

An introduction to audio post-production for film

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Declaration

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Signature

Date



Abstract

In South Africa there has been an increase over the last few years in audio engineering courses which include modules of study in audio post-production or even offer audio post-production as a major focus of study. From an academic standpoint however, and despite the growth in the local film industry, very little study of this field has been undertaken in South Africa until recently.

In 2005, a MMus thesis was submitted at the University of KwaZulu-Natal entitled *Acoustic Ambience in Cinematography: An Exploration of the Descriptive and Emotional Impact of the Aural Environment* (Turner, 2005: online). The thesis briefly outlines the basic components of the soundtrack and focuses on describing and analysing the properties of ambience, a sub-section of sound effects. At Stellenbosch University, research has recently begun in the fields of film music and Foley (sound effects associated with human movement onscreen).

The purpose of this thesis is to provide an overview of audio post-production and the contribution of sound to the film medium. It provides an outline of the processes involved in creating a soundtrack for film and includes a description of the components of the soundtrack and recommendations for practical application.

Opsomming

Gedurende die afgelope paar jaar was daar 'n toename in oudio-ingenieurskursusse, insluitend studiemodules in oudio post-produksie, en selfs 'n aanbod vir modules in post-produksie as hoofstudierigting. Desnieteenstaande, en ten spyte van die groei in die plaaslike filmindustrie is tot onlangs min akademiese studies op dié terrein in Suid-Afrika onderneem.

In 2005 is 'n MMus-tesis aan die Universiteit van KwaZulu-Natal voorgelê, met die titel *Acoustic Ambience in Cinematography: An Exploration of the Descriptive and Emotional Impact of the Aural Environment* (Turner, 2005: aanlyn). Hierdie tesis gee 'n basiese oorsig oor die basiese komponente van die klankbaan, en fokus op die beskrywing en analise van die eienskappe van *ambience* – 'n onderafdeling van klankeffekte. By die Universiteit van Stellenbosch is onlangs 'n begin gemaak met navorsing oor die terreine van filmmusiek en Foley, d.w.s. klankeffekte geassosieer met menslike bewegings op die skerm.. Hierdie tesis beoog om 'n oorsig te gee van oudio post-produksie en die bydrae van klank tot die filmmedium. Dit verskaf 'n oorsig oor die prosesse betrokke by die daarstelling van 'n filmklankbaan en sluit ook in 'n beskrywing van die komponente van die klankbaan en aanbevelings vir die praktiese toepassing daarvan.

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List of Acronyms

ADR	- Automated Dialog Recording/Replacement.
A.M.P.A.S.	- Academy of Motion Picture Arts and Sciences
AMPS	- Association of Motion Picture Sound
CGI	- Computer Generated Images
DAT	- Digital Audiotape
DAW	- Digital Audio Workstation
DTS	- Digital Theatre Systems
EDL	- Edit decision list
EQ	- Equalization
FPS	- Frames Per Second
FX	- effects
M&E	- Music and Effects
M.P.S.E.	- Motion Picture Sound Editors. Los Angeles-based honorary organization of film and television sound editors; founded in 1953.
NTSC	- A frame rate of 29.97 fps as used in the USA. - National Television System Committee
OMFI	- Open Media Framework Interchange
SDDS	- Sony Dynamic Digital Sound
SMPTE	- Society of Motion Picture and Television Engineers (professional organization)

1 Introduction

Audio post-production is the process of creating the soundtrack for moving images (Nazarian: online). Since the inception of sound into film, technology has developed to allow for more control as well as enhancement of sound. Audio post-production is a process included in the production of films, television shows, documentaries, games and more. With the advent of free software for home movie production, the average computer user can carry out audio post-production on the most basic level.

Texts on the subject of film sound and the process of audio post-production range from the theoretical - analysing the sound in relation to picture - to practical texts on technical procedures. Many practitioners of audio post-production contribute to the writings available and have made information freely available. Books outlining skills and current practices are available, as are conference proceedings, interviews, society newsletters and articles.

This thesis traces the history of sound in film with special mention of the evolution of audio post-production and examines different methods of viewing sound in film. The different components of the soundtrack are defined, the work involved in audio post-production and the assembling of the final soundtrack.

2 History

Sound as a part of commercial cinema is approaching its 80th year; it has undergone many transformations in delivery format, quality and content. Motion picture sound had actually been around, experimentally, for quite some time before *The Jazz Singer* (1927)¹, which is generally, though incorrectly, credited as the first motion picture with sound. The earliest known attempts to synchronise pre-recorded sound to film began in the early 1890's, the earliest known attempt was undertaken by Thomas Edison in New Jersey.

There were many other attempts, none of them successful, including Edison's; as the difficulties of synchronisation and amplification were underappreciated during that time (Kallay, 2004a: online). Cinema grew and evolved in other aspects though. From the first simple demonstration entitled *Fred Ott's Sneeze* in 1894, the art of storytelling rapidly advanced editing and cinematography with films such as *The Great Train Robbery* in 1903.

This segment of film history is referred to as the "Silent" film era. Yet even before recorded sound, synchronised to picture, was introduced to cinema, "silent" film was generally accompanied by a piano, organ or, in larger theatres, an orchestra (Bordwell & Thompson, 1979: 189). The inclusion of live music was largely to cover various undesirable elements: noisy projectors and audience noises, while at the same time reinforcing the mood and supporting the continuity of the film (Phillips, 1999: 169). An alternative theory by Cooke (2003: online) is that early cinematic presentations were offshoots of vaudeville and show-booth melodramas; therefore tradition demanded that as an entertainment spectacle, music should form the accompaniment. By the early 1900's, many film theatres all over the world would have a theatre employee playing live sound

¹ Kallay, 2004a: online

effects (Allen, 2003: online), either using sundry objects such as coconut halves, whistles and bells; or a specially manufactured sound effects machine (Phillips, 1999:169).

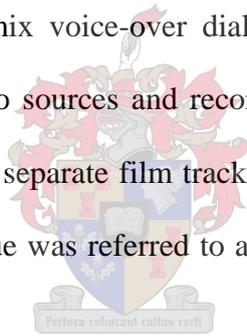
Music performed at theatres came from many sources. Davis (1999: 17) identifies the sources of music played to be classical favourites, popular songs, folk songs and café music. Davis traces the first commissioned film score to 1908, when Camille Saint-Saëns scored for the film *L'Assassinat du Duc de Guise*. The score was successful but the additional expense of commissioning a composer, preparing the music and hiring the musicians meant that the concept of music composed for a specific film did not prove popular. In 1909 Edison Pictures distributed cue sheets with their films in order to encourage appropriate music selection (Cooke, 2003: online). Music publishers began printing anthologies of music organized according to mood or dramatic situation and distributors' cue sheets would make cross-reference to these.

The addition of sound to film is largely tied to the development of sound recording and reproduction. Although many synchronization attempts had been made over the years, films shown to the public incorporated none of these, as there was no form of amplification. In 1907, Lee DeForest perfected the electronic Audion Vacuum Tube (Barsam, 2003); this made the production of microphones and speakers possible (Kallay, 2004a: online). Sound could now be magnified and reproduced through speakers for large movie audiences.

Warner Bros., a small studio struggling to survive, acquired a licence to the "Vitaphone" sound-on-disc system, where discs containing a film's soundtrack would run in sync with the film playing on the screen. The first film to use this was *Don Juan* in 1926; this was a ten reel silent film with the Vitaphone disk recording of sound effects and orchestral music. Historians are divided as to the impact of this film and the Vitaphone process; Kallay (2004a: online) writes that Vitaphone was

seen as a novelty and not a standard in the industry whereas The Academy of Motion Picture Arts and Sciences (2003: online) state that top filmmakers and executives believed that *Don Juan* represented sound technology's ultimate usage, that a silent film pantomime would be the "universal" language.

Shortly afterwards, in 1927, Fox introduced audiences to a sound-on-film presentation: The Fox Movietone News Reel. Initially, each news item had been introduced with silent titles, but it was soon realised that the addition of a commentary could enliven each reel of film (Wyatt and Amyes 2005: 5). Movietone News began to record sound with the visuals of events as they took place and coined the term "actuality sound and picture". The sound was recorded down the edge of the original camera film and the resulting optical soundtrack was projected as part of the picture print. A new technique was developed to mix voice-over dialogue with the original actuality sound (Wyatt 2005: 5), by combining the two sources and recording them on a new soundtrack. The extra sound required was recorded to a separate film track and held in sync with the original track using the film sprockets. This technique was referred to as 'doubling' and later became known as dubbing.



The combination of sound and picture of Charles A. Lindbergh's flight to Paris in May 1927 which amazed audiences was followed later that year by the Warner Bros. picture *The Jazz Singer*, which is often incorrectly credited as the first sound film. *The Jazz Singer* is mostly a silent film with a few musical numbers and a small amount of ad-libbed dialogue. It does, however, represent the beginning of real commercial acceptance of the transition to sound films (Ulano: online).

In 1928 Warner Brothers released the all-dialogue feature film: *Light of New York* with the first British "Talkie", *Blackmail*, being released a year later. The incorporation of sound happened

comparatively quickly; following the lead of Warner Bros. Pictures, Inc. and the Fox Film Corporation, all companies made the transition to sound. In 1929 over 300 sound films had been released and by 1931 the last silent feature-length films were released (Academy of Motion Picture Arts and Sciences: 2003).

Following the lead of the innovators - Warner Bros. Pictures, Inc., and the Fox Film Corporation-all companies moved, virtually en masse to convert to sound. By the autumn of 1930, Hollywood produced only talkies. Many silent film actors found themselves out of work, as their voices were unsuitable for sound film. Silent film directors who refused to embrace sound film and talkies were soon to follow.

Walt Disney then released the first animated short cartoon with synchronised sound: *Steamboat Willie* (1928). As the medium of animation allows for no production sound, it was the first film to completely create a soundtrack in post-production (Middle Tennessee State University: online). In addition to this was the use of simple sound effects², combined with music and vocal talent (Kallay, 2004a: online). This set the precedent that sound could be used more as a storytelling device and not solely as a novelty item.

Universal had recently completed *Show Boat* just prior to the premiere of *The Jazz Singer*. Realising that the silent picture was now obsolete, Universal decided to retrofit it with sound before releasing it. A forty-piece orchestra was hired to perform the music visually to the picture, which was projected on a large screen. Concurrent to the music recording, Jack Foley and several others were isolated on one side watching the projected image and performing various sound effects such

² A sound typical of an event or evocative of an atmosphere, produced artificially in a play, film, etc (OED online)

as clapping and various crowd noises. This was the first instance of the process now known as Foley, named for its first practitioner (Yewdall, 2003: 295).

Between 1927 and 1935 most films were reliant on dialogue and music as the main part of their soundtrack. Recording sound was new and was prone to excess noise during takes and so soundstages³ were built to control/minimize this noise. Microphones were weak and did not pick up good dialogue. They were placed in set pieces or on actor's bodies in order to pick up a decent recording.

Systems were developed in the 1930's that could run several audio tracks in sync with the picture by locking sprocket wheels onto a drive shaft. Shots could be inserted into any point in a film assembly and the overall sync could be adjusted to accommodate the new material, this led to the term 'non-linear editing' (Wyatt and Amyes, 2005: 5). In this period the sound-on-film method of audio recording became standard which led to a standardisation of the mono optical soundtrack by the Academy of Motion Pictures Arts and Sciences (A.M.P.A.S.). Space on the left of the picture frame was allocated to an optical track, through which light was driven and picked up by a photo sensor. Variations in the width of the opening resulted in variations of voltage in the sensor, thus recreating the soundtrack (Florian, 2002: online).

Camera and sound technology improved and cameras and audio recording devices became smaller and quieter. The camera could now move with the action on-screen. Soundtracks became more complex, with better music scores, cleanly recorded dialogue and the use of Foley for sound effects.

³ A permanent enclosed area for shooting film and recording sound. As a controlled environment allows for filming and sound recording without unwanted sights and sounds (Phillips, 1999: 579)

Most films up until this point rarely re-dubbed dialogue or edited sound, music and dialogue were seldom heard simultaneously unless they had been recorded simultaneously.

King Kong (1933) was the first film to include the use of manipulated sound. The sound effects editor use the recording of a lion's roar, which was slowed down to an octave below, then mixed with the original (Middle Tennessee State University: online). This is considered the first use of sound design⁴ (Middle Tennessee State University: online). By the time *King Kong* was released, advancements in sound technology meant that sound effects technicians were able to use separate sound elements and then mix them into a final soundtrack mix (Kallay, 2004a: online).

Alan Blumlein invented the first stereo variable area soundtrack in 1935. Blumlein had previously been an inventor at the then EMI Central Research Laboratories, where he experimented with stereo sound recording and invented an apparatus for binaural recording, as well as designing several pieces of equipment, including a stereo microphone (Middle Tennessee State University, 2003: online).



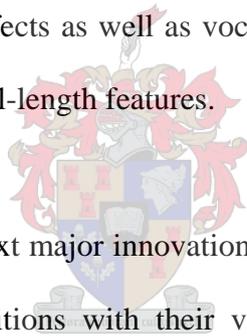
In 1938 an equalisation standard for theatre and studio monitoring was established. The Research Council of the Academy for Motion Picture Arts and Sciences found that many film theatres of the 1930's lacked the ideal flat frequency response in their sound systems. Many had poor high-end response and an almost non-existent low end and an equalisation curve, which became known as the "Academy Curve", was designed in order to have various theatres sound the same. Mixing stages and better theatres applied this equalisation to simulate the poor response of inferior facilities, ensuring that the construction of the soundtrack was being evaluated as it would be heard by the

⁴ Special sound effects created for films (Blake, 1999: online) OR The process of creating the overall sonic character of a production (Filmsound <http://www.filmsound.org/terminology/sound-terms.htm>)

public. Florian (2002: online) describes the *Academy Curve* as a dramatic attenuation of the treble and a high reduction of the bass. It is also known as the *Normal Curve* and is defined as:

40 Hz	- Down 7 dB
100 Hz - 1.6 kHz	- No Equalization
5 kHz	- Down 10 dB
8 kHz	- Down 18 dB

Soundtracks became more advanced as microphone and recording technology improved over the years. Various pioneers in film sound also contributed to this advancement. Kallay (2004a: online) describes Jimmy MacDonald, a sound effects technician, as Disney's main sound effects "wizard". He created both "man-made" sound effects as well as vocal sound effects, which can be heard on numerous animated shorts as well as full-length features.



Walt Disney was responsible for the next major innovations in film sound. In *Fantasia* (1940), the animators combined classical compositions with their visual interpretation of the music. His ambition was to surround the movie audience with the sound reproduction of a live orchestra, with directional effects of the music seemingly coming from different parts of the screen or even from off screen would add to the dramatic impact of the animation (Kallay, 2004a: online). The engineers at Disney invented "Fantasound" which used four mono optical sound tracks. The theory behind the recording was that by making a multiple channel recording with satisfactory separation between the channels, there would be suitable material available to obtain any desired dynamic balance (Garity & Jones, 1942: online). Another important contribution that "Fantasound" made to film sound history was developing a means to move a sound source across speakers. Dubbed the "panpot", it was developed to simulate a moving sound source with as smooth transitions as

possible (Garity & Hawkins, 1941: online). The result was described as “eight push-pull variable-area recording channels” (Garity & Hawkins, 1941: online). Six channels were used to record violins, violas, cellos and basses, woodwinds, brass and timpani. The seventh channel recorded a mix of these six and the eighth recorded a distant pickup of the entire orchestra, and a click track was used to allow for animation timing (MTSU: online).

