

Exploration of sound-based music composition tools and techniques for Hollywood-style science fiction films

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Abstract

This practice-based thesis explores the application of electroacoustic music composition techniques and tools in the context of entertainment science fiction film.

After an initial exploration of existing theories in the fields of electroacoustic music and film sound, a practical theory to evaluate and classify suitable sound sources is proposed to enable a composer to derive an amalgamation of the otherwise two distinct components sound and music. An approach from the perspective of sound-based music theories will be the starting point for this type of soundtrack. Based on Simon Emmerson's analytical tool, *the language grid* a practical application of sounds which are traditionally not considered musical is facilitated. Eventually—and at the minimum—this musical language is meant to supplement if not replace the traditional orchestral sound world.

Additional findings of the study include insights in the creation and usability of new instruments, tools to quickly apply and generate textures and gestures. During the research it has furthermore been concluded that while spatial mixing can be of major importance for sound-based music in the context of film, its successful application is stymied by a lack of flexibility (i.e. technological tools) to quickly render up- or downmixes for various settings. Additionally, the limited availability of suitable tools seems to prevent a wider application because of a lack of consistency in the implementation and use of audio standards in cinemas. Currently, a consistent audio experience regardless of the viewer's positioning in the cinema space can unfortunately not be guaranteed.

The accompanying demonstration portfolio pieces are segments of scores for the science fiction films *Star Trek First Contact*, *Dawn of the Planet of the Apes* and *Gravity*. Each segment provides a practical exploration of the proposed theory to demonstrate the practicality of electro-acoustic music concepts and composition tools.

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1 Introduction

1.1 The thesis

[C]inema is only one thing: an illusion of many arts working together.

(Bernard Herrmann in Smith 1991, p. 360)

Film is a combination of several art forms uniting into one work. Sound, combined with moving images, lead and focus the audiences' attention towards the dramatic impact of the narrative. Historically, before the dawn of sound films, accompanying music had taken on the role of directing meaning of voiceless and so ambiguously moving but otherwise silent images. Since then, the sound world and language of film music—originally orchestral and percussive sounds in various applications—have undergone many changes, with the most profound and extensive ones happening in the last few decades, when the digital revolution pushed technological developments into the next chapter of film making.

This thesis sets out to explore the application of acousmatic music composition tools and techniques to supplement or possibly even substitute traditional orchestral scoring practice in Hollywood. As such, 'everyday sounds' are meant to become instruments and clearly be distinguishable as music, surmounting a basic utilisation of semantically recognisable sounds in a musical way. It will also be explored whether the time necessary to sculpt

sounds into instruments can facilitate the needs and requirements of the fast-paced media industry in Hollywood.

Although film music's traditional language (mainly orchestral in nature) is indeed efficient and effective in its applications, it might still be a less direct language when combined with images than an organically conceived soundtrack, which consists of or is derived from the same or at least similar material as its sound design. Therefore, the thesis investigates as to why Hollywood has been holding on to an orchestral composition practice for so long.

Eventually a theory to classify and adjust levels of modifications and processing to disguise the applied source material for the compositions and instruments is proposed. The theory should allow the emerging composer to practically apply sound-based musical material in such a way as to ideally avoid confusion or misinterpretation regarding its function as score for a film.

Finally, a portfolio of sound-based film music works is presented to assess exclusively applied *sound-based music tools and techniques for Hollywood style entertainment science fiction films through a practical application.*

1.2 Research questions

This thesis attempts to apply composition techniques and tools which have been used in electroacoustic (EA) and particularly in acousmatic music for decades. The endeavour to bridge the musical gap between EA and film composers has arisen in an attempt to explore sound-based music's usability

to function as score and in especial to compose music for Hollywood entertainment science fiction film.

Before sound-based music can successfully be utilised in this setting two significant questions might need to be explored:

1. Since sound-based music has been composed for many decades, why has the style barely been explored in Hollywood's cinematic film scores so far?
2. Even if this style of music is practically usable, will it be accepted by a typical cinema (or in this case typical science fiction film) audience?

Thereafter the thesis seeks to address or clarify the following questions which aim at the practical applicability of sound-based music:

1. What qualifies sound-based music and which source material can be used for its composition in the context of film so that the sound world is clearly recognisable as score?
2. Are there audible differences between a sound utilised in the role of sound design and a sound applied as (sound-based) score, and if so, what are the distinguishing attributes?
3. Following the distinction of roles of sound and music in film, can a score derived from sound-based source material potentially lead to misunderstandings because of (un-)intentional interpretations at the receiver's end? In this case, would it be possible for the composer to overcome this weakness of every day sounds as source material through an application of specific EA composition tools and techniques which could already be identified during the conception stage?

4. Assuming that sound-based music leads to the creation of new musical instruments, are there particular indications for a sound's practical utilisation as a musical instrument which is to be applied to compose the film score?
5. How can these newly derived sound-based (instead of note-based) music instruments contribute to telling a story, considering that music—and not sound—has traditionally been the carrier of concepts (versus the reality of sound design)?
6. Which tools and techniques are at the disposal of the composer to successfully create sound-based music usable in Hollywood blockbusters? Will it be difficult or time-consuming to apply these, and eventually, how suitable are these for an application in the industry?

