

# **Sound as perspective in Culture, Science and Film**

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### **Declaration of Originality**

**This dissertation is submitted by the undersigned to the Institute of Art Design & Technology, Dun Laoghaire in partial fulfillment of the examination for the BA (Hons) in Film and Television Production. It is entirely the author's own work except where noted and has not been submitted for an award from this or any other educational institution.**

Signed \_\_\_\_\_

A handwritten signature in black ink, consisting of several overlapping loops and a long horizontal stroke extending to the right.

### **Acknowledgments:**

I would like to thank my tutor Thomas Kennedy and the staff of the IADT library for the help.

## **4) Table of Contents:**

1. Introduction - p.3
2. Chapter 1 - p.5
3. Chapter 2 - p.10
4. Chapter 3 - p.16
5. Conclusion - p.22
6. Bibliography - p.24

## Introduction:

Try to remember the last time a song completely caught you off guard or the last time a movie made you scared without anything obviously scary being on the screen. Sound was probably responsible for more of the shock than you were aware of. That's one of the strange things about our relationship with sound: we're least likely to analyze sound while it is happening and it is working on us all the time; creating how we feel, what we remember and how we understand the world around us. We refer to movies we've "seen," never referring to movies we've "heard," however, anyone who has seen a horror movie without sound or has watched a powerful scene with the sound muted, will know that they have missed out on an essential part of the experience. The emotional structure of the experience has collapsed, leaving you with simply pictures.

This thesis will examine why that is. I will argue that sound is one of the most powerful tools available to artists and story tellers and that cinema is the medium that has unlocked that potential most thoroughly and intentionally. Sound has been significant in music, theater, oral poetry, and religious rituals for thousands of years - and therefore this thesis begins not with film, but with sound: what sound is, how it functions, how humans have conceived of sound throughout history and what sound does to us physically and mentally. Once that base is established, then it becomes possible to develop an argument about what cinema has done with sound.

The thesis has three chapters before its conclusion. Chapter One explores the nature of sound as both a physical process and a cultural concept. First, it explains how sound travels, how sound is heard by the ears and processed by the brain. Then it addresses how humans have thought of sound as meaningful throughout the history of civilization - including the Pythagorean belief in cosmic harmony, the medieval church's rules regarding musical modes, and the significant breakthrough in the 19th century when the development of recording technology enabled humans to isolate a sound from the occurrence of that sound for the first time. This historical progression is relevant to understanding that sound has historically been conceptualized as more than just noise - that is, as cosmological, ethical, political, and emotionally personal, well before the advent of cinema to take advantage of those aspects.

Chapter Two delves into the psychology and physiology of sound in greater depth, drawing upon studies using neuroscience and experimental designs to describe the biological processes

occurring in the body and brain during the act of listening. It discusses the peripheral auditory system (the mechanisms of how sound is converted into neural impulses) and reviews the key contributions of scientists such as Hermann von Helmholtz and Georg von Békésy. Their research on how the cochlea analyzes frequency contributed to developments in hearing aids and cochlear implants, among other innovations. Finally, the chapter illustrates the dual roles of sound - that is, how sound can be both profoundly beneficial to mental health and cause genuine harm - and concludes with a review of how new experimental neuroimaging techniques allow researchers to objectively measure these reactions.

Chapter Three presents the argument in relation to the cinema. First, a short overview of the history of sound in film will be presented — from the pianist accompanying silent films to the contemporary multi-channel digital systems of the modern cinema multiplex. To illustrate the way sound can be deployed as a direct physiological intervention in the audience, the first example will be Gaspar Noe's *Irreversible* (2002).

The second example will be Francis Ford Coppola's *Apocalypse Now* (1979), with its revolutionary sound design by Walter Murch, to demonstrate how a film can use spatial audio and sonic montage to create an entire psychological world and physically draw the audience into it.

Finally, Christopher Nolan's *Dunkirk* (2017) will be used to illustrate how psychoacoustic techniques — particularly the Shepard tone, which is an auditory illusion of continuous increasing pitch — can maintain physiological tension over an entire feature length film.

Together, the three films will demonstrate the extent to which the most ambitious filmmakers deploy sound not merely to accompany their images but as a major expressive medium, one that is able to bypass conscious interpretation and act directly on the nervous system.

The focus of the thesis is more on what sound does to audiences than on the technical details of how sound is generated, although examples will be provided when needed. Throughout the thesis, the focus is to develop an argument about sound as an experience - sensory, affective, and cultural event. In the very best films, film sound is half of the total experience, and in some instances, even greater than half of the total experience. Understanding this requires an understanding of sound itself which is why we need to begin with the vibration in the air.