Experimentation with sound continued and in the 1940’s a few films used both silence and sound as a means for scaring or mystifying an audience. The idea of having silence merge into a sudden and unexpected sound emitting from the soundtrack proved to be effective and one of the earliest examples of this type of sound use was David Lean’s adaptation of Charles Dickens *Great Expectations* in 1946.

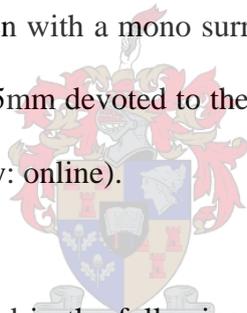
In the latter part of the 1940’s animation proved to be a groundbreaking medium in sound use yet again. Warner Bros. was making the now classic *Looney Tunes* shorts. These cartoons were the ideal of sound; not only being used as a storytelling device, but also as an ingenious use of timing and comedy (Kallay, 2004a: online). Many of these cartoons combined the voice talents of Mel Blanc, exaggerated sound effects and music to result in a well-balanced, effective soundtrack.

Surround sound was reintroduced to audiences in 1952 in *This is Cinerama* (Kallay, 2004a: online). Many audiences had not been exposed to the Fantasound presentation as only a few cinemas had been equipped to play the format. The 3 panelled movie combined sound emanating from all parts of the theatre and was a success with both audiences and critics. Kallay (2004a: online) writes that the success of *This is Cinerama* led to “CinemaScope”, which utilised a four-track magnetic 35mm print, and numerous other widescreen processes. The Todd-AO process used six track magnetic

70mm prints. This format was the forerunner to six-track Dolby Stereo (1976), DTS⁵ (1993) and SDDS⁶ (1993).

The development of multichannel surround sound opened up aural possibilities that had not been available in mono sound. Many of the techniques used are considered gimmicky by today's engineers, the process of having sound emanating from a person walking from left screen to right screen while the sound pans with him, was considered a breakthrough in the 1950's. Music tracks could be spread across the screen, instead of being placed in the centre and sound effects could be heard from behind the audience.

Oklahoma! opened in 1955 and featured Todd-AO sound format. Similar to CinemaScope, Todd-AO used five speakers behind the screen with a mono surround channel. The 65mm negative was printed onto 70mm film with the extra 5mm devoted to the soundtrack, 2.5mm on either side of the film (Middle Tennessee State University: online).



Yet the effective use of sound regressed in the following years. Despite the heyday of magnetic stereophonic sound, many factors contributed to the stagnation of sound. Expensive box office failures, the collapse of the studio system and the emergence of European and Independent cinema resulted in stereophonic sound and supreme visual presentations becoming out of vogue. Magnetic tape was more than ten times more expensive than optical print (Dolby, 2005: online), which meant that a significant number of films from the mid-fifties and early 80's were recorded and mixed in mono. The next major sound advancement was in the mid 70's with the introduction of Universal

⁵ "Digital Theatre Systems" (Smith, 2001: online)

⁶ "Sony Dynamic Digital Sound" (Smith, 2001: online)

Picture's "Sensurround". Featured best in the film *Earthquake* in 1974, it was a mono soundtrack with a low frequency rumble track.

Dolby's first technology was the Dolby A-type noise reduction, introduced in 1965. It was initially designed for use by professional recording studios to make quiet master tape recordings. In 1972 the International Standards Organisation formalised Dolby's X-curve EQ standard for theatres and mix rooms, this was to replace the Academy Curve of the 1930's. Using pink noise, the X-curve specified a 3dB per octave roll-off above 2kHz (Middle Tennessee State University: online). That year *A Quiet Revolution* premiered as the first film to have Dolby A noise reduction on the release print; the movie had been made to show the advantages of noise reduction to the exhibitors.

Despite the withdrawal back into basic sound as regarding methods of recording and presentation, Walter Murch and Ben Burt began to reinvent the art of making the soundtrack dynamic. Working with filmmakers (Francis Ford Coppola, Spielberg, Scorsese, Lucas) who recreated cinema art in the early 70's with films such as Coppola's *The Godfather* (1972) and *Apocalypse Now* (1979), George Lucas' *American Graffiti* (1973) and *Star Wars* (1977), Martin Scorsese's *Mean Streets* (1973) and Steven Spielberg *Jaws* (1975). Film had a rebirth due to the work of these directors, and the art of the soundtrack began to advance due to the work of Burt and Murch.

Murch was the first to be designated "Sound Designer", first seen in the credits of *Apocalypse Now* (Wyatt and Amyes, 2005: 167) and is also credited for creating the term (Caul, 2005: online). Sound design is the process in which the film's soundtrack emulates and augments the world in which the characters and story exists. It is not simply a combination of dialogue, music and sound effects but part of the reality created on screen. *Apocalypse Now* (1979) is cited as an example of great sound design as is *Star Wars* (1977), which won Burt several awards, including a special

achievement award from A.M.P.A.S. The work of these two designers was the first time many saw the title of sound designer in the credits.

Both sound technology and the art of the soundtrack advanced jointly in the mid 70's. The release of *Star Wars* in 1977 by director George Lucas was a significant moment in film history for many reasons: it supposedly created the "blockbuster" mindset in Hollywood (Kallay, 2004a: online) and made advancements in special effects, sound effects and sound presentation to a level that we take for granted today. The pioneering work done in computer and miniature effects led to the CGI⁷ effects of modern films.

The release of *Star Wars* included the new Dolby Optical Stereo soundtrack, which was capable of delivering 4 channels of sound. Using their noise reduction technology, they were able to put two optical channels in the space previously occupied by the Academy Mono Track. The centre and surround channels were incorporated into the left and right channels so that when decoded in the theatre, the resulting sound was 3 screen channels and one surround channel (Florian, 2002: online). This was standard by the mid 1980's and is still used today as a failsafe or backup to digital tracks.

In the same year of the release of *Star Wars*, Dolby unveiled a new 70mm format, dubbed the "baby boom" format. Middle Tennessee State University describe the format as based on the same 70mm format as Todd-AO but had certain modifications. Three speakers were behind the screen (left, centre, right); there was one surround channel and two low frequency effects channels for frequencies below 200Hz. The release of *Star Wars* and *Close Encounters of the Third Kind*, both recorded with the Dolby stereo format, made a significant impression on both the film industry and audiences, who came to seek out Dolby equipped theatres over the standard mono soundtrack.

⁷ CGI: Computer Generated Images (Llewellyn, 2004: online)

THX sound, a certification program developed by Tomlinson Holman, was released by Lucasfilm in 1983 (Kallay, 2004a: online). By using select speakers, crossovers and auditorium acoustics, exhibitors were able to present an improved sound and picture presentation in their theatres, allowing audiences to enjoy the increasing complex soundtracks. While THX certification guaranteed superior sound, many theatres did not meet qualification standards or, in some cases, didn't pay for licenses.

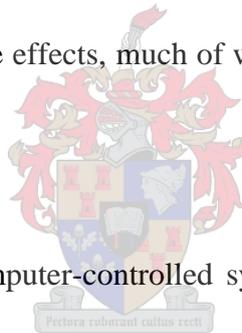
Digital sound made its first appearance in the early 1990's with Cinema Digital Sound (CDS), developed by Kodak and Optical Radiation Company (Kallay, 2004a: online) and was introduced on the film *Dick Tracy* (1990). Although sound quality of the format was good, CDS was unreliable and had no back-up system should the digital sound fail and lasted only until 1991.

The introduction of three digital formats to theatres changed the way films were heard in the theatres and at home. The formats; namely Dolby Digital (1992), DTS (1993) and SDDS (1993), allowed six tracks of audio, only previously able on 70mm film, to be available with 35mm prints. In the case of DTS, separate disks are supplied and the DTS theatrical system links time code printed on the film itself to corresponding codes on the disks. Dolby Digital and SDDS information are both printed on the film itself and SDDS is capable of allowing either 5.1 or 7.1 channels (Schoenherr, 2000: online).

2.1 Digital Audio Workstations (DAW's)

Before computers, the traditional method of sound editing and placing sound in synchronisation with the picture involved cutting a recording on perforated magnetic tape and joining it with tape (Wyatt and Amyes, 2005: 128). Aside from being a labour intensive method, it was a purely linear process.

Technological development has resulted in digital audio equipment that allows non-linear (non-sequential) editing and manipulation of sound (DiGregorio, 1998: online). Computers, software and electronic music instruments assist in almost every aspect of sound production (Westfall, 1998: online). With a growing trend in sound effects orientated movies, larger than life sound effects are a vital part of modern cinema (Tully, 1998: online). While the skill and work of the sound designer play a large part of the creation of these effects, much of what is accomplished is due to computer-based tools.

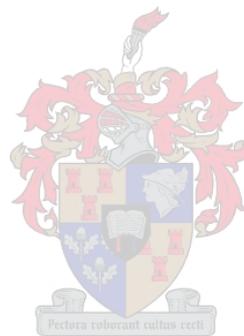


The digital audio workstation is a computer-controlled system that can record, edit, process and play back audio in sync with picture and other external systems (Wyatt and Amyes, 2005: 128). Many DAW's allow for a project to be completed within a single computer environment. The process of editing is entirely digital and non-destructive. A range of plug-ins (third party software) is also available for most systems; these may alter the audio or improve the original quality. Wyatt and Amyes (2005: 177) define plug-ins as self-contained modules that emulate traditional outboard processors or synthesizers and samplers. A mix can be completed in a number of formats, mono, stereo or multichannel or exported to another system for mixing.

At the core of the system is a specified operating system, such as Mac OSX or Windows XP, to support the DAW software. Other requirements are a minimum amount of RAM (random access

memory) as specified by the DAW software manufacturer, a video card to capture picture as a digital file to play with the audio track and a sound card, which allows sound to be sent to and from the DAW via analogue or digital inputs and outputs (Wyatt and Amyes, 2005: 130). The Digital Signal Processing (DSP) card carries out all audio processing and a synchronisation card enables the system to receive word clock and external units. The term DAW may apply to systems ranging in size and ability from a stand-alone card-based plug-in for a desktop computer to various high-end systems.

A DAW designed for audio-visual work must support timecode in order to synchronise frame accurately to picture in all playback modes. The more peripheral devices being used in synchronisation, the more important the need for a good synchronisation card or unit.

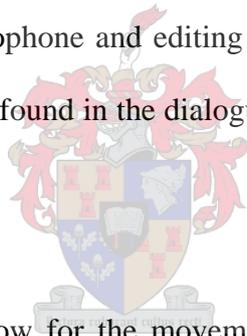


3 Aesthetics and uses of sound

Sound helps the filmmaker tell a story by reproducing and intensifying the world that has been partially created by the visual elements of the film (Barsam, 2004: 373). A good soundtrack can make the audience aware of the special and temporal dimensions of the screen, raise their expectations, create rhythm and develop characters. Sound can provide viewers with cues for interpretation and meaning in the story.

3.1 Early sound aesthetics

Many of the early “100 percent talkies” were visually dull. Giannetti (2002: 208) attributes this to restrictions caused by the early technology. The camera was unable to move from one position, the actors had to remain close to the microphone and editing was rudimentary. The major source of meaning found in these early films was found in the dialogue and the images tended to illustrate the soundtrack.



The development of technology to allow for the movement of the camera and use of overhead sound booms allowed for adventurous directors to begin experimenting with the possibilities of sound. Formalist directors however remained hostile towards the use of realistic, or synchronous, sound recording (Giannetti, 2002: 210). Eisenstein was one of these and was especially wary of dialogue. He believed that synchronous sound would destroy the flexibility of editing and thus kill the soul of film art. Synchronous sound did require a more literal continuity (Giannetti, 2002: 210), especially in dialogue sequences. Eisenstein’s metaphoric cutting, with leaps in time and space would not make much sense if realistic sound was to be provided with each image.

In the early sound era, many of the talented directors favoured non-synchronous sound (Giannetti, 2002: 210). René Clair believed that sound should be used selectively. Giannetti, (2002: 210) writes that Clair believed that the ear was as selective as the eye and so sound could be edited in much the same way that images can. Clair extended this to include dialogue, which also need not be totally synchronous; conversation can act as a continuity device, freeing the camera to explore contrasting information, a technique also favoured by Hitchcock and Ernst Lubitsch. Clair made several musicals that illustrate his theories. In *Le Million*, for example, music and song often replaces dialogue. Language is juxtaposed ironically with non-synchronous images and many of the scenes were filmed without sound and dubbed later when the montage scenes were completed.

3.2 Sound placement

Sound present in the soundtrack can be divided into three groups: Vocal sounds, which include dialogue and narration; effects, including environmental sounds, ambient sound, sound effects and Foley; and music. Barsam (2004: 363) adds silence as a fourth category, but this inclusion is unique. Other theorists and practitioners, including Balazs (1970: online) and Sonnenschein (2001: online), classify silence as an acoustic effect that is only effective when presented juxtaposed to sound, and not a category of sound.

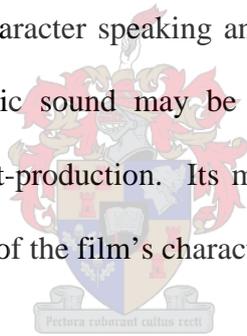
Film engages two senses, that of vision and hearing. Sound can be as expressive as any of the narrative and stylistic elements of the cinematic form. The sources of sound can be:

- Diegetic or nondiegetic
- Internal or external
- Onscreen or off-screen
- Synchronous or asynchronous

- Production or post-production

The word “Diegesis” refers to the total world of the films’ story (Barsam, 2004: 356). Diegetic sound is sound originating from a source within the film’s story space, while non-diegetic sound comes from a source outside that story space (Bordwell & Thompson, 1979: 199). Diegetic sound may give an awareness of both the spatial and temporal dimensions of the shot from which the sound emanates while most non-diegetic sound has no relevant spatial or temporal dimensions.

Diegetic sound may fit into any of the above sound sources listed above (aside from the non-diegetic sound source). The most recognizable movie sound is diegetic, onscreen and synchronous, where the sound heard occurs simultaneously with the image. The most obvious example of this is dialogue, where the viewer sees the character speaking and hears the dialogue in synchronisation with the lip movements. Non-diegetic sound may be any or all of the following: external, asynchronous and recorded during post-production. Its most familiar forms are that of narration spoken by a voice not belonging to any of the film’s characters or a musical score.

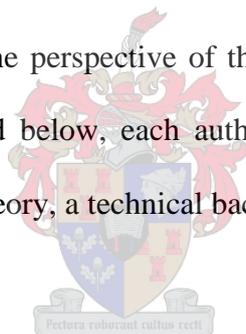


Internal sound is always diegetic and occurs when we hear the thoughts of a character seen onscreen but we assume the characters around them cannot hear them. Barsam (2004: 359) likens this concept to Shakespearean theatre where we hear the characters thoughts in the form of a soliloquy. He compares this technique further by making reference to Laurence Olivier’s screen adaptation of *Hamlet* where the famous “To be, or not to be” soliloquy is delivered in a combination of both spoken lines and interior monologue. External sound, also always diegetic, originates from within the world of the story but audience or the characters do not see the source of the sound.