1.3 General approach

The research will set out to find reasons as to why sound-based music—as elaborate and sophisticated as it had become in avant-garde circles already by the mid 20th century—has barely been recognised by the film industry as music although electronic instruments had been adopted as musical instruments already at an early stage. Apart from a superficial usage in trailer soundtracks, acousmatic music composition techniques and tools have basically been neglected. Sound-based music compositions in the explicit role of music can barely be found in film—this is, aside from ambiences which technically fall into the category of sound design and so are not identified as music.

The here proposed EA composition style is based on electroacoustic music concepts, in especial the ones considered acousmatic or sound-based music. A theoretical demarcation is approached less strictly, and instead aims at the practical application of composition techniques common in the aforementioned styles. The techniques consist of the manipulation of recorded sound sources which can but do not have to be musical in nature, and are possibly enriched or supported with an additional analogue or digital sound source. Aiming to utilise any object capable of producing a sound to create music, the resulting sound-worlds are meant to be applied in a narrative setting to support moving images to eventually replace or at least supplement the current scoring practice for film.

The original stumbling block for this thesis was the restriction of source material. The definition of what constitutes or belongs to EA music itself is still controversial and so the restrictions of the raw material for the compositions initially posed an issue. Acousmatic music practice itself has come to accept a diversity of styles and embraced sound sources which were originally excluded.

EA music has embraced recorded as well as digitally synthesised sound sources for several decades by now but the musical parameter of pitch is still considered a controversial subject. Not only is there a tendency to avoid the defined pitch-space of note-based music, spectromorphology is based on pitch as a fluid entity; a notion rather opposing the decision taken for this research to focus on the musical parameter pitch. The choice to consider pitch

as a central musical parameter was reached after it seemed prudent to adopt the already existing and effective stylistic language of film scoring instead of having to additionally invent and lobby the introduction of a completely new musical language. As Robert Weale (2014) concluded from his 'intention/reception' research: it is easier for an audience to understand and accept something new if something familiar they can 'hold on to' already exists. Plus, focusing on pitch enables the composer to apply traditional orchestration concepts: easily blending or combining instruments of various origins which share the same tuning system.

On the other hand, as has also been advocated by many Influential acousmatic music composers, the previously considered disadvantage of fluidity of pitch-space facilitates a flexible distinction of practically applicable sound sources. Instruments conceived from every day sounds could then expand the already existing pool of raw material and so literally include any object capable of emanating a sound. At this point, only stylistic choices necessary to accommodate the language of film music could possibly restrict the practically usable sound palette.

However, the strict definition of roles and tasks, and time constraints in Hollywood might limit a composer to apply musical instruments which cannot be easily combined/orchestrated. While musical instruments can include ethnic, a wide variety of percussion and electronic instruments, the creaking of a door would not be considered acceptable, because the object classifies

as belonging to what is considered the 'real-world space' (i.e. reality) and therefore is associated with sound design.

Finally, suggestions for classifications and 'necessary amounts of processing' to disguise a sound source will be proposed. A crossover to a musical use of sounds normally reserved for objects in reality-space could lead to confusion in meaning and interpretation in a culturally broader audience, who is expecting to see a film abiding by the rules of an entertainment blockbuster film. The theory proposed in this research is approached from the perspective of a practitioner and aims to stir the necessary thought processes needed for the task of composing a score which is meant to intentionally evoke a pre-defined mood as outcome.

A description of the portfolio works follows thereafter. It has to be pointed out that the presented practical work consists of incomplete soundtracks. The research originally focused on a practical implementation of EA music and therefore aimed at a practical adaption of tools and techniques for the composition of acousmatic or sound-based music. At the outset, the decision had been taken to focus on similar scenes found in all three example films and to create appropriate but comparable cues. Any discourse of criteria accounting for the suitability of these music styles in the context of blockbuster films has to revolve around an ability to support and propel a narrative.

This thesis is not meant to be an aesthetic analysis, but, as a matter of fact, aims at a pragmatic application. However, a broader acceptance in an audience which is not accustomed to this style would be a welcomed additional outcome.

1.4 Why Science Fiction

Science fiction (in this text mostly referred to as sci-fi) is a mass art aiming at a mass audience. It can either describe a possible future, offer an examination of technology and its use, depict ethical controversies or contentious socio-cultural circumstances which could better be described or questioned in a future setting (purely for the reasons of comprehension or to circumvent censorship) or it concerns itself with the implications of inter-planetaryism (Hayward, 2004).

Science fiction films were chosen as focal genre for this thesis because it seemed to be a suitable and believable testing ground for the hypothesis of applying a for a broader audience rather unfamiliar sound-world. The genre's exploration of new or unknown futures, advanced technologies or the deviation from terrestrial-physical laws suggests a facilitation of plausibility of diegetic as well as musical sounds-worlds which deviate from the known or accepted norm. History and conventions are less of a 'burden' because a precedence for the depicted narrative future world has not yet been

established¹, and the composer is left with a greater level of freedom to invent what a possible future might sound like. Additionally, an audience might already expect a sound-world which is at least to some extent different from current or known reality². Consequently, the resulting soundtrack could be more inventive and play with the impression and expectation of what reality or music of an imaginary world or future might sound like.

Furthermore, science fiction as an originally low-budget film genre (i.e. B-films) needed sounds to become believable. In this way, sound effects would make up for the limited appearance of sets or visual effects (Donnelly, Hayward 2012). Chion (1994), on the other hand, acknowledges that sci-fi is an appropriate example for the exploration of new technology, and that it enlarges the already available sound vocabulary for other emerging inventive films.