# **Chapter I: The physics and experience of sound**

## **Chapter 1.1: Sound as motion through the world**

In reality, sound is motion. Every time something vibrates it ripples through the surrounding air molecules and pushes them together and pulls them apart in a repetitive sequence. These molecules then transfer the force to their neighbors and creates a series of pressure variations that spread out in all directions. What reaches your ears is not the actual vibrations themselves but a type of organized ripple, a pressure wave traveling through the air. For this reason, sound cannot travel through a vacuum - if you take away the medium be it air, water, or a solid material there is nothing for the wave to travel through. This is the same reason that the famous tag line from the movie *Alien*(1979) is, "In space, no one can hear you scream".

Sound must have a world to move through. As such, there is something inherently social about sound, even in its earliest stages. In short, sound must have a relationship between the source that generates it and the medium that transmits it. This aspect of sound (the insistence of connection) will be of significance again later in this thesis when examining how cinema utilizes sound to engage its audience within the world of a film. Sound allows no separation.

The speed of sound varies according to the medium it is transmitted through. In air at room temperature, sound travels at approximately 343 meters per second — fast enough that in everyday life we perceive sound as instantaneous; however, at greater distances the delay may be noticed. Everyone who has observed firework displays from a great distance and witnessed the flash before hearing the explosion has been aware of this personally. In water, sound travels about 4 times as quickly; in steel, over 14 times as quickly. While this variability is significant in fields such as underwater acoustics and building design, the essential point here is simply that sound does indeed travel and that the journey alters it.

## **1.2 Frequency, Amplitude, and Timbre**

Once we leave behind the basic fact that sound is created by waves in the air, the next logical step is to explore the ways in which the many different types of sound vary from one another. The key elements to help us do this is the holy trinity of sound - frequency, amplitude and timbre. Frequency is defined as the number of times per second a wave compresses and expands. A high-frequency wave compresses and expands many times times per second while a low-frequency wave does so much slower. Our experience of this concept is pitch - high frequency sounds are perceived as being high pitched while low frequency sounds are perceived as being low pitched. The range of frequencies that humans can perceive is roughly 20-20,000 Hz (Depending on age)..

Our ears can detect the tiniest of whispers and we can survive extreme sound levels for short periods of time. In our daily routines we generally experience environments from anywhere to 20 decibels to 70 decibels, a live rock concert can reach up to 110 decibels or greater, with the loudest reported one being Manowar at the 2008 Moscow show, which reportedly reached 139 decibels making it potentially harmful if you are not equipped with ear buds. Timbre is the most elusive of the three and is probably the most interesting. Timbre is the ability to distinguish between a violin and a flute when the notes and loudness match. The reason is due to the fact that almost all actual sound waves are consisting of multiple frequencies playing at once. The combination of the overtones determines the unique timbre of each source. Sound designers and composers are essentially good at manipulating this as they realize that the emotional color of a scene can be dramatically changed using sounds with slight differences in texture, even when the pitch and volume of the sound remains unchanged.

## **1.4 Historical Perspectives**

We have been producing and conceptualizing sound for as long as there are historical records to review, and the most striking feature of the earliest systems of thought is how much they diverged from a scientific

description. In most ancient cultures sound, particularly musical sound and spoken language, was regarded as cosmological - as having a direct connection to the structural elements of the universe and even to the will of the gods. According to the Hindu tradition, the concept of Nada Brahma (which translates approximately to "sound is god" or "the world is sound") posits that sound is not merely something that exists in the world, but rather is the material from which the world itself is constructed. The Vedic texts differentiate between normal, audible sound (ahata nāda) and a non-struck, non-auditory cosmic sound (anahata nāda) that is more fundamental than any sound detected by the human ear which is not merely a creation myth as it might appear at a first glance. It is in fact the philosophical base for a complete philosophy of music and listening in which the purpose of music-making is not for passing time, but a type of connection to reality of sorts.

On the other side of the globe, In the six century BCE the philosopher/mathematician Pythagoras is credited with discovering that the musical intervals that sound pleasing to the human ear - fifth and fourth, correspond to simple whole number ratios. Pythagoras further expanded upon this idea to include the cosmos itself, suggesting that the planets move according to the same simple mathematical ratios that as musical intervals -- producing a cosmic "music of the spheres" that is beyond the range of human auditory capabilities!

The idea that the universe has a "voice" in many different ways, in many different cultures. Like in ancient Egypt where the power of spoken words was considered magical- Thoth was the god who controlled both writing and divine speech. In the Hebrew Bible, God does not create or imagine the world into, but he speaks it: "let there be light" (Gen 1.3).