Onscreen sound is another diegetic sound type and emanates from a source that we can both see as well as hear and may be internal or external. Off-screen sound may be diegetic or non-diegetic as it derives from a source that we do not see. As a diegetic sound, it may be sound effects, music or vocals originating from the world of the story. When non-diegetic, it takes the form of a musical score or narration. Non-diegetic off-screen sound does have the potential to become diegetic sound if a source is revealed to the viewer.

3.3 Defining film sound

The soundtrack is not merely a tool to aid and support the visuals but also is an artistic tool. Authors attempt to categorise methods used, either as definitions or as guidelines to the practitioner. The possibilities and functions of sound in connection with visual media are perceived from different viewpoints, associated with the perspective of the author involved. The definitions and guidelines of four authors are outlined below, each author with a different background in film including general film studies, sound theory, a technical background and an industry professional.



3.3.1 Barsam: “Functions of film sound”

Richard Barsam is Professor Emeritus of Film Studies at Hunter College at the City University of New York. He has written several books on aspects of film studies and contributed articles to several journals including *Cinema Journal* and *Film Comment*, and is co-founder of the journal *Persistence of Vision*. His book *Looking at Movies: an Introduction to Film* (2004), discusses various aspects of film composition and his outline of the functions of film sound was unique when compared to other general film sound books studied.

The terminology listed below may be used for analysis, theoretical texts or practically. That is, the terms themselves may be applicable to academic studies, but may also be used as guidelines in constructing a soundtrack.

Character

Sound in any form may function as a part of characterisation. Barsam (2004: 376) refers to Mel Brooks's *Young Frankenstein* (1979) where at the first mention of a certain character ("Frau Blucher") horses rear on their hind legs and whinny. The implication is that she is so ugly that even horses can't stand to hear her name. For the remainder of the movie, every time her name is mentioned, the same sound is heard.

Music themes are a more common use of the idea of characterisation. Specific themes recurring as a character makes their entrance or exit. In the original *Star Wars* films, the music score by John Williams makes substantial use of this method of characterisation. Specific leitmotifs are recurrent throughout the movies; for example, the "Imperial March" representing the Galactic Empire is present in five of the six *Star Wars* films (it is only absent in the first film *Star Wars: A New Hope*).

Fidelity

Sound can be faithful or unfaithful to its source. Barsam (2004: 377) illustrates this with an example of James Mangold's *Cop Land* (1997) when, during the climactic shoot-out, the sound is faithful to the severely impaired hearing of the character. Non-faithful sound is demonstrated when the devil speaks through the mouth of Regan MacNeil in the 1973 film, *The Exorcist* and when an explosion makes no sound in the opening montage of Coppola's *Apocalypse Now*.

Continuity

Sound can be used as a bridge, linking one shot to the next, indicating that the scene has not changed in time or space. This sound bridge or sound transition carries the sound from a first shot over to the next before the sound of that second shot begins.

Emphasis

A sound can create emphasis in any scene, functioning as an audio punctuation mark when it accentuates and strengthens the visual image.

Juxtaposition

By juxtaposing visual and aural images, the director can express a point of view.

Montage

A montage of sounds in a mix is a mix that ideally includes multiple sources of diverse quality, levels and placement and, usually, moves as rapidly as a montage of images. Sounds collide to produce an overall sound that is often harsh and discordant. *Apocalypse Now* uses more than 140 soundtracks combined including Ride of the Valkyries during the helicopter assault on the beach of a Viet Cong stronghold.

Sound versus Silence

The tendency to divide movie history into two distinct periods, “silent” films produced between 1895 and 1927 and “sound” films in the subsequent years, is an erroneous categorisation according to Barsam (2004: 381). His reasoning behind this is that contemporary sound films have the ability to use silence in ways that silent films could not and, furthermore, some experimental filmmakers

continue to make silent films. Silence is very effective in direct contrast to sound or as the result of a gradual fading out of sound

3.3.2 Chion: Terminology

Michel Chion is an experimental composer and a critic for *Cahiers du cinéma*. He has published books on screenwriting, Charlie Chapin, David Lynch and Jacques Tati in addition to books on film sound, including *Audio-Vision: Sound on Screen* and *The Voice of Cinema*. The list below is taken from the terminology section of the film sound website www.filmsound.org/terminology (Carlsson b: online) and expanded on from Chion's book *Audio-Vision: Sound on Screen* (1994: 221-224).

Chion's terminology is appropriate only to theoretical or analytical studies as they are terms best used for descriptive purposes and do not easily apply to practical applications.

Acousmatic sound

The sound one hears without seeing the originating cause. Radio is an acousmatic medium, while in film, offscreen sound is an acousmatic sound.



Acousmètre

A type of voice character specific to cinema that in most instances of cinematic narrative derives mysterious powers from being heard and not seen. A voice's source is not seen, not from the view of being off-screen, but in the terms of the character's presence being based on the absence from the core of the image by being hidden by curtains, in rooms or any other type of hideout. An example of this is the wizard in *The Wizard of Oz* (1939) whose reputation as "The all-powerful" is supported through a lack of physical presence.

Added Value

The expressive and/or informative value with which a sound enriches a given image. This is to create the impression that the meaning emanates from the image itself.

Audiovisual contract

The audiovisual relationship is unnatural but is more a symbolic pact to which the viewer agrees when he/she considers the elements of sound and image to be part of the same entity or world. www.filmsound.org simplifies this somewhat to define the audiovisual contract as ‘an agreement to forget that sound is coming from the loudspeakers and picture from the screen.’

Anempathetic sound

Sound, usually music, that seems to exhibit conspicuous indifference to what is going on in the film’s plot. For example, a radio that continues to play a happy tune even as the character who first turned it on has died.



Chronography

The stabilisation of projection speed that made cinema an art of time.

Empathetic sound

Music or sound effects whose mood or rhythm matches the mood or rhythm of the action onscreen.

Extension (of sound space)

The designation for the degree of openness and breadth of the concrete space as suggested by sounds both beyond the borders of the visual field and also within the visual field around the characters.

External logic

The logic by which the flow of sound includes effects of discontinuity as nondiegetic interventions.

Internal logic

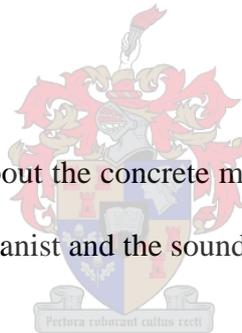
The logic by which the sound flow is apparently born out the narrative situation itself.

Magnetization (spatial)

Mental spatialisation, or the psychological process involved, when watching a monaural film of locating a sound's source in the space of the image, no matter what the real point of origin of the sound in the viewing space is.

Materializing Sound Indices

Sonic details that supply information about the concrete materiality of sound production in the film space, for example, the breathing of a pianist and the sound of fingernails on the piano keys.



Rendering

The use of sounds to convey the feelings or effects associated with the situation on screen. This may be in opposition to faithful reproduction of the sounds heard in reality. Rendering may translate as an amalgamation of sensations; for example, sound accompanying a fall is often a crash, conveying weight, violence and pain.

Synchresis

The forging of an immediate relationship between a sound and a visual when these occur simultaneously, which is what makes dubbing and other post-production sound mixing possible.

Temporalization

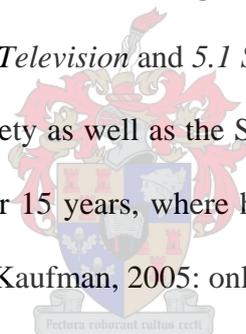
The influence of sound on the perception of time in the image.

Vococentrism

The privilege of the voice in audiovisual media.

3.3.3 Holman: “Commandments of Film Sound”

Tomlinson Holman is best known for his development of new products and processes in the field of audio and video. He is Professor of Cinema-Television at the University of Southern California and President of the TMH Corporation. He is the founding editor of *Surround Professional* magazine and Author of both *Sound for Film and Television* and *5.1 Surround Sound: Up and Running*. He is a fellow of the Audio Engineering Society as well as the Society of Motion Picture and Television Engineers. He worked at Lucasfilm for 15 years, where he became Corporate Technical Director and developed the THX sound system (Kaufman, 2005: online) described in chapter 2.



The “Eleven Commandments of Film Sound” (Holman, 1997: 213) cover basic work methods and principles for both production and post-production sound work. The quality of production sound has a direct influence on post-production work, hence the inclusion of all eleven ‘commandments’. Holman’s career background is of a technical nature and this is reflected here with guidelines of a practical nature, although he does state that any of the rules are breakable in order to serve the story.

Separate physical sound cause and effect from psychoacoustic cause and effect

The advantage of doing so is that the problem solving is best handled in the domain of the cause. Human perception of sound fields wraps together physical and psychoacoustic sound. Test

equipment virtually always works in the physical domain, and thus may not show best what is perceived to be a problem.

Allow the sound crew on the set an overhead boom microphone

The overhead position is usually decently far from the room boundaries so that directional microphones can work properly, and it is usually the best location to capture actors' voices.

Always either wait a moment before calling “action” or “cut” so that the sound editor has some footage that matches the scene for a presence track

This is often overlooked in production, but a few seconds on each shot saves a great deal of time in post-production. The few seconds can be made into a loop and an x-copy made of any length necessary to fill out the scene.

Make sensible perspective choices in recordings

Extreme perspective changes are jarring as the direct-to-reverberant ratio changes from shot to shot; only subtle changes are typically useful. Remember that it is always possible to add reverberation⁸, but exceedingly difficult, if not impossible, to remove it post-production.

In narrative filmmaking, exercise discipline and control on the set by minimizing all undesired noise sources and reverberation, and maximizing the desired source.

When you are making a fictional film, you have the ability to “pan off” an undesired object; use the same control for the sound.

⁸ Reverberation - Multiple, blended sound images caused by reflections from walls, floor and ceiling. Also can be created artificially by electronic or mechanical devices (Smith, 2001: online).

Make sure the sound is in sync with the picture

Nothing is more amateurish than out-of-sync production sound: there is a need for traceability of sound sync and camera sync to a common or to matched sources

Organise tracks during editing with a strong eye to mix requirements

Fit tracks to the available number of dubbers or tracks of a multitrack, leaving as much space between different sounds as possible. Keep similar sounds in the same units, and different ones in different units.

Normally, provide a complete audio world, including adequate presence and Foley or equivalent effects

Many poor films simply do not have enough effects: silence is rarely found in nature, and should not be found in films either. The lowest level sounds, such as background noise of rooms, must be brought up to such a level that it will “read” through the medium in use. This means the noise will have to be louder than natural to be heard on a 16-mm optical soundtrack, for instance.

In mixing, one job is to get the program material to best “fit” the dynamic and frequency ranges of the target medium

It is silly to mix an 80 dB-wide dynamic range for a 16-mm optical soundtrack, and it may be equally silly to mix a 40 dB-wide dynamic range for a Dolby SR 35-mm release.

Storytelling always comes first: if it works, break the rules

Other than doing damage to people or equipment, all the “rules” given are breakable for artistic purposes, if breaking the rules results in art being produced

Separate strongly the requirements of production from those of reproduction

The filmmaker is highly involved with the first, but the second should be practically a mechanical process.

3.3.4 Thom: “Sound’s Talents”

Randy Thom began his career in radio and began his career in film sound working for Walter Murch in *Apocalypse Now* as a sound recordist. He has been working for Lucasfilm for approximately 25 years and has done sound work for approximately 57 films. He has been nominated for 12 Oscars™ of which he won two, one for best sound effects editing in *The Incredibles* (2004) and the other for sound in *The Right Stuff* (1983). In September 2005 he was named Director of sound design at Skywalker Sound (Lucasfilm, 2005: online).

Randy Thom’s sound attributes are applicable both in analysis and in practice, and can form guidelines to the construction of the soundtrack. He maintains that the combination of dialogue, music and sound effects can achieve one or more of the following descriptions as listed below. According to Thom, sound is likely to be performing several of these functions at any one time but should try have a life of its own beyond utilitarian functions. His attributes are not unique, similar guidelines may be also be found in *Audio Post-production for Television and Film* (Wyatt and Amyes, 2005: 166 - 167). The ultimate use of sound is when it is part of a continuum, when it changes over time, has dynamics, and resonates with other sound and with other sensory experiences. Sound may (Thom, 1999: online) :

- Suggest a mood, evoke a feeling
- Set a pace

- Indicate a geographical locale
- Indicate a historical period
- Clarify the plot
- Define a character
- Connect otherwise unconnected ideas, characters, places, images, or moments
- Heighten realism or diminish it
- Heighten ambiguity or diminish it
- Draw attention to a detail, or away from it
- Indicate changes in time
- Smooth otherwise abrupt changes between shots or scenes
- Emphasize a transition for dramatic effect
- Describe an acoustic space
- Startle or soothe
- Exaggerate action or mediate it

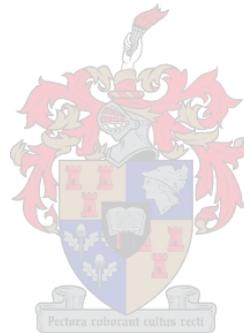


3.3.5 Describing sound with musical terminology

The terms and guidelines outlined above are largely interchangeable between music and the remaining sound elements: sound effects and vocal sound, if music is to be assessed as a separate element. In some texts, the use of music terminology is applied to defining and analysing sound. In Bordwell and Thompson's book, *Film Art: an introduction*, the terms 'loudness', 'rhythm', 'pitch' and 'timbre' are defined in relation to sound and examples from various films are given. In Tony Zaza's *Audio Design: Sound recording techniques for film and video* (1991: 43 - 49), similar terms are used to describe the elements of sound in the sense of every sound having a perceived pitch,

timbre and, where appropriate, rhythm. He moves away from music terminology when discussing the construction of a soundtrack.

Rick Altman (1992: 15-16) feels that merely using musical terminology is insufficient and is based on the assumption that all films sounds have the nature of musical notes. To fit these properties they would have to be instantaneously produced single phenomena that are emitted from a point source and perceived in an immediate and direct fashion. Following this definition, aspects such as contrast and confluence can be described in terms of volume, frequency and tone. Altman's (1992: 15 – 16) argument is that besides the assumptions of the nature of sound, music terminology is inadequate to describe sounds used in film. His reasoning is that music terminology diverts attention from the discursive properties of sound; sound is a complex, heterogeneous and three-dimensional medium.



4 The audio post-production process

The Motion Pictures Sound Editors Organisation defines audio post-production as the process of creating the soundtrack for moving pictures (Nazarian: online). Wyatt and Amyes (2005: 3) define the term more specifically as the part of the production process that deals with tracklaying⁹, mixing and mastering of a soundtrack. Although sound is recorded during filming, most of the soundtrack is constructed during post-production. Sound recorded during filming is referred to as production sound and includes atmospheric sound, location ambience, sound effects and dialogue (Nazarian: online). In audio post-production, sound is edited, synchronised with the visual image and mixed. Depending on the size, type and budget of a production, audio post-production consists of several processes, including:

- Production Dialogue and ADR¹⁰ editing
- Sound effects design, editing and mixing
- Foley editing and mixing
- Music composition, editing and mixing
- Final Mixing/re-recording



The complexity of the finished soundtrack varies according to the type of production and its needs, its aims and purpose remain the same.