Finally, as will be shown in the literature review of this research, sci-fi has historically been at the forefront of latest technological inventions for both, the demarcation of possible futures and the realisation of the film itself.

¹ Unless the film is a sequel, in which case the composer/sound designs are bound to the existing sound palette, of course.

² Naturally the soundtrack cannot be too far 'out' as it still needs to be recognizable in its role as signifier, providing interpretable signposting for an audience to make sense out of pictures and their suggestions.

1.5 Thesis and portfolio overview

After defining the framework terminologies, the practical validation of sound-based music to score sci-fi entertainment films will start with an historical examination of the Hollywood soundtrack, focusing on financial, technical, practical and labour divisions which influence the production of the total soundtrack. This will be followed by a section speculating as to why acousmatic music and its composition techniques might not have been more fashionable among Hollywood composers and production companies.

The following section discusses the respective roles of sound and music as part of a soundtrack which includes an exploration of possible consequences if roles are interchanged or unintentionally blurred (consequently blurring diegetic and non-diegetic roles), possibly leading to misinterpretation or even confusion in an audience conditioned to look for the rather clearly defined narrative and production rules of blockbuster films.

Next, a brief overview over electroacoustic music concepts will be provided. Focusing on sound-based music as it is currently practiced, its advantages and disadvantages will be examined. It will be argued that adapting and adjusting the composition style, its techniques and tools, could offer a valuable alternative to the current scoring practice. Musical parameters such as pitch, timbre and rhythm (including tempo and timing) have been identified for further exploration.

The literature review will be rounded off with an historical overview of important science fiction blockbusters and their film music, emphasising the changes brought to film music in general through their first application in the genre.

The findings in the theoretical section are utilised to propose a theory to support the composer's choices and decision making and the practical works are presented in the attempt to overcome the dividing lines between sound and music—which, at the same time, strengthens the recognition, position and importance of the perception of the soundtrack as a unity.

The thesis closes with a conclusion and a list of suggestions for future research topics to acknowledge additional questions which have arisen during the study.

1.6 Terminologies and working definitions

In science it is recognised that better and more refined taxonomies are needed in many areas of research (regardless of in scientific, EA music or film theory/film sound studies). This research also struggled with controversial definitions but an engagement in these discussions would deviate from the topic and excessively extend the scope of this thesis. Instead, all here proposed definitions are provided to allow the construction and interpretation of a

practical framework to eventually adapt electroacoustic music composition in the context of a blockbuster sci-fi film soundtrack³.

1.6.1 Hollywood

The first term to be delimited is Hollywood for which—among others—the following definitions are acceptable. Hollywood is first and foremost a brand focusing on making a profit and which consists of/is...

(a) Conglomerates specialising in the 'globalisation of cultural industries, pointing at the increased circulation of cultural products across national borders[,] and increasing borrowing and adaptation of images, sounds and narratives across cultures' (Behil, 2016, p. 27).

(b) A location of geographically concentrated businesses, structured similarly, related or complementary with access to communication channels, labour and specialised infrastructure. This definition is embraced by academics in economic geography and focuses on an idea of headquarters which are within a cluster but with access to the global market (ibid.).

(c) A local industry run by 'global entertainment mega-companies' (ibid., p. 29) facilitated by the change of technology and the movement of money, but with a strong focus on the 'division of labo[u]r' (ibid., p.30). Products are sold everywhere 'through a global system of copyright, promotion and distribution [...] to minimi[z]e cost and maximi[z]e revenue' (p.30).

³ Where applicable, terminologies relevant to this thesis will be explored in more depth in the literature review.

As such its products show features such as transnationality, hybridisations of innovation and remakes, but always with a high-quality production standard.

1.6.2 Sound and music

This thesis' framework is based on the ability of all kinds of sounds to function in a musical way. It has to be pointed out that a discussion of what exactly constitutes music or what is a 'non-musical' sound (and their dividing line) can only be considered as a working proposition to explore the practical work.

The distinction of what constitutes music seems mainly based on aesthetically or socio-culturally accepted rules and their observation (or defiance) and has been disputed throughout various cultures and centuries. In *The Liberation of Sound* (1966) Varèse for example examines the provenance of an (aesthetic) distinction between sound and music and at the same time questions and opens the doors for a new, suitable musical source material. He emphasises that music is nothing more than 'organi[z]ed noises' (1966, p. 18) and furthermore suggests, that the definition of what constitutes music depends on a listener's 'stubbornly conditioned ears' (1966, p. 18). Deducing from his essay that a composition is nothing other than the organised succession of sounds, a re-definition of a film's sound design to constitute music might need to be considered.

The soundtrack of a film consists of sound design and music, both of which are subject to a practical representation of their assigned role(s). The word

sound has traditionally been associated with sound design which tends to represent real-world objects⁴, while the word music—or in the filmic context score, underscore or cue—has been applied to abstract sounds which represent concepts and ideas.

1.6.3 Musical instrument

I BELIEVE THAT THE USE OF NOISE

Wherever we are, what we hear is mostly noise. When we ignore it, it disturbs us. When we listen to it, we find it fascinating. The sound of a truck at fifty miles per hour. Static between the stations. Rain. We want to capture and control these sounds, to use them not as sound effects but as musical instruments. [...]

TO MAKE MUSIC

If this word 'music' is sacred and reserved for eighteenth- and nineteenth-century instruments, we can substitute a more meaningful term: organi[z]sation of sound.