### **1.5 The Middle Ages: Sound Under Control**

The medieval Christian world in Europe took that significance and made it a matter of control and dogma. Music was subject to strict theological regulation. The church put an enormous amount of institutional effort into controlling which kinds of sounds were considered suitable for spiritual purposes and language was of both spiritual and political importance. Thus, the medieval church demonstrated an awareness of sound that

modern advertising and film have proven to be true -- sound is not neutral, it influences how people feel and what they want. (Later I will also attempt to examine this from a scientific perspective.) The epic poems, legal traditions, and folklore of medieval Europe were carried through performance in the bodies and memories of singers, storytellers, and orators like bards, hermits and poets. Such cultures tend to organize their thinking according to memory and patterns that are designed to be remembered and repeated like tribalised commandments, and they organize knowledge within communities of performance. They also perceive time and narrative in ways shaped by the rhythms of speech and song. Growing up in a culture of this sort, would lead to a completely different relationship to sound than most people in today's literate, screen-based society have.

## **1.6 The Modern World and the Problem of Recorded Sound**

Over the next several hundred years after the Renaissance, the way that sound was conceived began to undergo a fundamental shift. As natural science began to experiment and divide objective fact from subjective experience, sound came to be perceived as two completely separate ideas: the measurable physical wave in the air, and the subjective experience of hearing. In the late 19th century, technological innovation created a new cultural environment for sound. The invention of the telephone by Alexander Graham Bell in 1876 and the development of the phonograph by Thomas Edison in 1877 did not simply provide better communication systems - they transformed what sound was, ontologically.

The phonograph, and with it the ability to capture sound and replay it, opened up the possibility for capturing a live performance for the first time, and even storing it for later playback! With the addition of the microphone, a performance could now be recorded in one location and played back in another, and the voice of someone long dead could once again be heard. As Emily Thompson wrote in her book about early twentieth-century acousticians, the idea of separating a sound from its originating source was a concept that

caused some initial confusion among those who first experienced it, and they described it as having an "acoustic ghost" quality (Thompson 131-132).

The impact of the phonograph on the way people perceived the world around them and the eventual development of cinema was quite profound. In his book "The Soundscape: Our Sonic Environment and the Tuning of the World" published in 1977 R. Murray Schafer introduced the term "schizophonia" to describe the process of taking a sound from its original source or environment and recreating it in a new one. Schafer saw this as a negative aspect of the use of recording technology. However, the same technology that Schafer lamented over, was the same technology that allowed filmmakers to create their own sonic realities through the combination of disparate sounds into one single space.

By the time film emerged at the end of the 19th Century humans have had thousands of years of experience in perceiving sound as being meaningful, morally significant, and even cosmically significant. Humans have developed sophisticated musical traditions, oral narrative traditions, and theatrical traditions that combine sound and visual spectacle alike. What film did and what the remainder of this thesis will examine more, was to combine all of these elements in a completely new way allowing filmmakers to synchronize and manipulate both sound and images to create the most complete artistic experience. I would argue that in doing so, film did not simply utilize sound as a medium or a mere tool but rather, it unleashed the full capabilities of sound.

## **Chapter Two: The Psychology and Physiology of Sound**

### **2.1 Peripheral Auditory System: A Brief Overview**

To understand how we can interpret and utilize sound, we must begin by examining our own auditory system.

The peripheral auditory system is how we are able to convert the acoustic energy present in our environment into neural impulses. The peripheral auditory system consists of the outer, middle, and inner ear. These areas of the ear receive the acoustic waves and transform them into signals that can be processed by the brain. Acoustic energy enters through the external auditory canal, and generates vibrations of the eardrum which then initiate a series of movements in the middle ear and the three tiny bones that make up the so-called "ossicular chain" amplify the vibrations of the eardrum and then send those vibrations on to the inner ear.

The ossicles include the malleus, incus, and stapes and they all enhance the sound pressure, thus helping to maximize the potential for the energy to travel further inward to the next level of structures in the ear. Within the inner ear, the cochlea is responsible for transforming the mechanical energy into electrochemical signals, it is a spiral-shaped structure and has the hair cells which are sensitive to the motion produced by the vibrations, these hair cells produce electrical impulses that travel to the auditory nerve and eventually to the brain for processing. The reason the hair cells are so significant is due to both their arrangement and their ability to "distinguish" between sounds. Their ability to distinguish sounds is why humans are able to recognize a wide range of frequencies and sounds.

### **2.2 Scientific discoveries**

For many years scientists have studied the complex and fascinating processes of the human body's perception of sound. One of the first scientific attempts to explain how the human body perceives frequencies was done in the book "On the Sensation of Tone" written in 1863 by Hermann von Helmholtz. In essence Helmholtz was the first scientist to provide a theoretical explanation of how the human body perceives frequencies.

