwith.)

Tricking the brain tricks the person

The stereo image provides the visual system with artificial, deliberately manipulated, depth information. While we are usually aware, from the context of attending a 3D event and from understanding that the image contains manipulated depth information, that the apparent and real location of a stereoscopic image do not match, this conscious knowledge is often not sufficient to override the physical sensations initiated by mismatching visual and kinaesthetic positional information. This is why an audience often physically responds to the stereoscopic imagery with reactions such as reaching and grasping, jumping and flinching, or with not so pleasant responses such as motion sickness and tiredness. Stereographic film-maker Clyde Dsouza understands these perceptual effects as potential means of enhancing the affective power of a story. "A stereoscopic (3SD) movie is such a realistic optical illusion that it even activates our reflexes, this is why we flinch or duck when we see something "flying" out of the screen in a 3D movie. We don't usually have the same reaction in a 2D movie. So the main question I have to ask is… If S3D is an illusion that fools our brains into believing that what we see on a screen is real, can we use Stereoscopic 3D movies to heighten our psyche…heighten our subconscious? If this is possible…we have then discovered a new purpose for delving into this new art of visual story-telling"[14].

In contemporary dance the stereoscopic illusion provides a potential means of

Fig. 4. The animated lines and the performer move in common fate (© Megan Beckwith.)

Fig. 5. The animated bubbles confuse the common fate. (© Megan Beckwith.)

Fig. 6. The colour of the costume and animation draw the two elements together. (© Megan Beckwith.)

creating or manipulating emotional elements of a work through its ability to create strong perceptual reactions. The stereo image is not simply a passive stage dressing or a virtual prop, but can be a potent means of enhancing emotional effects within the performance. The stereo image has the ability to add a new dimension to the performance experience which, in their potential to provoke strong visual/embodied sensations, are not unlike Holms' "Frightful images" from the 1830s where the images were perceived as almost assaulting the audience [15].

Cognitive loading and Perceptual Organization

The stereoscopic images viewed alone can cause visual fatigue due to the disjuncture created between the visual functions of accommodation and convergence [16]. Including the stereoscopic illusion within the live theatre experience adds to the visual cognitive processes required of a viewer. The brain is required to synthesize left and right eye images and coordinate this information with object depth information derived from the accommodation system. This creates a mismatch, since the objects are in focus at the screen plane but appear to be located either in front or behind the screen plane. This information must then be integrated with visual information regarding the positioning of real bodies. In the stereographic theatrical scene, actual and virtual objects must be blended into a single percept, even though depth cues arising from the different kinds of visual information do not match. Combining these elements into one theatrical scene creates an unusual perceptual load.

Given the inherent disjuctures between the spatial locations of real and projected objects in stereoscopic theatre, there is potential for scenes to appear complex and confusing. Finding ways to assist the perception of a single, unified scene rather than a visually incoherent one is therefore important in this kind of work. In our experience, the potential for visual chaos is never far away in stereoscopic theatre, and it is therefore important to provide cues that can enhance visual coherence. Gestalt theory, since it deals specifically with creating perceptual wholeness, seems a good method for understanding how to create a more cohesive experience for the audience. The following discussion concerns the ways in which we have been able to map Gestalt perceptual principles to the process of making different elements of stereoscopic theatre appear congruent rather than dissonant, despite the inherent tension involved in presenting two different kinds of depth information within the same theatrical scene.

Gestalt

Famously, the Gestalt theorist Kert Koffka wrote in 1935 "the whole differs from the sum of its parts"[17]. Koffka was expressing the difference between what we look at in a scene and what we focus on when viewing an object within that scene. The Gestalt theorists developed a series of laws to describe this phenomena and based these laws on the nature of the mind to perceive patterns. These laws revolve around the notions of proximity, similarity, continuity and closure. The Gestalt grouping rules reflect visual regularities in the world and these rules have currency in the 3D stereoscopic theatrical environment. These ideas can help to facilitate a more cohesive viewing experience for the audience within a stereoscopic dance environment.

The examples below are from the development of stereoscopic theatre in particular contemporary dance.