(Cage, 1973, p. 3-4)

Regardless of electronic or non-electronic, objects which have an ability to attenuate musically usable frequency bands are declared musical instruments by dictionaries: any tool or thing which can be used to produce a sound usable in a musical setting (Grame and Westrup, 2019). This definition includes

⁴ Technically, ambience sounds of a film constitute a careful conception of composed, successive (and layered) sounds with the intention to emotionally or structurally impress or please, and so could be interpreted in Varèse's words, as music.

any object which can emanate a sound when excited, as long as it exhibits a musical feature which can either be extracted or at a minimum be enhanced. In 'The Liberation of Sound' (1966) Varèse supports the above claim, justifying that music can and should be created out of any sound emanating object, given it fits into the desired musical context.

Based on these assumptions, any form of object capable of emphasising musically advantageous frequency bands could be considered a musical instrument. However, for an instrument to be musically functional in the context of a film, it also has to be distinguishable from objects depicting reality-space (normally covered by sound design), as these sounds could otherwise be confused in their contextual meaning. Therefore, to test the here presented hypothesis and in order to decide if the sound of an object can quickly and easily be source material for a score it has to demonstrate an affinity to express certain, pre-defined musical parameters with the unmistakable intention to function as music.

According to Adorno, who based his concept of music on Aristotelian theories and ideas of the actualisation of the imitation of natural beauty, music does not offer a semiotic system (Rattigan 2002) and so cannot have an implicit meaning or even be considered a language. However, while music does not use irrefutably translatable words, musical styles can nevertheless be considered similar to a language's sentences: phrasing, timing, flow and the performer's interpretation are important for an audience to be able to discern

and understand the music. Still, for an object to function as musical instrument it cannot be a carrier of a distinct meaning.

The timbre of a musical instrument is by itself considered abstract and devoid of a definitive translation⁵ in Western music. For these reasons, instruments have become perfect carriers for the representation of suggestable, emotional meaning instead of carriers of semantic meaning—a distinction which will be important in the later examination of sounds as source material for sound-based scores and their opposing use as sound design in the context of film.

During the classical studio era a typical orchestration for Hollywood's sound films consisted (more or less) of the same instruments found in the symphony orchestra (see for example scores by Korngold or Steiner) or (orchestral) jazz big bands for the musicals (Buhler, Neumeyer and Deemer, 2010). After the breakup of the studio system and the introduction of the first electronic music instruments in Hollywood (e.g. Theremin) the lush orchestral sounds were slowly replaced with popular music instrumentation, only to return to big classical orchestras after the box office hits with music composed by John Williams in the mid to late 1970s (ibid.). Since then, the sound colours of the symphony orchestra have dominated the cinema again.

⁵ Definitive representations exclude general representations which have established themselves through frequent use: for example, trombones for the underworld, trumpets and snare drums for military, the sound of a New Orleans (early Jazz) Brass Band for funerals, bac for death, etc.

More powerful computers have slowly changed the scenery and in 2001 Hans Zimmer set an example using FFT processed helicopter sounds for the score in *Black Hawk Down* (Scott, 2001; Rudy, 2004). However, from the practical point of view of a soundtrack, any object could theoretically function as an instrument as long as either its musical properties can be extracted or adjusted in such a way as to function in place of a traditional instrument.

Furthermore, at the mixing stage—from a technical point of view—music is treated just like any other sound element of the total soundtrack (among others Hillman, 2017). For this reason, the score as part of the film could be considered similar to the rest of the soundtrack as another ‘type of sound’.

To conclude, a musical instrument—as used in this thesis—is defined as an object from which a minimum of one musical quality can be extracted. The emanating sound does not need to exhibit a periodic signal but should ideally express a musically controllable or malleable frequency (i.e. pitch). In either case, the instrument must be designed from a sound with the tangible intention of bringing forth music which, in the context of a film's narrative, is unmistakably perceived in the role of music by a wider audience.

1.6.4 Electroacoustic (EA) music and reduced listening

A detailed historical overview of electroacoustic music and in especial acousmatic music can be found in the respective literature⁶.

It is acknowledged that Pierre Schaeffer originally called the newly invented music, composed from recordings and played back uncoupled from the sound's source or cause, *musique concrète* (Field, 2000; Landy 2007). To allow a better distinction, the term *acousmatic music* was later suggested and mainly used in reference to music produced at the GRM in Paris (Battier, 2007). Leigh Landy (2007) eventually coined the term *sound-based music* to distinguish music derived from sounds as smallest unit instead of music composed from notes.

The term *electroacoustic music (EA)* is used in this thesis as umbrella-term for *acousmatic music*, *sound-based music* and any other form of blended acoustic-electronic music which is re-presented through a speaker system. The term seemingly offers the broadest coverage and the least confusion regarding source material and composition techniques and tools, and can so be deemed the most appropriate and least challenging description for music derived from this practice⁷.

⁶ A summarising overview can be found at <https://ears2.dmu.ac.uk/encyclopedia> (Landy, n.d.).

⁷ Please note, that this thesis often exchanges *electroacoustic music (EA music)* with the terms *sound-based music* or *acousmatic music* for the ease of reading.

Reduced listening, the abstraction of an object's sound from its implied signification, is at the very heart of Schaeffer's theory *traité des objets musicaux* (1966; Treatise on musical objects): only when the function as a signifier (not reality) has been severed from the sound can an object be used in a musical setting (Cohen, 2015). Through reduced listening a sound turns into a building block for acousmatic music and so results in a purely aural experience.