Since that time there have been several improvements made to the study of the cochlear system. These improvements, combined with the newer research being conducted today, allow scientists to gain a greater understanding of both the treatment and the cause of problems like tinnitus and hyperacusis that result from prolonged exposure to loud noises. The major advance in the field of cochlear physiology occurred during the mid-20th century. During that time, Georg von Békésy conducted a series of experiments in the 1940s and 1950s using a microscope to demonstrate how acoustic vibrations do not stimulate the entire inner ear but rather generate what he referred to as "traveling waves" along the membrane from the base to the apex of the cochlea. He also coined the term "tonotopic organization" which describes how various frequencies stimulate different parts of the membrane. For his contributions to science, Békésy received the Nobel Prize in Physiology or Medicine in 1961. Today, scientists continue to learn about the anatomy of the human body and its auditory systems to help improve our hearing health and to better understand ourselves as a species.

A notable example of the application of Békésy's findings to develop new technologies is the development of the cochlear implant, a device that bypasses damaged hair cells in the cochlea and sends electrical signals directly to the auditory nerve. Cochlear implants were first developed in the 1970s and have continued to be improved upon since then. As a result of the development of this implant, hundreds of thousands of people around the world have experienced some measure of restoration of their hearing that they would otherwise have lived without (National Institutes of Health). The reason for the development of a device that provides individuals with the ability to hear even possible is a direct result of an understanding of tonotopic organization. Because different parts of the cochlea respond to different frequencies, engineers were able to create an implant with electrodes placed along the cochlea in a manner similar to the natural frequency map found in the human ear. Békésy simply wanted to know how the ear worked and that led to technological advancements that significantly impacted the lives of people and continue to do so everyday.

Beyond the ear canal and into our brain, we find a complex and intriguing connection between sound and emotion. Research has demonstrated that music is capable of influencing and shaping our emotions in numerous ways through our brain's reward system. Music triggers the release of dopamine, which is a neurotransmitter and a chemical that contributes to the sensation of joy, pleasure, and emotional excitement.

It is evident in research that goose bumps that occur at times when people listen to music that has a strong impact on them is one of the most effective ways to measure how strongly we react to it. Neuro-imaging studies have established that this phenomenon is directly correlated with the release of dopamine in the striatum of the brain, which is the area of the brain responsible for pleasure derived from eating and social bonding (Salimpoor et al., 257). The sensation is interesting because not everyone gets goose bumps and the people that do, generally possess similar personality characteristics, primarily a greater level of openness to experience. This illustrates that our emotional reactions to sound are shaped not only by the structural composition of the sound itself, but also by the type of people we are - our character and manner, how we pay attention to things and how open we are to being affected by something. The fact that sound never functions independently of our current self is a small but significant demonstration that sound is always received in the context of the present.

Studies have consistently shown us that various musical parameters such as tempo, harmony and dynamics can have considerable effects on physiological responses such as heart rate and skin conductivity. Examples demonstrate a connection between the structural aspects of music and our individualized emotional states, which can result in a variety of different thought and emotional states, and that occur in real time. However, music is not simply a matter of perception and comprehension, rather it demonstrates how as individuals and culturally we can comprehend music as much more than what we hear and think, but also in terms of how we may emotionally and unconsciously respond to it. Individuals who may have developed a personal association to a particular sound, instrument, or period of music, can exhibit a wide range of responses when hearing music that they have previously had a relationship with, and that indicates that while many of the concepts and theories regarding music may be pretty objective there are many individually unique aspects to how we interpret and connect with sounds.

It is here that terms such as tempo, mode, dynamics and subversion of expectation become relevant. For instance, tempo can influence arousal: fast tempos tend to evoke a sense of excitement or a feeling of urgency, while slow tempos tend to elicit feelings of calmness or even soothing. Mode is also crucial in determining the mood of music: major modes tend to feel colorful and happy, while minor modes tend to feel

sad, despairing or melancholic. Dynamics add yet another dimension: using changes in volume to create tension. When music deviates from the listener's expectations via sudden shifts in tempo, rhythm or pitch, it can either positively or negatively surprise us depending on the intended outcome. By combining all of these elements, it becomes clear that music does not simply pass through our ears creating vibrations, but also creates neural signals capable of altering our emotions and state of mind.

It is also important to recognize the duality of the immediate effects that sounds can have on the mental and physical states of people. Researchers have been able to detect changes in brain activity through electroencephalography, tracing changes in brainwave patterns, allowing us to study the immediate and long-term effects of exposure to various types of noise. A rapid increase in heart rate and blood pressure can occur due to a loud or unpredictable sound, and while some frequencies have been found to cause mild nausea and anxiety after prolonged exposure, others are utilized during meditation and/or study sessions to promote focus and relaxation. The responses to experiences of this nature allow us to further understand the therapeutic or detrimental effects of sounds. Workers in industries that involve working in loud environments, such as construction sites or factories where equipment is constantly running, have shown increases in adrenaline and cortisol levels due to prolonged exposure to high decibel environments, potentially leading to chronic stress-related health issues. Employees in industries that include concert venues, and those that work in environments that expose them to high decibel levels such as airport employees must be aware of the potential damage that prolonged exposure to high decibel environments can cause. In addition to the auditory system, specific frequency ranges can exacerbate existing anxiety disorders. These examples illustrate that sound is not inherently beneficial by nature and that specific aural experiences can produce negative mental health outcomes.