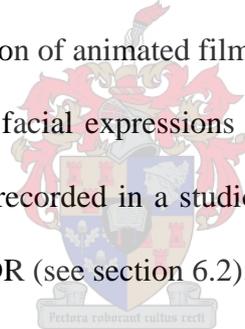
⁹ tracklaying: the editing and assembly of tracks in preparation for the final mix

¹⁰ ADR: Automatic Dialogue Replacement – the process of re-recording dialogue in synchronisation to picture

4.1 Pre-production and production phases

Pre-production is the planning and preparation stage of a project. While audio post-production is one of the final stages of a project, decisions and work done in previous stages have a profound effect on the audio post-production work. Scheduling, deadlines, creative content and budgets are discussed and outlined during this phase. This will outline the requirements of the audio post-production which include length, format (including mix), and budget allowance (Shepherd, 2003: 25).

Production sound is all sound recorded during the filming stage of a project. Once the script is finalised, a cue sheet is compiled listing all major audio events in the project. Audio post-production work may begin at this stage in larger projects if effects must be specially sourced or created. Another exception is the creation of animated films. Dialogue is recorded during this stage in order for the animators to draw the facial expressions and mouth movements of the characters (Shepherd, 2003: 31). As dialogue is recorded in a studio and not on location, dialogue does not need to be cleaned up or replaced in ADR (see section 6.2).



The number of sound personnel involved in production recording depends on the size of the project but most likely includes, at the least, a production sound mixer and a boom operator. The production sound crew are responsible for all sound recorded during principle photography and must ensure that the dialogue is of maximum intelligibility and, if possible, satisfactory for use in the final soundtrack (Allen: online). If, due to high levels of extraneous noise, the recording is not suitable for use in the final soundtrack, it can be used as a guide track for ADR. The production sound crew may also collect sound effects and atmosphere tracks for use in the final soundtrack (Shepherd, 2003: 89).

The quality of production sound has a great influence on the post-production dialogue. Cleanly recorded dialogue is easier to edit and results in less ADR work. The recording of room tone¹¹ and wild tracks¹² aid the creation of accurate sound representation of a scene and the correct documentation of takes aids the accessibility of required sound.

4.2 Post-production

The final visual edit, known as the locked cut (Nazarian: online) signals the start of audio post-production and the spotting session takes place. The supervising sound editor, director and composer meet to decide the film's audio requirements. Music spotting determines where the music score will be and where source music is required. Sound spotting determines if and where dialogue problems exist in order to cue ADR to be recorded, what sound effects are needed and where, Foley effects needed and if any sound design (creation of special effects) is needed.

A copy of the visual edit is given to the audio post-production team. The appropriate sound is sourced using the Edit Decision list, or EDL¹³, and transferred from the DAT tapes (most commonly used) into the editing system. Alternately, the production audio edit will be included with the visual in the form of an OMFI file¹⁴. This file type is used to communicate session information between editors of different types, for example a visual editing program and an audio

¹¹ Room tone: a recording of the sound of the room filmed in (CAS Webboard, 2002: online)

¹² Wild track: a sound recorded with no synchronisation reference (CAS Webboard, 2002: online)

¹³ Edit Decision List: A computer generated document listing the source, the timecode and editing instructions (including fades and dissolves) corresponding to all the segments used in the edit (Lerner: online).

¹⁴ OMFI: Open Media Framework Interchange (Shepherd, 2003: 30)

editing program. Opening an OMFI in Pro Tools will extract the audio files, session files as well as crossfade¹⁵ and automation¹⁶ data (Shepherd, 2003: 33).

Following the spotting session, production sound is cleaned up and replaced as necessary and sound editors locate all the additional sounds required. If necessary (and if the budget allows), the audio post-production team will create field recordings of any new sound effects needed. In a large project, different people will carry out each sub-division of the soundtrack. Sound may also be placed according to the format requirements; often several sub-mixes are required including multichannel (surround) and stereo.

After the sound has been sourced, edited and synchronised, the mixing stage, also known as dubbing or re-recording, begins. During the mix stage, all the separate elements of the soundtrack are assembled in their edited form and are balanced by a number of mixers to become the final soundtrack. The complexity of this process is dependent on the size of the project and on the number of personnel available/hired. The lead mixer may work with dialogue, ADR and possibly the music while the effects mixer handles sound effects and Foley. A simple split would be dialogue, effects and music.

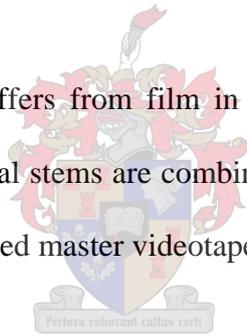
15 Crossfade: A picture or audio transition where a fade out mixes directly into a fade in (Wyatt and Amyes, 2005: 259).

16 Automation: A system where manual control of a process is replaced or enhanced by computer control, such as mixing desk automation where faders, mutes, and equalization can be controlled in part or in whole by a computer (Lerner: online).

To prevent the mix from becoming overwhelming, each mixer creates a small set of sub-mixes or “Stems” (Nazarian: online). These mix stems - dialogue, effects, Foley, music, extras - are easier to manipulate and update during the mix.

Once the mix has been completed and approved the final step is Printmastering. The various stems are now combined into a final composite soundtrack, which is used to create an optical or digital soundtrack for a feature film release print. In addition to this, it is also standard practise to run an “M & E” track, or Music and Effects track. This is the complete soundtrack with the dialogue removed. This allows for foreign language versions of the project to be dubbed easily whilst preserving the original music, sound effects and Foley. Any effects and Foley that are linked to any of the production dialogue are also removed and must be replaced in the foreign dub.

Audio post-production in television differs from film in that no printmasters are created unless surround sound has been used. The final stems are combined in a process called “Layback”, when the soundtrack is united with a final edited master videotape for ultimate delivery.



4.3 The Audio Post-production crew

Weis (1995: online) considers the soundtrack to be the most collaborative components of filmmaking. The number of people involved in post-production audio may number from one or two for an independent or low-budget project to over 50 personnel. The film *Serenity* (2005), for example, had over 55 people involved in audio post-production. Table 1 shows the credit listing for *Serenity* indicating the type of work involved in a large scale production as well the number of people involved in the different areas of audio post-production for this film.

Title in Credits	Number of personnel
Music (Opening credits)	1
Supervising sound editors	2
First assistant sound editor	1
Design Editors	4
Sound effects editors	5
Dialogue editors	4
Assistant sound editors	3
Re-recording mixers	2
Recordist	1
Foley supervisor	1
Foley editor	1
Sound effects recordists	6
Foley Artists	2
Foley mixer	1
Foley recordist	1
ADR mixers	2
ADR recordists	2
Voice casting	1
Executive in charge of music for universal pictures	1
Music Editors	2
Music Contractor	1
Music Preparation	Music services Company
Orchestration by	1
Digital Recordist	1
Score Consultant	1
Scoring Sound Supervisor	1
Score recorded and mixed by	1
Scoring Crew	5
Digital orchestral timings	1

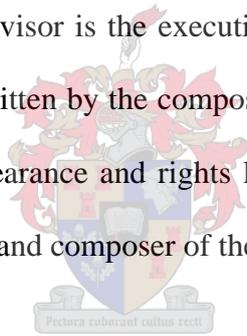
Table 1

Job requirements and descriptions may differ according to the type and size of project being undertaken. The following is a description of different types of jobs in audio post-production as outlined by the Association of Motion Picture Sound (online), Blake (1999: online) and Allen (online).

Supervisors are in charge of the sound editorial process. Their duties are to direct and coordinate the sound staff as well as any related administration tasks involved e.g. scheduling the mixing and dubbing sessions. Supervisors for Foley, dialogue and sound effects each answer to the supervising

sound editor who is in charge of the final soundtrack. If there is a sound designer, he may or may not have equal status with the supervising sound editor. If a sound designer is appointed for controlling the overall sound of the film, then the supervising sound editor controls the administrative detail while the sound designer is in control of creative decisions.

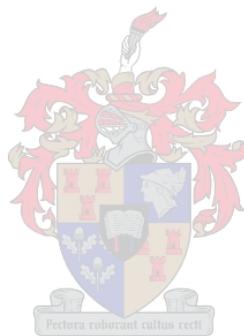
If an original score is composed for the production then various processes take place before the recording of the musical cues. The arranger/orchestrator takes the composed music material and arranges it for the specified ensemble or group. The arranger may also have to arrange music in different styles e.g. traditional music for a contemporary setting (rock group, big band). The copyist then prepares the music into readable parts for the musicians using the score provided by the composer or arranger. The music contractor hires musicians and the musical cues are recorded by the scoring recordist. The music supervisor is the executive who manages the licensing of music (and if necessary, the original music written by the composer) for a film or television project. The music supervisor handles the music clearance and rights licensing of any existing music but also functions as a link between the director and composer of the music.



Editors are responsible for assembling the tracks and sourcing or recording any extra material needed. Each field of sound requires a different approach and skills. Dialogue editing involves cleaning production audio, fixing synchronisation problems and replacing or fixing any unclear dialogue. The effects editor provides all the incidental sounds from footsteps to explosions; these may be sourced from libraries, specially recorded by sound effects recordists or constructed (Bridgett, 2002: online). There may also be a separate editor for Foley. A Foley artist performs to picture with the aid of props, simulating sounds generated by human movement, which are recorded by the Foley recordist/engineer. The music editor ensures that the music tracks fit with dialogue

and sound effects and are placed correctly according to cues. Editing is complete when the tracks are ready for mixing.

The re-recording (or dubbing) mixer is responsible for quality and balance of all the sound elements in the final soundtrack. Using the tracks provided by the editors, the pieces are assembled and enhanced (using equalisation, reverb and/or filtering of sound) then blended. The process may begin with submixes of the different sound elements done by sub mixers (e.g. a dialogue mixer) and then combined by the re-recording mixer.



5 Synchronisation

The process of audio post-production includes sourcing, constructing and mixing the audio for a film. The audio tracks are designed, however, to fit the visuals and therefore a form of synchronisation or sync is necessary. In manual, or tape, editing synchronisation was possible using the sprocket holes of film. With electronic systems, a universal code is needed for both visual and audio editing to allow for transfer between systems.

In the early days of film, scenes of a film were filmed from beginning to end in one take and the only editing that took place was cutting the scenes together in the correct order (Shepherd, 2003: 42). As new filming techniques were explored, there was a need for each individual videotape picture to be identified or labelled at specific points, in order to achieve accurate cuts (Wyatt and Amyes, 2005:27). By writing the information on the edge of the film, using notes and numbers, the “feet and frames” measuring system developed. Each second on 35mm film contains 24 frames and foot of film has 15 frames. Designating film with a foot and frame reference aided complicated editing and was the first time code (Shepherd 2003, 42).

Using timecode, it is possible to identify a frame and perform a precise picture edit. Similarly, time can also be identified by frames. Any sound recorded in sync with a picture retains the corresponding frame identity and so a particular point in time on the soundtrack relates to a particular frame of picture. Wyatt and Amyes (2005:28) do state however that sync drifts do occur within an individual frame, these are usually imperceptible either audibly or visually. Dialogue is most susceptible to noticeable synchronisation problems, drift of synchronisation of more than a

frame is apparent and the lipsync¹⁷ appears to be imperfect. In order to retain accurate sync the picture and sound must match each other on a frame-for-frame basis.

The advent of television resulted in various manufacturers developing their own editing systems, each with a time code system unusable by other systems. In 1969, the Society of Motion Pictures and Television Engineers developed a new time code standard which allowed all editing systems to speak the same language (Shepherd 2003: 43). It defined the means for encoding film so that each frame had an individual address. These addresses were sequential and were referable both visually and electronically. Each address represents hours:minutes:seconds:frames and is separated with a colon.

There are still two different standards in video prevalent today. The first is the NTSC¹⁸ standard used in America and Japan and the second is the European video standard, called PAL (phase alternate line) or EBU (European Broadcast Union). The frame rate of television was based on the carrier frequency of the electrical current of the AC outlet, as it provided a stable, convenient source of time reference that video systems could use. Each frame of video signal contains two fields, each representing half the horizontal lines comprising the image, one field with the even lines and one with the odd lines (Shepherd, 2003: 43).

In the United States the AC line frequency is 60Hz, engineers used the cycle to trigger each field of video with the resulting frame rate of 30 frames per second. With the advent of colour television, the frame rate was lowered by 1%, which is the reason behind the 29.97 frame rate used in NTSC today. The reason behind the 1% slowing of frame rate was that it allowed for backwards

¹⁷ “A term used to describe any on-camera speech and its sync relative to the picture.” (Wyatt and Amyes, 2005: 266)

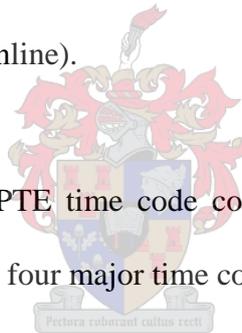
¹⁸ NTSC: National Television System Committee (Rees, 2001: online)

compatibility with black and white television sets with the most predictable results. The PAL/EBU system was similarly designed using the AC line frequency of 50Hz as reference, resulting in a frame rate of 25 frames per second. AC lines are no longer required to trigger video fields as there are more accurate and dependable methods, such as a quartz clock, which can run at various speeds.

5.1 SMPTE time code

In 1967 the Society of Motion Picture and Television Engineers (SMPTE) introduced SMPTE time code to allow for accurate synchronisation of video and sound (Rees, 2001: online). There are two parameters that affect the format of SMPTE time code. The first is frame rate, or the speed of the time code, and the second is the frame count, which determines if frame numbers are skipped in order to stay aligned with real time. The time data is coded in binary coded decimal digits in the form HH:MM:SS:FF (Poynton, 1996: online).

The different frame rates used in SMPTE time code correlate to the different speeds of visual media. Shepherd (2003:44) outlines the four major time code formats used as:



- NTSC Black & White 30 fps (frames per second), which is only used in music or audio-only applications. It does no longer relate to any standard visual signal.
- NTSC Colour 29.97 fps, which is the standard frame rate for NTSC colour video used in the United States since its inception.
- PAL/EBU Video 25 fps is the frame rate used in Europe and other countries using the PAL system.
- Film and HD Video 24fps is the most common frame speed for film, however if the final product is not film, a different frame rate may be used.

Frame count is the second adjustable parameter in SMPTE time code. It is mostly applicable to NTSC frame rate to solve drift between the time representation on an editing system and real time. With NTSC colour the frame rate is slightly slower than 30 fps, which became gradually more noticeable as time progressed. For example, after an hour of real time 29.97 SMPTE reads 00:59:56:12, a difference of over 3 seconds (Shepherd 2003:44). In projects of a short length (e.g. an advert), the difference is negligible but the time code drift is significant in any project over a minute in length. In order to maintain an accurate real time display, frame numbers need to be dropped. While no video is skipped, SMPTE drop frame will skip certain frame numbers so that the time display is more precise.