Generally, music and sound can affect the listener in two⁸ ways: objectively as the sound it is and subjectively as a sound connected to personal memory. This raises a difficulty with reduced listening when attempting to conjure up a particular emotion or mood. Listening to a sound objectively depends on a familiarity with the object and its excitation; once removed, an interpretation might either be impossible or dubious (e.g. sizzling of bacon in a pan for the actual cooking or the representation of heavy rain). From a subjective point of view an interpretation would rely on a listener's previous experiences—probably coloured by personal circumstances both of which could possibly deviate from its intent (e.g. hearing the wind might remind one person of a great time at the beach and another one on a frosty night spent in a train station).

Reduced listening in the context of acousmatic music requires a highly trained audience as well as an ability to consciously avoid any personal, subjective associations. A sound defines itself through its symbolism and

⁸ Additionally, it is worth noting that there are sounds (and music) stimulating a physiological-psychological response, which seemingly cannot be controlled by the listener (Dahlhaus, 1982).

tangibility as an object as well as through the listener's interaction with the object's attributes (Cohen, 2015). Rattigan (2002) confirms that the brain and our familiarity with the sound define how we perceive, identify and assign meaning to a sound. In other words, it is difficult—if not impossible—for a listener to avoid hearing an object as precisely what the object is and its (specific) connotation—that is, as long as the source is recognisable, of course. However, in a filmic context, the synchronised fusion of visuals with a sound happening at the same time will combine into what Chion (1994) called 'synchresis' and so enable the art of foley and profession of sound design.

Academia has come to a consensus that a sound can be both: an entity in its context as well as a sound with musical qualities uncoupled from its signification (Field 2000, Landy 2007). EA composers, sound designers and foley artists take advantage of the duality between signification and the pure sound object and play with the listener's perception and interpretation (Field 2000).

1.6.5 Musical sound

There are sound effects, there are abstract sound effects; there's music, and there's abstract music [...]. And somewhere music turns into sounds[,] and sounds turn into music. It's kind of a strange area.

(David Lynch in Kenny, 2000, p.133)

Thomson describes a *musical sound* as 'any tone with characteristics such as controlled pitch and timbre', which 'are produced by instruments in which the periodic vibrations can be controlled by the performer' (2010). The indeterminate definition of what constitutes a musical sound (or tone) might be justified because it has to conform to physical⁹ and aesthetic definitions (e.g. beauty and harmony through harmonic relationships of overtones), and because it also has to fit in a cultural background (e.g. context of use and interpretation as well as tuning systems).

The definition's possible weakness lies in its restriction of sound to periodic vibrations: sounds of every day objects do not necessarily exhibit periodic waveforms. However, with support from current digital signal processing technology periodic qualities can be successfully retrieved, extracted or simply amplified.

Focusing on the objective of a film soundtrack, if any sound can indeed be part of a pool of possible sources for compositions, the following categorisation for initial raw material is proposed¹⁰ (see Figure 1):

⁹ Tone as periodic and noise as aperiodic vibrations.

¹⁰ These distinctions are proposed for theoretical purposes only. Any demarcation in practice is indeed flexible.

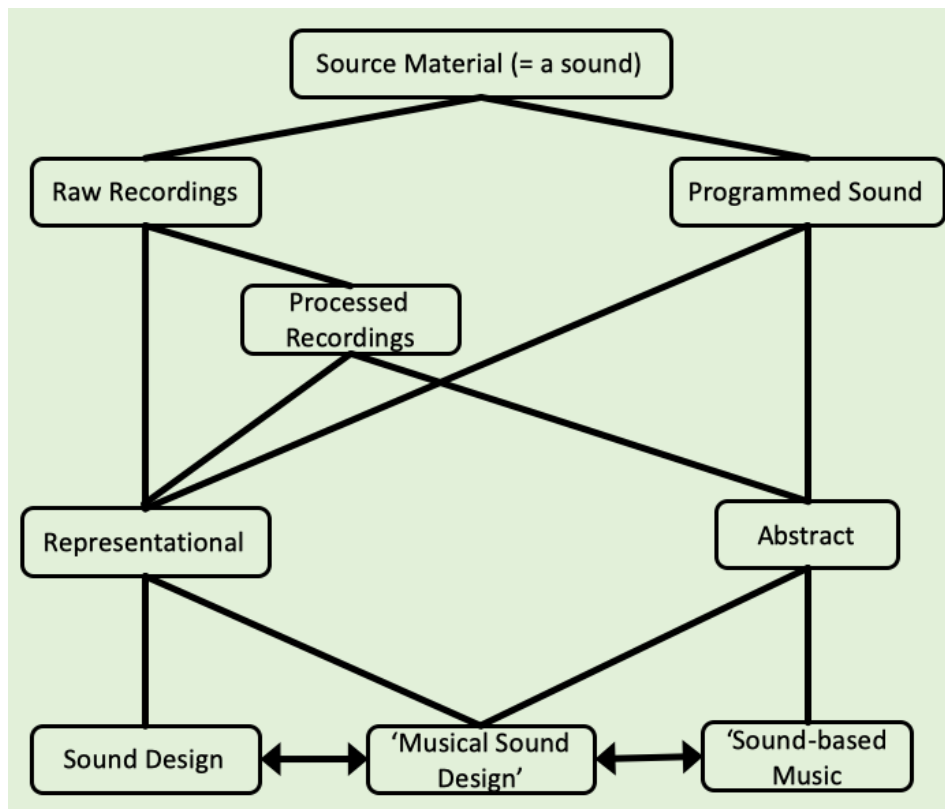


Figure 1: Categorisation of sound material (Grunewald, 2020).