But the potential of sound to benefit individuals, and society as a whole, should not be overlooked and the benefits of sound include music therapy that has demonstrated the ability to decrease heart rates and stress hormones like cortisol therefore helping your health. Sound has the potential to both create anxiety and produce relaxation, demonstrating the need for a better understanding of its physical and psychological effects, especially in today's fast-paced world where our surroundings are often being overlooked and

changing at an incredible pace. Understanding the soundscape of your daily routine, and taking steps to either alleviate negative influences or enhance positive ones is also essential. The therapeutic application of sound has evolved into a well-established, and growing field for research. Music therapy is now a widely accepted clinical practice that is implemented throughout the world in hospitals, rehabilitation centers, and mental health clinics to aid in pain management, reduce preoperative anxiety, provide neurological recovery after stroke and improve the quality of life for patients suffering from dementia (Thaut and Hoemberg, p.12). In dementia care specifically, music memory has proven to be a unique aspect of memory and the way it stores itself in the brain. Music memory is typically preserved longer than all other types of memory, even when verbal and spatial memory have been lost. Many patients that are unable to recognize their immediate family will often remember and react emotionally to songs from their past, remembering the lyrics to songs they had previously forgotten. The ability of sound to connect with patients in such a way is not only an emotional connection but also a significant indicator of how sound plays a deep part in the development of human memory, identity and character.

### **2.3 Individual and Cultural Influences on the Emotional Response to Sound**

Musical, noise or environmental sounds influence on individual emotional responses are a direct result of personal associations related to previous experiences, our upbringing, and cultural background. Examples of this include the fact that a particular sound may bring someone joy/happiness whereas trigger feelings of distress/uncomfortable sensations in another person regardless of whether those feelings are conscious or subconscious. These differences in responses are normal and primarily developed based on prior exposure/interactions with the given stimulus. A specific melody associated with positive/nostalgic feelings and resulting in feelings of happiness for one person can be the exact opposite for a second person, who associates that same tune with unpleasant feelings due to past associations.

Different cultures can demonstrate these aspects through varying degrees of distinctiveness in emotional meanings associated with identical sounds or tunes. For instance, a lion's roar may be viewed differently among people who grew up around lions in the wild versus people who never did. People from urban areas in various parts of the world who are not accustomed to lions in the wild may associate the sound with various

examples in pop culture or zooparks, and feel a sense of awe and excitement while a person who has grown up with large cats in the wild around where they live might have a stronger more primal reaction. Similarly, sounds considered soothing and ceremonial in one culture may be perceived as disturbing or disruptive in another. Traditional/folk music provides a prime example of how it captures and reflects the common emotional and cultural perspective of a nation, yet resonates differently with individuals and populations, again illustrating the role of context and subjective interpretation in discussing the effects of sound. (Cunningham and Grout).

The emotional connection of a nation's instrument or anthem can evoke a greater reaction than would be elicited by a foreign anthem or instrument. Heart rate or stress levels could be used to measure this reaction for instance. There is much more to why this is significant than just the academic study of cultural differences - If sound has the capability to both divide and unite people and if the same stimulus can cause fear in one person and awe in another, then whoever has control of the sound in a specific situation will have a large amount of influence on how that experience is felt by the individual. This concept is not new throughout history, political and religious institutions have inherently recognized this as they deliberately use sound to elicit certain emotions within a group, to signal unity, to elicit a sense of belonging, or to generate a sense of something larger than themselves. Sound has never been emotionally neutral it has always been a resource that can be utilized with intent and the emotional responses generated by sound, although influenced by individual and cultural histories, can be manipulated by those controlling the sound heard.

Cinema is directly applicable to this concept. A film score does not merely accompany visual images presented on screen; it is an instruction to the viewer on how to feel. Filmmakers and composers recognize this and utilize this effectively. A scene that may appear to be ambiguous or perhaps neutral can become perceived as menacing, romantic, or comedic based solely on the music underneath. The viewer processes the musical cue via the same biological and psychological mechanisms referenced throughout this chapter and adjusts their emotional interpretation of the scene as they hear the cue, often unconsciously.