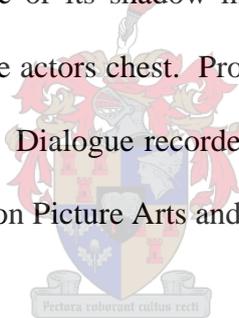
In every 10 minutes of film, 18 frames need to be dropped which is achieved by skipping two frames every minute for nine minutes and none in the tenth minute. This cycle is repeated every 10th minute and no actual video frame is skipped, just the number, so that after an hour of real time the time code number of 29.97 fps drop frame will also read 01:00:00;00. Drop frame time code is usually represented by separating the seconds and frames with a semicolon and not a colon, although occasionally all separators are semicolons. This method of identification is a standard representation but is not guaranteed and the visual post-production crew should confirm timecode parameters.

Most audio post-production software is equipped to operate with all standard frame rates and frame counts and many also have the ability to transfer audio from one to another.

6 Dialogue and ADR

Dialogue is considered to be the most important of the sound elements (Yewdall, 2003: 251). It has the ability to give direction to a story, communicate key plot and character information as well as tie the narrative structure of the movie together (Lucasfilm, 1998: online). The vocal element of the soundtrack may be heard in various forms: dialogue, narration and thoughts.

Dialogue is recorded from two main sources, production sound and ADR. Production sound is recorded on set by the production mixer, who tries to record the dialogue as cleanly as possible with a high signal to noise ratio (Weis, 1995: online). This is mostly achieved by a boom operator, suspending a shotgun microphone above and in front of the person speaking, getting as close as possible without letting the microphone or its shadow in the frame. An alternative to this is a microphone (lavalier type) hidden on the actors chest. Production sound may also be referred to as the *production track* or *location sound*. Dialogue recorded during filming makes up the foundation layer of the dialogue track (Academy of Motion Picture Arts and Sciences, 2003: online).



6.1 Dialogue post-production

Post-production work on dialogue consists mostly of cleaning up the production sound. Directors usually prefer to use production dialogue rather than replacing the dialogue with ADR (see 6.2) as it is closely connected to the actor's performance and is difficult to duplicate both the conditions of recording and the interpretation. Audio should be edited in such a way that the audience perceives the audio to be a continuous piece of audio and be unaware that the scene is actually constructed from discontinuous audio sources (Wyatt and Amyes, 2005:150). Wyatt and Amyes (2005:150) refer to this as an invisible art because of audience expectations, it is only when there are poor edits, synchronisation problems or badly fitted ADR that the audience is pulled out of the narrative flow.

Dialogue editing requires detailed, painstaking work such as reusing the final consonant of a word to complete another or removing unwanted noise. Methodical work and consistency of session preparation is crucial in dialogue editing (Yewdall, 2003: 259).

The process begins with the transfer of all production sound, alternative takes and wildtracks to the DAW. The production track is placed on a spare audio track to function as a sync reference as well as a guide track for ADR. As the dialogue editors are also given a copy of the sound report sheets, 'marked up' scripts (showing how a scene has been shot and marked with corresponding slate numbers) and a printout of the audio EDL, listing the takes used in the edit (Wyatt and Amyes, 2005: 152).

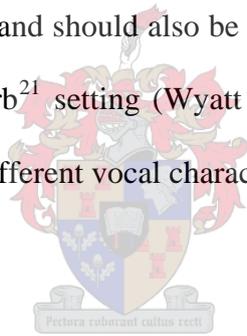
The complexity of any editing process is dependent on the scene involved. An interior scene, for example, should be relatively simple whereas an exterior scene may be more problematic as unwanted noise is more likely to intrude on the production track (Wyatt and Amyes, 2005:152).

The first task in dialogue post-production is to split the spoken lines onto separate tracks according to character and camera/microphone angles. This is done to make them as independently controllable as possible, making it easier to allow for seamless flow of dialogue. The scene should be analysed to determine the predominant background. This will be extended and smoothed to create a continuous background presence and any lines marked down for ADR should be split onto a separate track so that they are available if the ADR is not satisfactory (Wyatt and Amyes, 2005: 153). Unwanted FX¹⁹, bumps and clicks are then to be edited out and words, syllables or part syllables (phonemes) can be replaced from other takes if necessary, providing that the fix does not change the tone of the performance (Wyatt and Amyes, 2005:153).

¹⁹ Standard abbreviation of "Effects"

There are also various methods to provide continuity and realism in the dialogue tracks. When there is a cut from a wide shot to a closer angle, replacing the wide sound with takes from the close up provides perspective to the sound that matches the shot change. Room tone (the sound of a room with no movement or dialogue) is added to ADR, between the edited dialogue lines and, when applicable, voice over/narration. Room tone is used to create a matching background for new material to be inserted into the track, or to fill gaps created in the track by the removal of the director's voice or other background noises. If room tone was not recorded, tone may be taken from gaps in the dialogue and may be edited in and smoothed with crossfades.

Once editing is complete, the tracks are prepared for mixing. The tracks should be laid out so that the mixer can audition any alternatives and should also be split for perspective, as each perspective will require a different EQ²⁰ and reverb²¹ setting (Wyatt and Amyes, 2005:162). Tracks should also be split according to character as different vocal characteristics may require different EQ.



6.2 ADR

Some dialogue heard in the film is not recorded on location. This may be for a number of reasons: uncontrollable noise, such as aeroplanes or clothing rustle on the lavalier mikes. Occasionally it is easier to shoot silent (MOS²²) than achieving perfect quiet from cast, crew and extras. If dialogue

²⁰ Equalization: An effect that allows frequency selective manipulation of a signals amplitude. (Lerner: online)

²¹ Reverb: A signal processing effect which produces a continuous wash of echoing sound, simulating an acoustic space. (Lerner: online).

²² The term MOS is used when a scene is shot with no sound recorded. The original meaning of this acronym is unknown (MOS, 2001: online).

cannot be salvaged from the production tracks, it must be rerecorded in a process known as ADR (Automated/Automatic Dialogue Replacement), which is also referred to as looping.

Before the introduction of the digital audio workstation (DAW), looping involved an actor speaking lines in synchronisation to “loops” of the image played repeatedly along with matching lengths of magnetic tape. ADR, using DAW’s, is faster but it is still painstaking work. The actor watches the repeating image, listening to the original production sound over headphones as a guide. The actor then re-performs each line, attempting to match the wording, lip movements and emotional tone.

Other applications of ADR are the dubbing of foreign language films as well as the replacement of unacceptable words for television and commercial airline releases of a film (Kallay, 2004b: online).

6.3 Editing tips

Digital stations allow for audio editors to work with pictorial representations of sound. Rose (2001: online) warns that not all audio details appear on the graphic representation of a waveform. He maintains that relying solely on what is seen, by editing out any point where the waveform has dropped to zero may result in the discarding of useable audio. Waveforms should be used as a guideline only and edits should be marked whilst scrubbing²³ and listening. Rose (2002: 175) recommends using phonemes, the different types of sound made by the movement of the human mouth, for dialogue editing by taking advantage of pauses created by certain phonemes e.g. the ‘p’ in ‘special’. The vowels sounds are responsible for most of the pacing in a voice. If a word is said too slowly, a small cut out of a vowel sound may help to pick up the speed.

²³ Scrub: To move backward and forward through an audio under manual control in order to find a precise point in the wave for editing purposes.

6.4 Creative dialogue use

Berliner (2002: 4 - 6) observes that dialogue in American films follows certain conventions and is realistic to the viewer only in terms of the cinema, as it would not be natural in real life dialogue.

He names four principles of dialogue as standard practice:

- Dialogue in American movies either advances the plot or supplies pertinent background information.
- American movie dialogue tends to move in a direct line, often toward one character's triumph and another's defeat.
- Characters in Hollywood movies communicate effectively through dialogue.
- Whereas most real people adjust what they are saying as they speak, movie characters tend to speak flawlessly.
- When a film breaks one of the movie dialogue rules, the transgression normally serves a direct narrative function.



While these rules are meant to apply to American type films, they would also apply to any films made in a similar structure. This is not an area controlled or created by audio post-production but does indicate the necessity for dialogue to be clean, well edited and audible in the final mix.

Dialogue may be manipulated in order to affect characterisation. For example, in order to make an arch-villain sound more domineering, the volume of his voice may be raised and the tonal qualities altered. This creates the aural equivalent of someone standing too close and invading our space (Weis, 1995: online). ADR may be used to change the interpretation of character, or emotional tone can be altered.

With the exception of these though, post-production work on dialogue remains largely technical and affords little creative scope in audio post-production.



7 Sound Effects

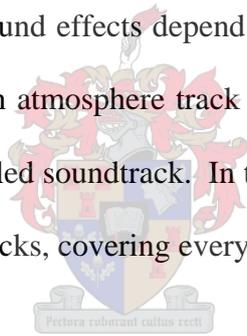
Sound effects refer to sounds, apart from dialogue, that objects or people make as well as sounds that occur naturally in the background. Sound effects create an audio landscape drawing an audience into the “reality” created by the director and out of the environment in which they are viewing the film (Wyatt and Amyes, 2005: 166). The strongest strength of sound effects is that of creating illusion with aural suggestion. Wyatt and Amyes (2005: 166) suggest that sound effects support the illusion of reality, continuity, special depth, space and suggestion. Other functions of sound effects may be masking problems in other areas of the soundtrack or setting the mood of a scene.

The illusion of reality is created simply through the use of sound effects. The setting of any scene may be given or supported by the use of the appropriate sounds. Continuous atmosphere tracks provide continuity though the scene is constructed from a number of discontinuous shots edited together. The properties of sound may also be manipulated for accurate perspective. The use of correct perspective on sound effects differentiates between foreground and background action, while the use of panning (surround and stereo) expands the spatial illusion.

The first rule of Sound Design: “See a sound; hear a sound” (Lucasfilm, 1998: online) sums up the most rudimentary function of film sound. When action is seen on screen, your mind expects a complementary sound. Any visual action becomes unbelievable without the appropriate sound accompanying it. Sound effects help suspend the viewer’s disbelief and become immersed in the movie experience. However, a sound heard offscreen is accepted into the reality of the story, without the need for visual support; a car crash heard through a window or the sound of rain: events can be introduced aurally and accepted by the viewer without visual confirmation.

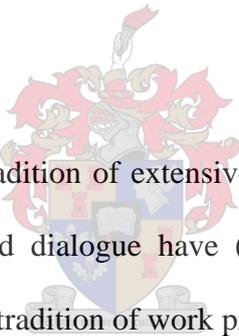
According to Wyatt and Amyes (2005: 167), sound effects can be divided into four categories: Spot/hard FX, Ambience/atmosphere FX, Foley (discussed in section 7.2) and Sound Design (discussed in section 7.4). “Spot FX” refer to individual effects that are related to a single source and are generally laid in sync with a specific action. This is consistent with the “see a sound, hear a sound” premise. “Spot FX” may also be used in a non-literal sense. As sound may be used singly or layered, e.g. an explosion effect may be used to add weight to falling buildings, a spot effect may be used for a purpose unrelated to its original source. Ambience or atmosphere FX refers to a non-synchronous sound used to create presence or ambience that places a scene in a specific location. These tracks aid in setting the mood of the scene and may also be used to signify a change in location.

The requirements and complexity of sound effects depend on the type of production; certain types of television production require only an atmosphere track and a few “spot FX” while high budget television as well as film require a detailed soundtrack. In the high-end productions, a large number of sounds are cut and laid over many tracks, covering every action onscreen.



The sound effects editor acquires sound effects from a number of sources: sync effects, wildtrack effects or effects libraries (Wyatt and Amyes, 2005: 169). Sync effects and wildtrack effects are effects recorded during production filming; the difference between the two is that wildtrack effects are recorded when the camera is not running. When the production sound is transferred, these sync effects are separated from the dialogue where possible and are either used in the mix or replaced. Sync effects may have an acoustic that is better than can be created in the studio or be a sound not easily sourced, while wildtrack effects can be incorporated into the soundtrack or used to replace sync effects.

Effects libraries form the major source of sound effects for any production (Wyatt and Amyes, 2005: 169). General libraries, organised according to subject areas are available for purchase as well as smaller specialist libraries (libraries with only cartoon sound effects or Foley). Major companies, such as the BBC and Warner Brothers, have developed their own private effects libraries and selected sound effects from these private libraries are for sale on CD. These are made up from sound effects specially developed for their productions. The Hanna-Barbara library, for example, offers selections from some of their cartoons such as *The Flintstones* while others offer sound effects from their movies. The *Hollywood Edge Premier Edition* consists of sixty CD's of sound effects, which include ambient sound and Foley as well as spot FX. Individual sound effects can be purchased online and downloaded from companies such as www.soundrangers.com (2004: online). If a sound effect is not available on any library or if a more exotic or unique sound is needed, then it must be custom recorded.



Sound effects do not enjoy the same tradition of extensive research from a scholarly, critical and professional perspective that music and dialogue have (Sergi, 2005: online). Composers and screenplay writers are able to draw on a tradition of work preceding theirs, as well as reference texts on method, theoretical writings and critical analysis of previous work done in the field. There is no single tradition or origin in sound effects. Practitioners of the art cite a wide variety of backgrounds as a source of their creative inspiration, including *musique concrète* and radio.

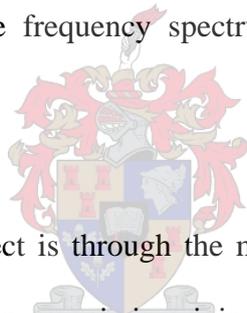
7.1 Sound effects post-production

Wyatt and Amyes (2005: 172) recommend that the sound effects editing begins with sourcing the majority of the FX that will be needed and transferring or recording these into the DAW. By grouping the sound FX in categories of similar sound, location of a specific effect will be easier at a

later stage. In the tracklaying of sound effects, it is better to supply more detail, if possible, than will be required, as the sound effects tracks can be thinned out at a later stage or in the mix.

Wyatt and Amyes (2005: 172 - 173) suggest a three-stage approach to large-scale projects. The first is to lay two or three ambience tracks, the second stage is the addition of picture/plot specific effects; for example, gun fire in a war scene. The final stage is the addition of extra touches or “sweetening” existing sounds (layering sounds on the original).

Most sounds require some form of manipulation. The most common strategy when creating sound effects is to use a sound source the same or similar to what was photographed and then distort it. The simplest method is to time stretch or compress it (slow it down or speed it up). Other methods may include filtering out parts of the frequency spectrum or reversing the sound (playing it backwards).



Another method to create a sound effect is through the mixing of dissimilar sound sources. By layering and mixing various sound, often organic in origin but digitally processed, many of today’s sound effects are created.

7.2 Foley

Foley is sound effects recorded in synchronization to the edited picture in post-production (Blake, 1999). Foley sounds are any sounds associated with human action but may also include any prop movement and is performed by a specialist department of the audio post-production crew (Brophy, 1987: online). Foley adds subtle sounds to the soundtrack to give the soundtrack depth. Foley sound is subtle and so rarely draws attention to itself but it is conspicuous when absent, as it helps anchor the visuals to reality (Stackpole, 2001: online). Foley artists, also referred to as Foley

walkers, as the reproduction of footsteps is one of their duties, perform these actions in synchronisation with the onscreen action and are recorded by the Foley recordist.