Source material can stem from recordings or can be programmed¹¹. Either sound source can be representational (i.e. related to the visuals) or abstract (i.e. unrelated to the visuals) in nature. However, raw recordings—if recognisable in their nature and attributable to semantic meaning—will be processed to obscure their source and to render the sounds (similarly to traditional musical instruments) abstract. In the cases that a sound's semantic meaning is discernible, it will be considered representational and so functions either synchronous (i.e. footsteps) or asynchronous (i.e. off-screen birds). In these instances, their combination with the image either leads to

¹¹ The sound choices acknowledged by current, established acousmatic music practice has been confirmed by Leigh Landy for EARS-2: the acousmatic music community widely accepted the inclusion of synthetically produced sounds (e.g. physical modelling) next to real-life and processed real-life sounds. The reason for this inclusion is their focus on sound quality or sound colour as main musical parameter (Landy 2012).

- (a) sound design depicting reality-space, or
- (b) 'musical sound design' (i.e. a 'musicalisation' of sound design and results in what is called 'the integrated soundtrack'¹²), or
- (c) 'soundification' of music (cartoon style; mickey-mousing).

If a programmed sound (synthesised) or a processed recording cannot be identified as an object representing reality-space (i.e. both are abstract sounds) and if some form of musical parameter can be extracted from it, the sound can be considered musical in nature. *Sound-based music* functions in a musical capacity; *musical sound design* could be regarded as an alternative term.

1.6.6 Timbre

In 1994 ANSI defined timbre as 'that attribute of auditory sensation which enables a listener to judge that two nonidentical sounds, similarly presented and having the same loudness and pitch, are dissimilar' (Oxenham in Deutsch, 2013, p.18; ANSI, 1994, p.35). However, this definition is missing necessary key attributes important for the perception and identification of timbre.

Science recognises that timbre—also interchangeable with the word *tone colour*—is a multidimensional phenomenon in both, frequency and time domain, showing a multitude of either discrete or continuous perceptual, musical attributes and functioning as an agency to categorise an object (e.g. perception, identity of its causality and spatiality, changes in spectral content

¹² For more information, see the writings of Danijela Kulezic-Wilson.

over time) (McAdams in Deutsch, 2013). Timbre covers physical characteristics such as pitch and noise content, spectral envelopes and duration, overall loudness and its development over time, relationships of partial tones, their amplitudes, levels and ability to blend (including formants) as well as information about the spatial positioning of the object (Peeters et al, 2011; McAdams in Deutsch, 2013; Lembke, PhD thesis 2014). Additionally, the ANSI definition, speaking of auditory sensation—a perceptual phenomenon—seems to aim to describe the physical characteristics of sound events (Roads, 2015).

Finally, it has to be mentioned that by now it has been acknowledged that timbre is a 'perceptual property of perceptually fused auditory events' (Siedenburg and McAdams, 2017, p.3), may result in an identification of objects (i.e. source identity) and so also allows an assignment of semantic meaning.

In summary, to facilitate a working framework for this thesis, timbre or tone colour will be recognised as the collection of physical as well as perceptual attributes, which at the same time may allow a listener to identify—not necessarily recognise—a source or cause of a sound.

1.6.7 Defining Film Sound

In general, the word *soundtrack* can be understood in various ways in the context of a film:

- The unity of all sound (i.e. sound design and music).
- Exclusively music:
 - Can be made up from various pieces of popular songs, which can be inspired by, but is not heard in, the film.
 - Songs as actual components of the film and its narrative.
 - Music explicitly composed for the film is referred to as *original soundtrack (OST)*.
 - The *score*¹³ is a designator for any music or sound in the role of film music (i.e. the exclusive support of the narrative's dramatic structure—but not songs—free from formal constraints of musical structure). Gorbman (1987) also defines this as the 'invisible music'.
 - *Soundscape* can also be used in place of *score*, but in film, the sound design team traditionally uses the term to describe the locale, setting or ambience of a place or period in time (Altman, 1992).

As can be seen, terminology is an equally difficult territory in film sound theories. Since this thesis would deviate from its aim if it had engaged in the discussion, it proposes following definitions as working frameworks:

1. *Soundtrack* is the sum-total of all sounds heard in a film.
2. *Score*, *underscore*, *cue* (and loosely also the term film music) consists of music (or musical sounds) which exclusively support the narrative. Depending on the placement, they can be diegetic or non-diegetic.
3. *Ambience* (instead of soundscape) is sound design defining the locale, time and setting.

¹³ At times the terms *underscore* or *cue* are used instead of *score*. *Underscore* mostly but not necessarily exclusively represents the music accompanying a dialogue; *cue* is alternatively uses as the music functions as signifier for a mood or atmosphere.

4. *Songs* or from a music theoretical point of view formal structured pieces are not part of this thesis and therefore will not be discussed.

Furthermore, the score as an accompanying support structure in film is mainly composed as a textural piece of music. It is meant to unobtrusively blend in with the rest of the scene or dissolve into the subconscious. It has background-music-like attributes in common with texture-based music in acousmatic music (both can exhibit a continuous 'done' with an obvious intrinsic movement).