## Chapter three: Sound in Cinema

### 3.1 A Brief History of Sound in Film

One of the more interesting facts in the history of cinema is that film was silent for the first 30 years of its existence, or at least it is perceived to be nowadays. Early cinema was rarely ever shown in complete silence and from the earliest public showings of the Lumiere Brothers in 1895 live musical accompaniment was always included, and by the 1910s large theatres were employing full orchestras to accompany their films with designated and unique scores made for them. Theaters relied upon pianos and organs, and often improvised from cue sheets distributed by studios, in the time while the films themselves were silent in the sense that there was no recorded sound to accompany the images, the experience of viewing these films was still entirely sonic; the division of the sound and image that we generally attribute to "silent film" is more a technical description than an accurate depiction of how audiences generally experienced films during that time (Altman 16).

The introduction of synchronized sound in *The Jazz Singer* in 1927 is commonly viewed as the dividing line that drastically altered the course of film history. And indeed, it did alter much-the silent film era in Hollywood effectively came to an end within three years, and nearly the entire nature of the film industry-from the design of studios to the distribution of films to the architectural design of theaters-was overhauled in relation to the inclusion of recorded sound. It's also worth to note that the shift toward the inclusion of synchronized sound was not welcomed by everyone at that time. Many of the most acclaimed filmmakers of the silent film era like Charlie Chaplin and Sergei Eisenstein, voiced strong reservations regarding the inclusion of synchronized sound. They were worried that the addition of the ability to include recorded dialogue would cause film to become nothing more than photographic theater, draining the cinematic image of its unique expressive qualities (Eisenstein et al., 258). Essentially, they were afraid that filmmakers would merely place microphones in front of actors speaking lines and cease to think about how the sonic dimension of a film could add depth to the visual dimension of a film beyond the purely informative and as we see nowadays perhaps they were correct to be afraid.

However, the history of film since that time is also a story of how the medium slowly coming to realize how incorrect their fears were, and learning and sometimes decade by decade-how to utilize sound not as a means to replace visual storytelling, but rather as a distinct layer and dimension that possesses its own nature and power. The advent of magnetic tape recording after WWII, the emergence of stereophonic sound in the 1950s, Dolby noise reduction in the 1970s, and ultimately the multi-channel digital audio formats of the 1990s each added to filmmakers' abilities and opportunities. The films analyzed in this chapter represent several of the most striking examples of what sound is capable of producing starting with:

### **3.2 Apocalypse Now (1979)**

*Apocalypse Now* (1979), directed by Francis Ford Coppola, is not just another example of the potential of sound to build worlds in movies. Coppola and his renowned sound designer Walter Murch use sound as a creative medium to elevate and manifest the sonic environments of the film and bring the audience to a state of mental confusion and a state of weariness, to a profound degree.

Walter Murch is one of the most significant people in the history of film sound, and *Apocalypse Now* is his magnum opus, he worked with Dolby Stereo, a technology that had only recently become available for theatrical presentation, and which made it possible for Murch to position sounds in a space with greater accuracy than previously possible (Murch, p. 98). Murch created a sonic representation of the Vietnam War that was both extremely realistic and also very surreal. One of the most known and adored sequences in the film is where the spinning of a ceiling fan blends into the rotor blades of a helicopter managing to perfectly showcase how the main character's daily routine and headspace have been consumed and torn apart by his experiences in the jungle we get to visit later. The fan and helicopter have the same frequency pattern and thus the blend is acoustically seamless. The lines separating the internal and external worlds, the domestic and the jungle, sanity and madness will be blurred throughout the film. It is a striking, rich and memorable use of sound that also establishes some of the narrative ideas in a creative way - sonically.

Murch's approach to the film was based on the "Rule of Three" (the notion that each element of a film should serve the story, the emotional content of a scene, and the rhythm of the edit) (Murch, p. 18). For Murch, sound was not something that you would add to a completed visual product, but rather a central component of the film's meaning making process. Additionally, Murch developed what he called the "Surround" channel in such a way that the positioning of sounds in *Apocalypse Now* were intended to elicit particular emotional responses in the audience and to surround them in the chaos of battle or isolate them in an unsettling stillness. The audience did not simply listen to the war; they were, in a relatively limited but physiologically real way, surrounded by it.

Under normal conditions, the brain acts as a filter when we hear sounds, deciding what to pay attention to and what to suppress but when you are watching *Apocalypse Now* that filtering is continually disrupted and subverted. Sounds come from places and levels that disrupt the hierarchical structure of attention that the brain normally maintains. This produces a feeling of perpetual anxiety and vulnerability, a psychological condition of a soldier in combat, and a condition that Coppola wished his audience to experience.

### **3.3 Dunkirk (2017)**

Christopher Nolan's *Dunkirk* (2017) may represent the most technically sophisticated and theoretically informed use of sound in contemporary mainstream filmmaking, and it is a film that warrants careful examination primarily because Nolan and his composer Hans Zimmer were aware of the psychoacoustic principles that Chapter 2 partially described. *Dunkirk*, a film about the 1940 evacuation of the Dunkirk beach, takes place in three interlocking time frames -- one week on the beach, one day at sea, and one hour in the air - and the task of sustaining a continued sense of tension through a film in which the audience already knows the historical result, requires both sonic and narrative solutions.