Foley sounds typically accompany the movements of character interactions with the environment, including footsteps, fistfights and clothing movement; as well as the sound of anything manipulated by onscreen hands, such as a door opening. A typical Foley stage is made up of one or more 'pits' or different surfaces such as wood, concrete for the re-enactment of walking as well as props of all types. Key props include an assortment of shoes, fabrics and common household objects and are continuously added to. Jackson (2005: online) adds tools, weapons and different car doors to this list of basic props.

Stackpole (2001: online) subdivides Foley into two categories: analogue and simulated. Analogue Foley is created by the same means as the movement depicted i.e. the re-enactment of footsteps or the opening of a door. A simulated Foley sound is one that is fabricated if it is not feasible to record it as an analogue event. The goal is for the audience to believe they are hearing what they are seeing. An example of this is to break a stick of celery to create the sound of breaking bones.

7.3 Editing tips

Editing choices made are dependent on the effect desired by the sound editor and, ultimately, the director. Wyatt & Amyes (2005) recommend introducing ambient sound in the opening of a scene so that the viewer registers the sound before dialogue begins. Alternatively, change or build the atmosphere sounds on either side of the scene change if the audience should be made aware of a location change, but these sound bridges must correlate to the dialogue.

Any loops of atmosphere should be as long as possible to avoid audible repeats and should be laid in stereo unless they are related to a single source, for example a clock tick, which should be mono. Spot FX are mostly laid in mono, the exception to this is if there is natural reverberation such as an explosion and if laid in stereo, the stereo movement of the sound should match the movement of the picture.

Production sound should be laid in sync (frame accurate) to the picture. The production sound can be used as a guide if the frame cannot be seen visually (e.g. a closing door). Sound effects matching on screen action may be more complex than an off screen sound. Someone opening a door on screen may require the sounds of the handle, the latch, door creak/opening and the release of the door handle. A door being opened off screen may be reduced to only a single effect.

A sampler may be used to play back sound effects at varying pitches by means of a MIDI keyboard. Alternatively, an effect can be assigned to each key of the MIDI keyboard allowing the editor to “play” effects into a scene. This method is useful for quick tracklaying of stock sound FX into a production (such as a television game show) where spot effects will be used repeatedly. Synthesizers can also be used for the creation of synthesized tones and effects and may also be useful in sound manipulation.

7.4 Creative sound effects and sound design

“Certain Academy Awards like Sound and Visual Effects and Editing are sometimes referred to as technical awards. They're not technical awards. They're given for artistic decisions.” – Randy Thom (Academy of Motion Picture Arts and Sciences, 2005: online)

Sergi (2005: online) writes that using all sounds possible results in confusion and not clarity and so a selection must be used. He believes that this selection is one of the most highly creative areas of sound effects work. There are significant possibilities for artistic input in sound effects post-production. Sound is subjective and we are dependent on the visual context and mood. We naturally focus on certain sounds and filter out others; for example, we mentally centre on a person speaking to us, even if the background is louder (Weis, 1995: online). The sounds of real life are too dense for film and so the sound effects editors and mixers select the focus.

With the exception of poor synchronisation or inferior quality of sound, sound effects may at the most utilitarian level fulfil only the “see a dog, hear a dog” maxim. Certain films require little more than this basic level of sound: dramas and other dialogue driven genres are an example of these. Other genres allow for greater creativity, most notably science fiction, fantasy or adventure films. A number of stereotypes and clichés have emerged in the choice of sound effects. There are many examples, which include the sound of explosions in space or the sound of feedback whenever someone speaks into a microphone. Further examples can be found at: <http://www.filmsound.org/cliche> (Anderson et al., 2000: online) and <http://www.moviecliches.com> (Cairella, 2000: online)

The creation of sound effects through custom recording or the layering of pre-existing sound effects requires creative thinking from the sound editor. Sounds that do not exist in nature (such as “alien technology”) or sounds that are unable to be recorded (body stabs), have to be sourced and combined from real world recordings. Jay Rose (2002: 243-244) groups sound effects into three broad categories: organic sound (naturally occurring sounds as well as human and animal noise), mechanical sounds and electronic sounds. He recommends combining sounds from within a single group, as they are more likely to combine successfully. Layering sounds may give a sound effect

impact or create something entirely different. Examples of sound effects and their real world sources are given in Table 2, further examples may be found at: <http://www.filmsound.org/starwars/> (Carlsson a: online), <http://sfx.davelab.com/> (Filskov, 2003: online), <http://www.c5sound.com/newsroom/secrets.php> (C5, inc. 2002: online) and www.union.unimelb.edu.au/ufilm (Ruhfus & Chambers, 2001: online).

Sound of:	Sound source:
Dragonfly (<i>Men in Black</i>)	A toy fan with the blades snapped off and replaced with duct tape
Starship Enterprise (<i>Star Trek</i>)	Generated white noise, an exhaust fan and an air conditioner combined
Land cruiser (<i>Star Wars</i>)	Los Angeles Harbour Freeway traffic heard through a vacuum cleaner pipe
Earthquake ground cracking	Rubbing on an inflated balloon
Human Mutilation	Cabbage, carrots and other vegetables
Stone coffin opening	Slide off top of toilet cistern
Walking on snow	Walk on corn flour
Boulder rolling	Record the wheel friction of a car rolling downhill (on gravel) with the engine off

Table 2

In an article on sound design, Randy Thom (1999: online) states: “Sound...has value when it is part of a continuum, when it changes over time, has dynamics, and resonates with other sound and with other sensory experiences.” The term ‘Sound Design’ was first used in the credits of the film *Apocalypse Now* (1979) and has two definitions: the creation of special sound effects for film (Blake, 1999: online), or the process of creating the overall design of the soundtrack (Wyatt and Amyes, 2005: 167). The latter explanation of the term is more all encompassing, as the process of designing the overall soundtrack would likely include the creation of special sound effects.

8 Music

In the audio soundtrack of a film, dialogue provides content while sound effects add realism. Music provides an emotional foundation; well-recorded music can manipulate the emotions of an audience while also providing dramatic emphasis. Films rely heavily on music to add appropriate emotional effect to the images being seen on screen. A good music score manipulates the appropriate emotions: joy, sorrow, and impending fear. Music plays a very large role in building tension. Many pre-recorded music scores in film music libraries are titled and catalogued by their suggested emotional effect.

Complexity of audio post-production work involving music is largely dependent on the budget of the project. Large-scale productions may involve an original score, with the possibility of recording; low-budgets or a project under time constraint will be tracklaid using library (pre-recorded) music. The advantages of having a score specially composed for the picture in question is that musical themes and textures used will be appropriate to the style of piece. As the music is written for the picture, changes in scene, action and mood can be supported by the music. Blatant mimicry of the action by the music is referred to as “mickeymousing” and Ruhfus & Chambers (2001: online) say this technique considered barely respectable by most film composers.

Many Hollywood films include a number of popular songs as part of the score and which are included in CD's of the film's music track (Auricle: online). The cost of using these songs varies depending on how popular the artist is. As an alternative, a number of companies produce volumes of high-quality, generic purpose music available in music libraries (Nazarian: online). The music is composed and recorded in a modular form so as to allow for easy editing. There are three types of fee for the use of library music: 'Needle Drop', screen minute or blanket. 'Needle drop' refers to buying music based on a per-selection-per use basis; screen minute is cost of music per screen

minute used and blanket permits unlimited usage of the entire library either per entire production or per entire year (Ginsburg, 2005:online). In determining their fees, music libraries want to know the intended purpose of the music and scope of distribution of the film (theatrical, educational, home video, nationwide broadcast, industrial in-house, etc.).

8.1 Music post-production

The post-production process of music varies according to the complexity and source of the score being used. In this section, a description of the most involved process is given. The process of music editing begins with the spotting session (Wyatt and Amyes, 2005: 193). Every cue should be noted along with precise timings of every appearance of the music as well as any emphasis points (hits). Notes should also be made of what the accompanying action and dialogue is for each cue. Any source music not written by the composer can be sourced, organized and edited.

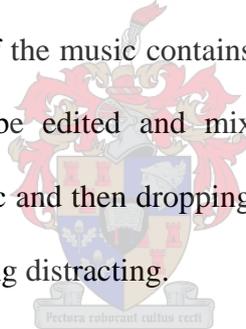
Once the music is complete, it is arranged and a score and parts are prepared. Ideally, by anticipating the accompanying action and dialogue, the composer (or orchestrator) may aid clarity by using instruments that do not overlap much with the frequencies of the human voice or any dominant sound effects being heard at the same time. If an original score has been written for the piece, recording sessions are then begun.

Click tracks for each of the cues are created, these are for playback through headsets worn by the conductor and the musicians (Ginsburg, 2005: online). When recording an orchestra score, each set of instruments should have its own microphone and track so that they can be balanced during the scoring mix (Zaza, 1991: 73). Timings should be kept of each take to keep track of which are usable and then these are tracklaid into their correct timecode positions.

8.2 Music Editing

A basic understanding of music is always beneficial when editing music. Wyatt and Amyes (2005: 200) offer several suggestions for improving editing techniques. The first is to always cut on the beat, as musical timing is affected if the edited beat is an incorrect length. The edit itself will also be masked by the beat immediately following. If the beats are out of sync or edited incorrectly and then crossfaded together, the merged beat will flam (a double beat will be heard). Cue must still make musical sense if it is being shortened; any important transitional phrases such as key changes should not be edited out.

When editing any diegetic music it is a conventional practice to omit the introduction and start at either the start of a verse or chorus (Wyatt and Amyes, 2005: 200 - 201). This will make the music cue seem a natural part of the scene. If the music contains lyrics and is heard simultaneously with dialogue or a voice-over, it should be edited and mixed so that it does not interfere with intelligibility. By introducing the music and then dropping the level before the dialogue allows the music cue maximum effect without being distracting.



9 Mixing

The process of mixing the various stems together has different terminology according to the area of use. In film, mixing is referred to as re-recording or dubbing; while in television, the terms mixing or sweetening are more common (Holman, 1997: 181). The main function of mixing the soundtrack is to combine and condense the pre-mixes into a final mix, which may be mono, two-track stereo or surround sound.

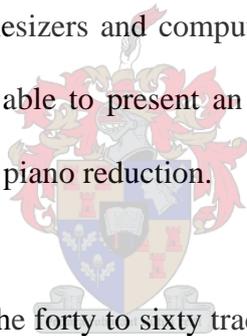
The most important function of mixing is the setting of levels (Holman, 1997: 181). Each recording made by the various departments will be recorded for optimal sound, thus the Foley mix will be as loud as the dialogue recording (Holman, 1997: 181). It is necessary to balance the levels with one another in order to assume a correct relationship between the sound elements.

There are both aesthetic and technical aspects of sound mixing. Technically, the sound needs to match the visuals so as to give the impression that the sound is coming from the picture as ideally; the visual perspective should match the aural perspective. Surround channels allow for the panning of sound around the audience. Use of changes in acoustic atmosphere through reverb is also possible. If the actor is seen to be moving towards the camera, aurally he should also move towards the camera through changes in the acoustic properties of the sound. Aesthetically, the various soundtracks need to be mixed in such a way as to produce a cohesive, pleasing whole that enhances the picture. Whilst the visuals comprise of one picture following another, the sound-track consists of interlocking sounds that have the ability to bind scenes and create the atmosphere.

The tendency to bring the supervising sound editor onto the project at an early stage then is a direct result of the demand for sound in early screenings. A scratch sound mix is created even for the first screening of any footage filmed. The tracks used (other than the dialogue) are all temporary. The

inclusion of temporary music and sound effects is to give those watching an idea of the feel of the finished product. The process is kept as simple as possible though, with the work being done by a single sound editor and an assistant.

Although the demand for the scratch mix places a lot of pressure on the sound editor due to greater time constraints, it does allow a chance to introduce ideas to the director(s) and producers whilst they are still open to experimentation. A lot of the clean up work has also then already been done. The demand for scratch mixes has also affected music scoring. The music editor is forced to use temporary music as the final score has yet to be completed and recorded. The editor may use music composed for a previous film. The result is that the director and editors will then want music that is similar. This limits the composer as they are then not allowed to branch out creatively, they must stick to the formula. The use of synthesizers and computers has been a positive development in scoring practices. The composers are able to present an “orchestrated” idea for approval of the directors and producers instead of just a piano reduction.



The mix of a film is the summation of the forty to sixty tracks per reel of picture (approximately 10 minutes in length); there are ten or eleven reels of picture in a full-length movie (Ginsburg –*Final Mix*: online). If a large number of tracks are being mixed, then it may be easier to subgroup the tracks and pre-mix, allowing for easier handling. The tracks are then reduced in number in the pre-mix stage in order gain manageability. The tracks are reduced in relation to one another.

Within each section of sound, groups can be made up. For example, in sound effects: Foley, ambience and sound effects can be separately mixed. These can then be combined to form the sound effects track(s). A few tracks for each type of sound (dialogue, music and sound effects) are

easier to manage and balance out than controlling many separate tracks. However, careful mixing is needed, as a sound that is audible in the pre-mix, may not necessarily be audible in the final mix.

The dialogue pre-mix is usually recorded first and the best possible quality is needed. Sound levels need to match, equalisation is often done and stereo positioning must be correct. Dialogue is usually recorded in mono, rarely in stereo. Panning is done in the pre-mix and dialogue is usually placed on the centre channel unless a specific panning effect is required.

The final/climactic moment of post-production is the final mix or dub. The various tracks (also known as elements) are adjusted in volume and in tonal quality in relation to both each other and to the picture. During this process, the director and/or picture editor are also present, deciding with the mixer what sounds should be emphasized and what should be less prominent. A balance between all the elements of the film sound has to be achieved, a particularly moving piece of music may be dropped in favour of the dialogue, and an effect may be left out as the music may provide sufficient dramatic effect. Using automation, the different tracks are balanced. Multiple attempts may be done as slight adjustments to one track may radically alter the balance. The requirements of the final sound balance need to conform to various technical requirements (Wyatt and Amyes, 2005: 239):

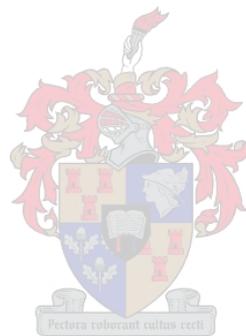
- Correct relative sound levels
- Correct dynamic range for reproduction
- Consistent tonal quality
- High intelligibility
- The required perspective
- The required acoustics

Weis (1995: online) compares mixing the soundtrack on a par with orchestration, working with sonic textures, as opposed to instruments. The pitch, rhythm and pace must be taken into account. A solid wall of sound from the beginning of a movie to the end is aurally disturbing; variations of sounds and sound levels create interest and control the dramatic tension. Sounds that come from different sources can be matched in intensity and quality through manipulation. Filters can also be used to rid the soundtrack of unwanted frequencies, such as the buzz of an air conditioner. Humans perceive perspective of image size as a ratio of direct sound to indirect (or reflected) sound. This can therefore be manipulated through the use of artificial reverberation.