At the mixing stage, practice distinguishes between sound that can be heard by the protagonist(s) and what can be or is heard by the audience (Thom, 2007). Therefore, the score will have to be considered in the context of diegetic and non-diegetic settings (Winters, 2010, 2012).

1.6.8 The mix

The task of mixing a complete soundtrack is normally assigned to a group of specialists who, over the span of a several weeks, spatially place and balance a high number of objects, tracks and stems filled with sound effects, music and dialogue.

In the finalising stages of this thesis surround and especially Dolby ATMOS have become the accepted mixing standard in delivery for cinemas. At the

time of writing, surround standards also seems to become the norm for streaming services. While this thesis recognises the importance of surround which has raised the complexity of mixing but also created an exciting experience for the viewer, discussing the mix in a depth appropriate for the subject would unfortunately deviate from the exploration and application of acousmatic music composition techniques to entertainment science fiction film. However, since the movement of individual musical events aggregating into a composition constitutes an integral part of the final product and because movement is an important musical parameter in acousmatic music, mixing will briefly be discussed as an electroacoustic music composition tool.

2 Literature Review

The literature review aims to source relevant publications substantiating sound-based music's current or future ability to function as a substitute—or at a minimum supplement—sound source for the current existing practice of scoring music for entertainment films without offering a risk in misinterpreting the audio-visual context.

The literature review opens with a brief overview of technological developments influencing the compilation and organisation of sound in Hollywood film. Although the arrival and spread of digital technology in the last few decades have empowered every-day and electronic sounds to take on an even more prominent role, their colloquial use of having to match the visuals literally has not necessarily been surpassed.

The discussion continues with an analysis of roles and functions sound has taken on in comparison to music in the filmic context. An examination of a possible experiential consequence for applied film sound practice follows the brief exploration of the opposing terms diegetic and non-diegetic as interpreted by Ben Winters.

A brief summary of EA music theories (in particular Smalley's theory of spectromorphology) attempts to establish a framework for the combination and integration of film sound with EA music. Timbre qualities seem to be at the centre of an audience's experience and interpretation of a soundtrack.

Subsequently soundtrack—image relationships will be discussed in attempts to map the musical parameter of rhythm to the mediation and understanding of the telling of a narrative.

An overview of science fiction music milestones and their impact on the film soundtrack concludes the literature review. The consultation of scholarly publications about the genre's soundtracks has been included to demonstrate the reception of inventions and the resulting changes in approach to (sci-fi) music and consequently sound design.

2.1 Technological developments influencing blockbuster sound

Technology has always steered film making processes, but it was the rapid evolution of computer technology from the 1990s onwards which changed the conception of and possibilities for soundtracks and their experience as part of a film's narrative.

2.1.1 Hollywood's resistance to sound (design)

During the transition to the talkies Hollywood drew its recording and sound specialists from the pool of former radio engineers who, experienced with the medium, were able to make use of the for film new technology in creative ways (among others O'Brien, 2005; Hansen, 2007). These engineers shaped the

understanding of early sound recording and aesthetics, but given their engineering background also engendered the profession's originally purely technical perception (Mott, 1990; Sergi, 2016).

Following the first influx more radio veterans conquered Hollywood: following Orson Welles into film composer Bernard Herrmann substantially influenced underscoring practice¹⁴. Herrmann's composition style was adapted and derived from the restrictions imposed by (live) radio. He brought along his impeccable feeling for storytelling with sound and might have been the compose who gave birth to what could be considered the perception of multi-dimensional sound (i.e. sound in 3D space)—although, sound was still in mono at the time. In the meantime, Pierre Schaeffer, the originator of *musique concrète*, began composing with sounds while developing a theory of composition techniques¹⁵ for this new music at the radio in France. Both pioneers introducing their craft to the world of cinema could have provided a basis for unified storytelling using sounds. However, it seems that mainly financial implications (i.e. technology and division of labour) stymied the advancement of sound. By the time technology was eventually ready for the sound film, its industry—the studio system and screening theatres—had taken

¹⁴ Radio, live and a fast-paced medium, did not leave much time to Herrmann to convey meaning or to produce. He had to invent a new, creative use of music to drive the story line. At the same time, Herrmann belonged to a new generation of composers, opposing established, neo-romantic composers such as Steiner, Korngold and Waxman.

¹⁵ Although it is disputed that Schaeffer was the first one using sound as source material and processing it, he might as well have been the first one to write a justification and theory around the subject. Radio engineers from all over the world seem to have used similar techniques before him—however, not in the same context and with the same aesthetical aims.

root and was imperturbably in place. With structures, investments and formalised workflows established, the studios had no reason to change; unions protected their members' interests and were not interested in change either. Technological change of this magnitude was costly and replacing or upgrading the existing cameras to handle sound meant a major financial risk (O'Brien, 2005; Mast and Kavin, 2011).

Technology eventually caught up and sound engineers successfully experimented with aesthetic frameworks—albeit preferably recorded and rendered in postproduction—and the need to reach and please a mass market led to a business model promoting a rinse and repeat strategy of what had already proven profitable.