Perhaps the most discussed idea is the use of the "Shepard tone" in the score of *Dunkirk* which is an auditory illusion, a sound that seems to climb in pitch indefinitely without ever reaching a new level. It is made by layering various tones over each other in various octaves and then slowly reducing the levels of each tone

such that when the uppermost tone has faded away a lower tone fades into play, thus providing the constant sensation of climbing (Shepard 2346). Zimmer and Nolan used this as the focal point of the film's score, and incorporated it in the sound of the plane engines, in the ticking of a clock, and in the extended orchestral instrumental of the film's most intense moments. The end result is a soundtrack that never concludes, never relaxes and always continues to build up towards an ever distant climax.

Continuously ascending pitches are one of the most reliable aggregators for the sympathetic nervous system, the "fight or flight" response since pitches that go up in the natural world generally indicate approaching threats like the growling of an approaching predator increasing to a roar, the sound of an accelerating vehicle coming towards you. As we mentioned earlier, the human auditory system responds to sound involuntarily, and since the continuous increase of a sound will cause a continued state of alertness the effect gets amplified subconsciously. Nolan and Zimmer effectively caused the audience to remain in a state of high alert for about 106 minutes which is a tempo and a task that would have been impossible for the story line and visuals alone to achieve, especially during the longer segments of the beach sequence where very little occurs in terms of action on screen.

Another area where Dunkirk stands out is its treatment of silence and the division between diegetic and non diegetic sound. Diegetic sound is sound that exists within the world of the film, and is therefore something that the characters can hear while nondiegetic sound is something such as a film score, that exists solely for the audience. In many films, there is a distinct separation between these two forms of sound, but Zimmer and his score for Dunkirk intentionally blends them and it adds to the confusion, like the ticking clock heard throughout most of the score, sounds like it is coming from a real source, but is actually a part of the nondiegetic soundtrack, the engine sounds of the planes in some cases are virtually indistinguishable from the musical textures. This intentional blurring of the lines between diegetic and nondiegetic sound is not coincidental. It serves to explore deeper the film's thematic core tied to the subjective nature of time, and it creates a feeling that the audience is not watching the events unfolding from outside of the world of the film, but rather that they are experiencing the events themselves, along with the soldiers on the beach and in the air. Overall it is a masterful application of the cinema's ability to control and shape the audience's experience

of sound in a controlled environment, in order to create a unique and highly immersive psychological experience.

### **3.4 Irreversible (2002) – Sound as a Tool for Torture**

There is arguably no film in the entire history of cinema that better illustrates the ability of sound to cause involuntary physiological responses in an audience than Gaspar Noé's *Irreversible*. While the film is infamous for its graphic content which including a nine minute rape scene shot in a single continuous take and a graphic murder sequence at the opening of the film, what is far less commonly referenced in popular descriptions of the film is the way sound is used.

For the first 45 minutes of the film, Noé and his sound designer Ken Yasumoto collaborated with composer Thomas Bangalter to include a low frequency tone of approximately 27-28 Hz into the soundtrack, a frequency that lies just below the threshold of conscious hearing but above the frequency range that the human body is physically capable of detecting (Whittington 203).

They intentionally used it based upon the research that the previous chapter illustrated regarding the physiological effects of certain frequencies on the human body and nervous system. Studies published in the scientific literature have shown that infrasound in this frequency range has been capable of inducing feelings of unease, disorientation, mild nausea and/or anxiety in individuals exposed to it, even when they are unable to consciously determine why they are experiencing those feelings (Tandy & Lawrence). Noe has openly acknowledged this decision in interviews and described the use of the infrasound as a means to put the audience in a state of physical and psychological vulnerability prior to the film's most graphic sequences occurring. The infrasound itself did not represent anything or signify an occurrence, instead acting on the body.

Audiences and critics attending the premiere of *Irreversible* at Cannes in 2002 reported several distinct reactions - many of the audience members reported leaving the theater during the screening, citing feelings of dizziness, nausea, and extreme anxiety. While some attendees felt that the graphic images in the film caused them to leave early, there is little doubt that the infrasound would have been affecting the audience members

from the beginning of the film, causing physical symptoms consistent with anxiety, paranoia and making the visual aspects of the film appear to be more unpleasant than they likely would have without the presence of infrasound. That's how Gaspar Noé utilized the sound in the film not merely as a complement to the visuals, but as a method of physiological intervention, a form of manipulation of the audience that circumvents rational thinking and utilizes the audience's nervous system.

Irreversible illustrates the principle that applies to virtually every film — that the emotional experience of viewing a film is not solely a cognitive reaction to the story and the images on screen. Rather, it is a physical experience influenced by the physical attributes of the sound that the audience is listening to, and it can be engineered and manipulated.