The final sound balance with the desired artistic effect is the final soundtrack and is also referred to as the dub-master (Smith, 2001: online). The number of tracks in the final mix depends on its final format. A film made for video will consist of a two track, stereo mix while a surround mix will have more, depending on the format. The dub-master is used to create the printmaster, the music and effects (M&E) print and also possible a mono and airline version. The printmaster is the composite mix to be transferred either directly the delivery medium (the magnetic film) or encoded into the various sound formats, such as DTS. A re-edited version of the film removing swearing, sex and violence may be created. Smith (2001: online) refers to this edit as the airline version as the airline censors are stricter than broadcast networks so the airline version will also be suitable for television broadcast.

A film that is to be dubbed into other languages for sale to foreign countries has a special soundtrack made up. This soundtrack is called the M&E track, as it consists only of music and sound effects. This track also contains any vocal sounds not specific to a certain country or language: screams, whistles, crowd noise. The M&E track is often an additional expense, usually not justifiable for smaller film productions. One solution to this is the use of subtitles, rather than

overdubbing dialogue. With the use of digital audio workstations and “virtual” mixes, however, re-creating the M&E mix should not be too time consuming, provided the tracks and pre-mixes were well done.



10 Conclusion

When applying methods and practices as described in this thesis, it is easy to appreciate the number of people required in audio post-production for a large film project, as the process may be very labour intensive. The skills and techniques described were used in various projects over the previous 18 months with varying degrees of success. Experiments with audio post-production methods have shown that under time constraints, only a basic level of creativity is possible when working alone. Some of these projects are outlined below, along with the appropriate techniques used and why the techniques were successful or unsuccessful.

10.1 Audio post-production applications

10.1.1 Hypnotherapy Project: Dialogue and music

This was a commercial project where the client requested the vocal recording of supplied scripts and the composition of appropriate music, to be provided by a fellow student and myself. As the budget could not afford a professional voice over artist, a local singer with professional stage experience was hired. The first stage of the project was the recording of the scripts. The first error made in this project was the choice of venue for recording, which was a large studio with a noisy air-conditioning system, meaning that all the dialogue recorded was overlaid with a low frequency hum. Correcting this was possible by filtering out all the frequencies below the vocal range.

Each script was recorded into a separate session to allow for easy file management. During the recording, notes were made of errors during reading as well as poor pronunciation and articulation. The voice artist then re-read the appropriate sections and these were marked accordingly on the DAW session. The recording of the dialogue took several days and once recording was complete, editing began. The first stage was to remove unnecessary silences from the dialogue. It was

decided between the two of us responsible for the projects to place the dialogue according to a musical bars and beats system, while still keeping the natural spoken flow of dialogue. This tempo would then be gradually slowed during the session, to aid relaxation. The inferior dialogue was replaced and the pacing of the dialogue finished.

The client then requested that some sound effects be added, for re-enforcement of the dialogue. These were sourced from a sound effects library and added to the session. Before the process of adding music began, the recordings of the scripts were reviewed and the level changes between the different sessions were also marked. The tracks were all normalised in volume, which was the next mistake in this project. As the dialogue had been edited and cut for placement, almost every word lay at the same volume level, resulting in no natural rise and fall of the human voice. This step was reversed and automation of the faders was attempted instead. Although automation was a more time consuming process, adjustments to the level of any track was quicker at a later stage.

A pre-mix of the sound effects and dialogue tracks was then made before the music was begun. Each sound effect was to be heard three times, each time successfully softer. The sound effects were placed between words so that clarity was not compromised and at a volume that did not mask the dialogue, but could still be heard.

The addition of music suitable to the production was problematic. The characteristics of hypnotherapy meant that traditionally structured music could not be used. The music needed to have a calming effect that lasted not only for the duration of the hypnotherapy session, but between sessions. The final choice was that of combining synthesized sound and pitched ambient sounds. A low soft bass was used with layers of sound; these were blended and were slowly faded in and out of the overall mix creating different combinations. A soft pulsing white noise, imitating breathing

was added at a barely audible level. The pulse of this “breathing” effect was slowed gradually during the session, imitating the slowing of the dialogue placement.

This music was then imported into all the sessions and separate automation of the music tracks in each session allowed for sufficient difference between the sessions, without compromising the flow between sessions. A sub-mix of the mix was done for each session and vocal mix was compressed and had light reverb added to it. The final mix was then done and the project delivered to the client on a series of CD’s. During the process of removing the project from the DAW, our final error was discovered. During the transfer of music and sound effects, file settings were not checked and many audio files lay in incorrect folders and were poorly named, if named at all and others were duplicated unnecessarily.

Most problems encountered during this project were due to poor planning and minimal understanding of the equipment. The final product was completed to the client’s satisfaction.



10.1.2 Live concert DVD: music editing and mixing

This project was the recording and filming of a performance examination of a final year violinist who requested a DVD in addition to a CD recording. The concert was recorded using three microphones, one close miking the violinist, as well as a stereo pair in the concert venue. The visuals were recorded on a consumer camera using mini DV (digital video) tapes. The visuals were then captured onto computer using Apple Mac’s imovie. The footage was then imported into the DAW along with the sound from the camera recording.

When viewing the footage with the audio recording, the sound was badly out of synchronisation, although care had been taken to synchronise the start of the music with that of the production sound.

Once again, settings had not been checked during the transfer, this time of the visuals. The default setting of the picture-capturing program was the American NTSC setting (29.97 fps), whilst I had ensured that the DAW settings were that of the PAL (25fps). Once adjusting the settings in the DAW, the audio was still out of sync with the picture. On reviewing the visuals, it appeared that frames had been lost during the transfer. Rose (2002: 9 - 10) attributes this to cost-sensitive design of commercial cameras.

As the DVD was a concert performance, sync problems had to be fixed as the onset and duration of notes were clearly visible. Silences between movements and phrases were edited out and the production sound was used to synchronise the start of the music passages. Once this was complete, minute edits of a few milliseconds were made and crossfades used so that the music quality was not effected. The concert length was less than an hour in length, but the process of re-synchronising the music to the picture took several days to complete. Matching the violinist's bow movement with the appropriate sound was a process involving looping fragments of sound in order to find a suitable edit point. Once each edit was completed, it was then listened to as part of the musical phrase to ensure that the edit is unnoticeable, before continuing to the next edit. Once synchronisation was complete, the sound was then mixed and transferred to the video editor for the writing of the DVD.

10.1.3 Ly-la Laffie: Sound Design

Ly-la Laffie was a children's play due to show at the 2006 *Klein Karoo Nasionale Kunstefees*. I was approached in November 2005 and asked to provide sound effects. Initially the director was only looking for a few spot effects, but later requested sound effects that needed to be specially created giving a basic description of the type of sound he required.

The ambient sounds were fairly easy to construct, the “night time in the forest” ambient sound requested by the director was constructed by mixing two ambient tracks from the *Hollywood Edge* sound effects collection, namely: *Hollywood Edge Premier Edition* CD 1 Track 16

- Night Ambience 2: Heavy Bed Of Mid-range And High-pitched Crickets Hum

and

Hollywood Edge Premier Edition CD 1 Track 28

- Exotic Rain Forest [special Mix]: Insects Chirp Close To Medium Perspective

“Icy Wind” was created by using computer generated red noise, which was sent through a Doppler effect Plug in. The tracking time was set and then the direction automated to the same time as the track time, resulting in a smooth revolving stereo movement. This was then sent to an audio Track EQ. Bass frequencies up to 250Hz were boosted to 15dB, low-mid frequencies were sent through a linear gradient from +12dB at 250Hz decreasing to -12dB at 1KHz, hi-mid frequencies on a parabolic arc from -12dB at 1KHz to -3dB at 15 KHz and hi frequencies on a linear gradient increasing from -15dB. A sample from a free sample CD from Computer Music Magazine which had an “icy” quality to it was reversed, compressed and had reverb added before being mixed to the processed red noise.

The “crackle” sound effect was created from two different sound sources. The first was an unprocessed sound effect of the mechanical noise of a record playing on a gramophone. The second effect was a computer generated triangle wave sent through three plug-ins. The first, UltraPitch 6 Voices (setting: octave down chaser) added frequency depth to the wave which was then sent through a modulation plug-in named Enigma (setting: Wobbly dirt) and finally sent to an

audio track EQ with a setting to enhance the bass frequencies. These were then combined and mixed for the final effect.

Several attempts were made before the director approved the final sound effects. While the descriptions could be considered fairly ambiguous, sound effects did not always blend as expected and a certain amount of experimentation with plug-ins available was needed for the desired results.

10.2 Finally

The purpose of this thesis was to provide an introduction to the process of audio post-production. The literature available shows a diverse subset of possible research fields ranging from analysis of the various components of the soundtrack to more technical subject areas on technology and software. The information becomes more valuable when applied practically as it allows for greater understanding of the literature as well as the development of usable skills.

Projects resulting from this study have improved practical skills as well as the purchase of equipment aiding audio post-production. With the equipment available and the increased availability of literature, it is hoped that research on audio post-production and the film soundtrack will continue.

References

Allen, R. n.d. *The Wonderful World of Sound: Bounded only by Talents, Technique and Imagination*. From: <http://www.bksts.demon.co.uk/training/sound.htm> Accessed 03/06/2003

Altman, R. 1992. The Material Heterogeneity of Recorded Sound. In: Altman, R. ed. *Sound Theory/Sound Practice*. Routledge: New York.

Academy of Motion Picture Arts and Sciences. 2003. *Sound and music- the Power to Enhance the Story*.

From: www.oscars.org/teachersguide/sound/index.html Accessed: 22/03/2005

Academy of Motion Picture Arts and Sciences. 2005. *Oscar Night: Winner: Sound Editing*.

From: http://www.oscar.com/oscar/night/winners/win_34478.html Accessed: 22/03/2005

Anderson, C et al. 2000. *Film Sound Cliches: Film Sound Stereotypes and Common Logic Flaws*.

From: <http://www.filmsound.org/cliche/> Accessed: 08/02/2005

The Association of Motion Picture Sound. n.d. *Some sound job descriptions*.

From: www.amps.net/ Accessed: 05/03/2005

Auricle. n.d. *Frequently asked questions about the art of film scoring*.

From: <http://www.webcom.com/%7Eauricle/welcome-fmusfaq.html> Accessed: 23/06/2003

Balazs, B. 1970. *Theory of the Film: Sound*. In: Wiess, E. and Belton, J. eds. 1985. *Film Sound*. Columbia University Press: New York

Barsam, R. 2003. Chapter 7: Timeline. In: *Looking at Movies: An introduction to film*

From: <http://www.wwnorton.com/web/movies/chapters/ch7/timeline.asp> Accessed: 17/04/2005

Barsam, R. 2004. *Looking at Movies: An introduction to film*. W. W. Norton & Company, Inc.: New York

Berliner, T. 2002. Hollywood Movie Dialogue and the “Real Realism” of John Cassavetes. In: *Film Quarterly Sample Copy*.

From: <http://www.filmquarterly.org/index2.html> Accessed: 20/05/2005

Blake, L. 1999. *What's a Binky?*

From: <http://web.archive.org/web/20000816063641/http://www.mixonline.com/filmglossary.html> Accessed: 08/02/2005

Bordwell, D & Thompson, K. 1979. *Film art: an introduction*. Addison-Wesley: Boston.

Bridgett, R. 2002. *Sound Design: An Introduction*.

From : www3.telus.net/kbridget/introduction.pdf Accessed 08/02/2005

Brophy, P. 1987. *Soundtrack Lecture: Foley Performance and Recording*

From: http://media-arts.rmit.edu.au/Phil_Brophy/MMAlec/Foley.html Accessed: 08/02/2005

- C5, inc. 2002. *Foley Artists at C5, inc. share their secrets*.
From: <http://www.c5sound.com/newsroom/secrets.php> Accessed: 08/02/2005
- Cairella, G. 2000. *The Movies Cliché List*.
From: <http://www.moviecliches.com> Accessed: 29/05/2006
- Carlsson, S. n.d. (a) *Sound design of Star Wars*.
From: <http://www.filmsound.org/starwars/> Accessed: 08/02/2005
- Carlsson, S. n.d. (b) *Terminology*. From: www.filmsound.org/terminology Accessed: 08/02/2005
- Caul, H. n.d. *Biography for Walter Murch*.
From: <http://www.imdb.com/name/nm0004555/bio> Accessed 08/11/2005
- Chion, M. *Audio Vision – Sound on Screen*. 1994. Columbia University Press: New York.
- Cooke, M. 2003. Film Music. In: Macy, L. ed. *The New Grove Dictionary of Music Online*.
From: <http://www.grovemusic.com> Accessed: 08/10/2003
- Davis, R. 1999. *Complete Guide to Film Scoring*. Berklee Press: Boston.
- DiGregorio Jr., B. 1998. *Non-linear editing: a basic understanding*.
From: www.newenglandfilm.com/news/archives/98april/nonlinear.htm Accessed: 2005/04/15
- CAS Webboard. 2002. *Need vocabulary (Discussion Thread)*
From: <http://www.filmsound.org/QA/vocabulary.htm> Accessed 05/06/2005
- Dolby. 2005. *Who we are: Company History*.
From: http://www.dolby.com/about/who_we_are/history.html Accessed: 08/11/2005
- Filskov, D. 2003. *Davelab.com's guide to sound effects*.
From: <http://sfx.davelab.com/> Accessed: 20/05/2005
- Florian, B. 2002. *Learning from History: Cinema Sound and EQ Curves*.
From: http://www.hometheaterhifi.com/volume_9_2/feature-article-curves-6-2002.html
Accessed: 08/10/2003
- Garity, W. & Hawkins, J. 1941. Fantasound. In: *August issue of the Journal of the Society of Motion Picture Engineers*.
From: <http://www.widescreenmuseum.com/sound/Fantasound1.htm> Accessed 05/03/2005
- Garity, W. & Jones, W. 1942. Experiences in road-showing Walt Disney's "Fantasia". In: *July issue of the Journal of the Society of Motion Picture Engineers*.
From: <http://www.widescreenmuseum.com/sound/Fantasound3.htm> Accessed 05/03/2005
- Giannetti, L. 2002. *Understanding Movies*. Prentice Hall: New Jersey
- Ginsburg, F. 2005. *The soundtrack: a basic introduction*.
From: www.equipmentemporium.com/soundtra.htm Accessed: 08/02/2005