Proximity

Often, within a stereoscopic performance, the audience doesn't know what to look at. The stereo image and the performer appear as different entities and not a cohesive work. The audience will look from one to the other rather then viewing the two elements as a scene. The Gestalt law of proximity can assist in the drawing together of the elements of the real figure and the virtual image. This law looks to the proximity of objects or elements. If objects or elements are near to each other they tend to be seen as a unit or one thing [18]. Making the stereoscopic image appear close to the performer will invariably draw the two different parts together. The dance work Bug [19] explores the idea of the post human through xeno – technology where the dancer becomes a Kafkaesque, part human, part insect monster, (see Fig. 2). It is through the use of proximity that the 3D animated image and the performer almost appear as one, chimera like.

Fig. 7. The dancer is placed within the animated scene to finish the line of good continuation. (© Artist Copyright Holder. Photo © Photographer.)

Common Region

Common region is a principle of perceptual grouping described by Stephen Palmer in 1992. Palmer's ideas on groupings take into consideration depth perception, the planes the objects appear to be on, and occlusion of objects. This principle takes into consideration 3D environments [20]. Getting the performer to appear to be on the same plane as the stereo object is difficult, because the dancer's real body becomes a depth cue within the space and the stereoscopic illusion can be lost. When the stereoscopic image occludes the performer the stereoscopic illusion is destroyed as the image rolls across the un-polarized body. This is not unlike a window violation but is referred to as a choreographic violation.

This problem of the depth cue and occlusion can be minimized when using animated particles. For example, in Fig. 3 the petals appear on different planes behind, in front and directly to either side of the performer. This gives the illusion of the performer existing within the same space as the petals [21]. The confusion created by the many petal particles also appears to cover the choreographic violation through a conflation of movement and texture within the space.

Common Fate

Common fate is 'when elements move in the same direction, we tend to see them as a unit' [22]. The most effective way of developing the effect of common fate in stereoscopic theatre is through the use of motion capture. Real time motion capture can create this appearance as the dancer and virtual object are essentially tied together. When objects and performers are choreographed on the same movement pathway the animated theatrical scene appears composed. However, when there are many animate objects connected to a performer it becomes confusing and the common fate becomes lost (see Fig. 4 & 5). In the first example, the animation and performer move in a line of common fate as a dance duo. In the second example the common fate is lost due to confusion arising from having too many objects within the space.

Similarity

Within the stereoscopic theatre environment the use of costume colour and animation texture is an effective way of creating similarity. The Gestalt similarity law 'describes why certain elements seem to go together', in particular how objects that are alike appear to be grouped together and therefore appear as a collective of things [23]. For example, objects of the same color and shape will appear grouped even if randomly placed.

Within this example (see Fig. 6) the costume of the dancer matching the animation makes the two elements of the real dancer and the virtual object and performer appear similar, and they then appear to operate within the same space or world. The color of lighting also draws the image and the performer together. In the 3D dance environment lighting can become a mediator between the real and virtual. In this performance the animated cups consistently fall around the dancer, ending with an avalanche of cups [24].

Good Continuation

Good continuation describes the phenomena when elements or objects which are set in a straight line or a smooth curve are likely to be viewed as a unit or one thing [25]. In choreography this principle is often used within a composition technique called cannon, where one element moves after another, giving the appearance of a continuing line. In this example (see Fig. 7) the dancer completes the smooth curve of the animation, creating cohesion and assimilation within the stereoscopic scene. In this scene from the work *Parallax* [26], the dancer explores inner emotional and outer physical viewpoints of the notion of perspective and placement. The dancer is placed within the animated scene to finish or complete a line or in contrast as juxtaposition.

Conclusion

With the use of projection technology becoming increasingly normalized within theatre, the stereoscopic illusion has the potential to become one of many techniques available to the theatre choreographer or director. We have found that using these principles in creating stereographic theatre can be an effective way to unite the perceptual world of the work despite the sensory dissonance in depth information. Our experience is that, though difficult to achieve and by no means fool-proof, using the perceptual organization ideas described by the Gestalt theorists provides an approach to creating cohesive stereographic theatre scenes.

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