### **3.5 Sound, Immersion and the Issue of Total Potential**

The cinema theatre is a place where the audience has the chance to experience both sound and image at their very best capabilities. No other medium presents the same combination of factors quite in the same way.

Live music may elicit physiologic reactions of similar intensity, but it cannot synchronize them to corresponding images and narratives to the extent cinema can, drama theater provides the physical presence of performing artists, but cannot command the sonic environment with the precision of a film mix, recorded music and radio provide direct sound to the ear, but cannot isolate the listener in the way only a cinema can and written literature allows authors to describe sound with considerable detail, but ultimately it has to rely upon film adaptations to convey the ideas physically to the viewer. Cinema combines the controlled environment of the audience, synchronization of sound and image, manipulation of sound across frequency and direction and shared experience of experiencing the narrative together in the same space like opera or a play.

What Gaspar Noe and Yasumoto accomplished using infrasound in *Irreversible*, what Murch accomplished using spatial audio in *Apocalypse Now* and what Zimmer accomplished using psycho acoustic illusions in *Dunkirk* represent the many and varied approaches one can take to sound design in film in order to create and shape human emotion in real time. In the appropriate hands and in the right room, sound can be a powerful tool that can alter the way we perceive and treat the world around us.

## **Conclusion:**

From the preceding chapters, we know that prior to the existence of cinema and artificial sound, humans perceived and understood sound as something with a sense of importance - cosmological, spiritual, moral, political. The Pythagoreans saw the structure of the universe in musical proportions, medieval theologians determined which sounds were suitable for the soul to be exposed to, the introduction of recording technology in the late nineteenth century, in the view of many of the time, was literally unnatural. Therefore, while cinema did not create the power of sound, it provided a new, and unique method of utilizing that power to its greatest extent yet.

Chapter Two provided an overview of the biological and psychological mechanisms that underlie the reasons why sound has such power. Since the auditory system cannot be turned off, emotional responses to sound, the dopamine release that occurs when music elicits an emotional response, the increase in heart rate associated with a sudden, loud noise, and the anxiety that results from exposure to certain frequencies of low pitch - occur, below the level of conscious awareness, within parts of the brain that operate independently of normal thinking. Also what all of us bring to the experience of listening makes these responses into what they are, including our personal memories and associations based on culture and the environmental conditions in which we experience the sound such as in cities or nature. The culmination of all of this is the cinema theatre which is a space specifically designed to exclude outside distractions and to surround an audience with sound from multiple angles and to synchronize the sound with images in a room that is dark, so that there is no

distraction from looking or listening. This combination exists nowhere else in the same form. It is not available in the concert hall, it is not available in the theater and not available at home, where the room is inappropriate or perhaps the speakers are insufficient and the distractions of everyday life take away from the experience.

The three films analyzed in Chapter Three demonstrate what filmmakers have accomplished using that control, both deliberately and to the fullest extent possible. Gaspar Noé's *Irreversible* used infrasound to elicit involuntary physical distress in his audience before showing a single disturbing image on screen. What he demonstrated is that a filmmaker with the proper equipment such as in the cinema, has the ability to affect the physiological states of their audience without those audience members even being aware of what is happening to them. Sound in film is more than just background, like music in theater. In film, the director can create a mental picture of a place or time, and the audience will actually see it in their imagination, rather than seeing it on the screen. This is achieved through using multiple sound sources, and placing them in space. The audience hears the sound in front of them, behind them, above and below them. This makes the audience feel as if they are in the scene, not just watching it which is the ultimate way of experiencing a story.

This idea was first shown with Walter Murch's work on *Apocalypse Now* with how he used Dolby stereo to surround the audience with the sounds of war, making the audience feel as though they were in the middle of the battlefield, their senses overwhelmed by the sounds of explosions, gunfire and screams. This same idea was later applied similarly by Christopher Nolan and Hans Zimmer's use of the Shepard tone in *Dunkirk*.

I also want to point out that while this thesis has focused on film and its ability to use sound, many other mediums use sound in powerful ways as well. Music and theater for example have been using sound for years upon years to tell stories and evoke emotions but film has the unique ability to combine visual and auditory elements to create a truly immersive experience.

The difference between music and film is that music is usually listened to passively. We sit back and let the music "wash over us" but when we watch film, we are actively participating in the story in one way or

another and we are constantly trying to figure out what is happening next, and the sound serves as a compass or a guide depending on the context and situation.

In conclusion, I believe that when people watch a film in the way it was intended - in a large theater with a good sound system, the results are unlike anything else. Film has the ability to engage audiences emotionally and physically, and I believe this is due to the way film combines sound and visuals to create a fully immersive experience, like nothing else we have seen before.

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