- Ginsburg, F. n.d. *Alpha: sound effects*.
From: <http://www.postproducer.com/Article/Alpha/21/xt/sfx.htm> Accessed: 12/02/2005
- Ginsburg, F. n.d. *Alpha: Final Mix*
From: <http://www.postproducer.com/Article/Alpha/14/xt/final%20mix.htm> Accessed: 12/02/2005
- Holman, T. 1997. *Sound for Film and Television*. Focal Press: Boston
- Internet Movie Database Inc. 2006. *Internet Movie Database*. From: www.imdb.com Accessed: 27/08/2006
- Jackson, B. 2005. *Foley Recording*.
From: http://mixonline.com/sound4picture/film_tv/audio_foley_recording Accessed: 31/10/2005
- Kallay, W. 2004a. *Interpreting The Sound and The Theory: a look back at Motion Picture Sound*.
From: www.fromscripttodvd.com/sound_theory.htm Accessed: 05/03/2005
- Kallay, W. 2004b. *Creating the illusion of dialogue: Focusing on ADR with Avram Gold, MPSE*
From: www.fromscripttodvd.com/adr_fixed.htm Accessed: 05/03/2005
- Kaufman, D. 2005. *Tom Holman sounds off on audio*.
From: <http://www.digitalpostproduction.com/articles/viewarticle.jsp?id=24817> Accessed: 05/03/2005
- Lerner, S. n.d. *The Dilettante's Dictionary*.
From: www.dilettantesdictionary.com Accessed: 20/05/2005
- Llewellyn, R. 2004. *Chronology of Animation: Introduction*. From:
www.public.iastate.edu/~rllew/chrnprod.html Accessed: 03/07/2004
- Lucasfilm, Ltd. 1998. *Skywalker Sound: The Making of a Movie Soundtrack*.
From: <http://web.archive.org/web/20001207043100/http://www.thx.com/skywalker/skywalker.html>
Accessed: 08/02/2005
- Lucasfilm, Ltd. 2005. *Skywalker Sound names Randy Thom as Director of Sound Design*.
From: www.skysound.com/press/20050930_release.html Accessed: 23/11/2005
- MTSU (Middle Tennessee State University). n.d. *Film Sound History*.
From: <http://www.mtsu.edu/~smpte/pre20s.html> Accessed: 08/10/2003
- MOS. 2001. Excerpts from Discussion Thread "MOS original meaning". At:
<http://www.soundspeedmovie.com/forums/>
From: <http://www.filmsound.org/terminology/mos.htm> Accessed: 20/05/2005
- Nazarian, B. n.d. *What is Audio Post Production?*
From: <http://www.mpse.org/education/whatis.html> Accessed: 10/02/2005
- Pallot, J. 1994. *The Third Virgin Film Guide*. CineBooks: New York
- Phillips, W.H. 1999. *Film – An Introduction*. Bedford/St. Martins: Boston

- Poynton, C. 1996. *Technical Introduction to Timecode*.
From: <http://www.poynton.com/notes/video/Timecode/> Accessed: 01/04/2005
- Rees, P. 2001. *Synchronisation and SMPTE timecode (time code)*.
From: <http://www.philrees.co.uk/articles/timecode.htm> Accessed: 01/04/2005
- Rose, J. 2001. *Say what? Editing voice tracks like a pro*.
From: www.dplay.com/dv/0104edit Accessed: 04/04/2005
- Rose, J. 2002. *Audio Postproduction for digital video*. CMP Books: San Francisco.
- Ruhfus, J. & Chambers, L. 2001. *U Film Fest Workshop Notes: Film Sound*.
From: www.union.unimelb.edu.au/ufilm Accessed: 06/05/2005
- Schoenherr, S. 2000. *Digital Film Sound Formats*.
From: <http://history.acusd.edu/gen/recording/motionpicture3.html> Accessed: 2005/03/15
- Sergi, G. 2005. *In defence of Vulgarity: the place of sound effects in the cinema*.
From: www.filmsound.org/articles/sergi/sound-effects-place.htm Accessed: 17/11/2005
- Shepherd, A. 2003. *Pro Tools for video, film, and multimedia*. Muska & Lipman Publishing: Boston
- Smith, C. 2001. *Film/video Sound Glossary*.
From: <http://homepage.mac.com/craigsmith/html/Prod%20Sound%20Glossary.html>
Accessed: 13/06/2005
- Sonnenschein, D. 2001. *Sound Design: The expressive power of music, voice, and sound effects in cinema*. Michael Wiese Productions: Michigan.
- Soundrangers. 2004. *Soundrangers Royalty free music and sound effects*. From:
www.soundrangers.com Accessed: 15/04/2005
- Stackpole, K. 2001. *Sound in the Key of Life*.
From: http://emusician.com/mag/emusic_sounds_key_life/index.html Accessed: 08/02/2005
- Thom, R. 1999. *Designing a Movie for Sound*.
From: www.stardustfilm.com/Articles/Randy%20Thom%20article.htm Accessed: 05/06/2005
- Tully, T. 1998. How did they do that? Computer-aided sound design. In: *Music & Computers 4:4 [May-June 1998]* p. 28, 30. From:
http://iimpft.chadwyck.com/cgi/fulltext?ACTION=BYID&FILE=./session/1107882492_29068&subset=3&entries=37&ID=00058575&JID=JID10802770&ROYID=LOUJID10802770
Accessed: 08/02/2005
- Turner, B. 2005. *Acoustic Ambience in Cinematography: An Exploration of the descriptive and emotive impact of the aural environment*.
From: www.folkbildning.net/~e-kurs/sound/research_article.pdf Accessed: 17/11/2005.
- Ulano, M. n.d. *Moving Pictures that Talk – Part 1*.

From: <http://www.filmsound.org/ulano/talkies.htm> Accessed: 08/02/2005

Weis, E. 1995. Sync tanks: The Art and Technique of Postproduction Sound. In: *Sync tanks.*, Vol. 21, *Cineaste*, 01-01-1995, pp 56.

From <http://www.filmsound.org/synctanks/> Accessed 05/06/2005

Westfall, L. 1998. Computers in the Movies: How Desktop PCs Help Create Hollywood's Amazing Music and Sound Effects. In: *Music & Computers 4:4*. From:

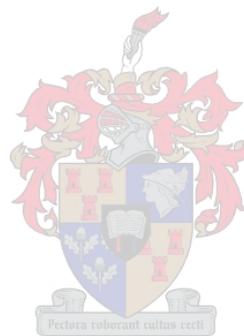
http://iimpft.chadwyck.com/cgi/fulltext?ACTION=BYID&FILE=./session/1107882492_29068&subset=2&entries=37&ID=00058573&JID=JID10802770&ROYID=LOUJID10802770

Accessed: 08/02/2005

Wyatt, H. & Amyes, T. 2005. *Audio post production for television and film*. Focal Press: Oxford.

Yewdall, D. 2003. *Practical Art of motion picture sound*. Focal Press: Boston

Zaza, T. 1991. *Audio Design: Sound recording techniques for film and video*. Prentice Hall: New Jersey



Additional Reading

Clemmensen, C. 2005. *Filmtracks editorial review - Star Wars : A New Hope*.
From: http://www.filmtracks.com/titles/star_wars.html Accessed: 23/05/2005

Congleton, P. n.d. *Critics Corner: a Guide to Film Critique*.
From: www.mecfilms.com/critic1.htm Accessed: 22/11/2005

Dawson, A. 2004. *Guide to Video Sync II: A Bit More Advanced*.
From: www.prosoundweb.com/recording/articles/andrew/video2/sync.shtml Accessed: 15/04/2005

Dirks, T. 2005. *Film Genres*.
From: www.filmsite.org/genres.html. Accessed: 24/11/2005

Droney, M. 2005. Randy Thom: The year of living animatedly. In: *Mix Magazine*
From: http://mixonline.com/mag/audio_randy_thom/ Accessed 12/02/2005

Frazer, B. 2005. *What Randy Thom Hears*.
From: <http://www.filmandvideomagazine.com/articles/viewarticle.jsp?id=31778>
Accessed: 20/05/2005

Gillespie, R. n.d. *Timecode formats and options*.
From: <http://www.itg.uiuc.edu/help/avdoc/timecode/timecodeFormats.doc> Accessed 01/04/2005

IEEE Virtual Museum. n.d. *Sound-on-film*.
From: <http://www.ieee-virtual-museum.org/collection/tech.php?taid=&id=2345859&lid=1>
Accessed: 10/05/2005

IEEE Virtual Museum. n.d. *The Beat Goes On: How Sounds are Recorded and Played*.
From: <http://www.ieee-virtual-museum.org/exhibit/exhibit.php?id=159246&lid=1&seq=7>
Accessed: 10/05/2005

Jarrett, M. n.d. *Sound Doctrine: an interview with Walter Murch*.
From: <http://www.yk.psu.edu/~jmj3/murchfq.htm> Accessed: 08/02/2005

Kelleghan, F. 1996. *Sound effects in SF and horror films*.
From: http://www.lysator.liu.se/lssf/confuse96/Sound_Effects_in_SF_and_Horror_Films.html
Accessed: 17/04/2005

Knowles Marshall, J. n.d. *An Introduction to Film Sound*.
From: <http://www.filmsound.org/marshall/index.htm> Accessed: 06/05/2005
Original URL: <http://130.132.143.21/ynhti/curriculum/units/1988/4/88.04.04.x.html>

Kramer, L. 2000. *DTS: A brief history and technical overview*.
From: www.dtsonline.com/company/history/brief_history_and_technology_overview.pdf
Accessed: 2004/05/2004

LoBrutto, V. 1994. *Sound-on-film: interviews with creators of film sound*. Praeger Publishers: Connecticut

Martin, W. 2000. *Sounds Good: a day in the life of an independent professional*.
From: http://1099.com/c/ar/di/foley_d030.html Accessed: 20/05/2005

Mavros, S. 2000. *What is Foley?*
From: <http://www.sound-ideas.com/foleymavart.html> Accessed: 08/02/2005

Microsoft® Encarta® Online Encyclopedia. 2003. *History of Motion Pictures*.
From: <http://encarta.msn.com/encnet/refpages/RefArticle.aspx?refid=761567568&pn=5>
Accessed: 08/10/2003

Murch, W. 2002. 25 Years of Film Sound: Making Movies in the Digital Era. In: *Mix Magazine* (July).
From: http://mixonline.com/ar/audio_years_film_sound/ Accessed: 07/03/2005

Pearson, B. n.d. *Movie Genre Examples*.
From: www.createyourscreenplay.com/genrechart.htm Accessed: 23/11/2005

Peck, N. 2000. *Favourite effects tips from the trenches*.
From: http://emusician.com/tutorials/emusic_favorite_effects_tips/index.html Accessed: 08/02/2005

Rose, J. 2003. Reality (Sound)bites: Audio tricks from the film and TV studio. In: *Proceedings of the 2003 International Conference on Auditory Display*. Boston, USA (July 2003).
From: www.icad.org/websiteV2.0/Conferences/ICAD2003/paper/08%20Rose.pdf Accessed: 13/06/2005

Steer, M. 1995. *A Brief History of Film Dubbing*. From: <http://web.archive.org/web/20020616033749/http://www.appleonline.net/msteer/factual/jfilmdubbing1.html> Accessed: 20/05/2005



Thom, R. n.d. *More Confessions of a Sound Designer*.
From: <http://www.filmsound.org/randythom/confess2.html> Accessed: 08/02/2005

Thom, R. n.d. *The Machinery aimed at the ear*.
From: <http://www.filmsound.org/randythom/machinery.htm> Accessed: 08/02/2005

Tone, K. 2000. *'How to' Digital Sound for Indie Film*.
From: <http://www.soundrangers.com/html/film-sound.html> Accessed: 15/04/2005

Williams, P. n.d. Sound for Motion Pictures. In: *MovieMaker Magazine Issue 50*.
From: <http://www.moviemaker.com/issues/50/sound.html> Accessed: 05/03/2005

Appendix – Film List

Films viewed were selected from winners of the sound and/or music categories of the Oscar, Golden Globe and/or Bafta awards and have been grouped accordingly. Films recommended by members of various film sound newsgroups, that have not received awards, have also been included. Film information was taken from Pallot (1994) and the Internet Movie Database (online).

Awards for Sound and Music:

E.T. The Extra-Terrestrial. 1982. Directed by Steven Spielberg. USA: Universal

Indiana Jones & the Raiders of the Lost Ark. 1981. Directed by Steven Spielberg. USA: Lucasfilm

Lord of the Rings: Return of the King. 2003. Directed by Peter Jackson. USA: New Line Cinema

My Fair Lady. 1964. Directed by George Cukor. USA: Warner Bros.

Star Wars V: The Empire Strikes Back. 1980. Directed by Irvin Kershner. USA: Fox

Star Wars VI: Return of the Jedi. 1983. Directed by Richard Marquand. USA: Lucasfilm

The Sound of Music. 1965. Directed by Robert Wise. USA: Fox

Titanic. 1997. Directed by James Cameron. USA: 20th Century Fox/Paramount

Award(s) for Sound:

Amadeus. 1984. Directed by Milos Forman. USA: Orion

Apollo 13. 1995. Directed by Ron Howard. USA: Universal/Imagine

Back to the Future. 1985. Directed by Robert Zemeckis. USA: Amblin/Universal

Indiana Jones and the Last Crusade. 1989. Directed by Steven Spielberg. USA: Lucasfilm

Jurassic Park. 1993. Directed by Steven Spielberg. USA: Universal/Amblin Entertainment

Lord of the Rings: The Two Towers. 2002. Directed by Peter Jackson. USA: New Line Cinema

Pearl Harbour. 2001. Directed by Michael Bay. USA: Touchstone Pictures

Saving Private Ryan. 1998. Directed by Steven Spielberg. USA: Paramount

Speed. 1994. Directed by Jan De Bont. USA: 20th Century Fox

The Incredibles. 2004. Directed by Brad Bird. USA: Walt Disney/Pixar

The Matrix. 1999. Directed by Larry and Andy Wachowski. USA: Warner Bros.

Award(s) for Music:

Aladdin. 1992. Directed by Robert Clements & John Musker. USA: Walt Disney Productions

Beauty and the Beast. 1991. Directed by Gary Trousdale & Kirk Wise. USA: Walt Disney/Silver

Screen Partners IV

Breakfast at Tiffany's. 1961. Directed by Blake Edwards. USA: Paramount

Crouching Tiger, Hidden Dragon. 2000. Directed by Ang Lee.. (USA): Sony Pictures Classics

Lord of the Rings: Fellowship of the Ring. 2001. Directed by Peter Jackson. USA: New Line

Cinema

Sunset Boulevard. 1950. Directed by Billy Wilder. USA: Paramount

The Legend of 1900. 1998. Directed by Giuseppe Tornatore. Italy: Sciarlo Productions

The Lion King. 1994. Directed by Roger Allers & Rob Minkoff. USA: Walt Disney

The Red Shoes. 1948. Directed by Michael Powell & Emeric Pressburger. UK: Archers

The Truman Show. 1998. Directed by Peter Wier. USA: Scott Rudin Productions/Paramount

The Wizard of Oz. 1939. Directed by Victor Fleming. USA: MGM

Other:

Blade Runner. 1982. Directed by Ridley Scott. USA: Warner Bros.

Blazing Saddles. 1974. Directed by Mel Brooks. USA: Warner Bros.

Fantasia. 1940. Directed by Samuel Armstrong, James Algar et al. USA: Disney

Full Metal Jacket. 1987. Directed by Stanley Kubrick. UK: Natant

Gone with the wind. 1939. Directed by Victor Fleming. USA: Selznick

Hero. 2002. Directed by Yimou Zhang. UK: Beijing New Picture Distribution Co

Independence Day. 1996. Directed by Roland Emmerich. USA: 20th Century Fox

Indiana Jones and the Temple of Doom. 1984. Directed by Steven Spielberg. USA: Lucasfilm

Saturday Night Fever. 1977. Directed by John Badham. USA: Paramount

Serenity. 2005. Directed by Joss Whedon. USA: Universal

Singing in the Rain. 1952. Directed by Gene Kelly & Stanley Donen. USA: MGM