Hollywood's industry, by then been battered by several major crises¹⁶ and declining visitor numbers, was long forced to reinvent itself. So, after the transition from the studio system, it was the next generation of film makers, emerging in the 1970s and influenced by French Film Noir, who brought major changes to how Hollywood films were made and eventually perceived. Directors like Francis Ford Coppola, George Lucas and Steven Spielberg empowered sound through their vision of entertainment cinema (i.e. blockbusters) and how a creative use and the design of sound could tell and

¹⁶ First the film industry was forced to sell their theatres (breakup of the studio system in 1948), because it was found that the industry was dictating American entertainment from production to distribution. In the meantime, production companies also had to upgrade expensive technology or were financially still suffering from the change to sound film. Then the TV was invented and audiences started choosing for home entertainment instead.

embellish a story on the screen. The third major change after the breakup of the studio system (1948) and the change to blockbuster cinema in the mid-1970s was brought about by the development of digital technology in the 1990s (Behlil, 2016).

2.1.2 The digital revolution in the 1990s

Early synthesisers such as the *Synclavier* or *Fairlight CMI* (both late 1970s) had extensively been utilised for music composition and manipulation of sound design, but synthesisers and studio equipment in general was initially rather expensive and so access was limited. It was the rapid evolution of computer technology¹⁷, which gave birth to the digital audio revolution and empowered Hollywood's sound professionals in the 1990s.

Digital audio workstations (DAW) eventually facilitated the possibility to work in a non-linear fashion (previously impossible because film and its audio was on reels), which additionally decreased production costs and time. At the same time DAWs introduced new ways of creating and controlling audio: flexible recording, mixing, processing and automation¹⁸ of sound and music on more tracks than before became possible, was executable in less time and with less people. Mainly (former) pop music composers were at the forefront of these developments introducing and streamlining the use of new technology and practices in the industry of Hollywood's soundtracks.

¹⁷ I.e. faster computers in increasingly smaller sizes and at lower costs.

¹⁸ Movements normally executed in real time with help of a fader for example.

Several sound designers began experimenting with the software-hardware combination Kyma to express narrative in more intricate ways (KYMA, n.d.). After the integration of synthesisers followed the integration of virtual orchestras. Especially composer-production companies such as Hans Zimmer's *Remote Control Productions* changed the landscape for emerging composers revolutionising the production quality of mock-ups and virtually orchestrated scores. Since then, digital systems have led to radical changes in the production and perception of film (Kerins 2011; Brend 2012).

Starting from approximately the mid- to late 2000s trailers pushed the sound landscape one step further while heavily borrowing sound design techniques from popular electronic music. With help of software synthesisers such as *Native Instruments MassiveX* and *Xfer Records Serum* for example, trailers have raised the bar for dramatic impact and the blend of orchestral and synthesised sounds has become a widely applied standard. It is again Hans Zimmer's production company which is often credited introducing (electronic) music production techniques and the typical trailer sound worlds to film music¹⁹ (Trailaurality, 2020).

Nowadays computer power is cheaply available to average households and affordable plugins and more flexible (orchestral) sound libraries lower the entry barriers for aspiring film composers. Technology has led to an even

¹⁹ Zimmer was among the first to apply the typical trailer sound dubbed 'braam' to a blockbuster science fiction film (*Inception*, 2010).

stronger competition in Hollywood's workforce. In addition, on-demand streaming services like Netflix and Amazon Prime are flooding the market with similarly well-polished products as have previously been connected to the brand 'produced-in-Hollywood' (Behlil, 2016). Just like in Hollywood, the new generation of content producers of streaming services is a collection of international freelancers backed by the money from production companies—however, enabled by technology and unencumbered by Hollywood's large budgets, relatively free and less restricted to explore alternative routes to storytelling.

2.1.3 The 'integrated soundtrack'

In the last few decades, scholarly research has embraced a new way of analysing soundtracks. Heard as unity, consisting of sound, music and dialogue, it is perceived in the context of the film, appreciating the functional interdependence and resulting influence on the film narrative (Neumeyer, 2000; Greene, Kulezic-Wilson, 2016). Academia has additionally begun to recognise a difference in the practical approach to the soundtrack: the 'emancipation of sound effects' (Kulezic-Wilson, 2020, p. 1) acknowledges an equality and musicality of sounds in comparison to music. Labelled *integrated soundtrack*, it can be augmented with synthesisers, virtual orchestration and sophisticated audio recording and processing techniques. Shaping and conveying a narrative and narrated reality in novel ways the *integrated soundtrack* seems a suitable medium to examine the style changes in

soundtracks caused by the development of digital technology. Together with its accompanying new approaches which are applied to work processes by film sound professionals an extra layer of depth and intensity is rendered to the story telling.

Sergi Casanelles (2016) identifies these changes in approach to orchestration, the recording of instruments and the production of the music. The *hyperorchestra* can be a blend of real, virtual and designed instruments combined with the deliberate use of various recording and production techniques, enhancing the composition of film music; a trend further facilitated by the rapid rise of trailer music, where electronic music and its production techniques have taken centre stage to shape instrumental and non-instrumental sounds.

Particularly sound design and its musical and rhythmical qualities, in addition to how well either one or their combination can synergise with the edits of visuals, is recognised in several articles and books by Danijela Kulezic-Wilson (2008, 2012, 2016, 2017, 2020). The exploration of advantageous relationships between rhythmical sound effects and picture edits can indeed yield invigorating final results; on the downside, rhythmical sound and its development will have to dominate picture edits—a luxury rarely granted to sound designers in the industry. Here, the predicament can especially be true since the focus of the product (i.e. visuals) dictate tempo and picture edits. Furthermore, Hollywood's approach to (precious) film time—facilitated by

digital editing—seems to aim at ‘more action scenes²⁰ in less time’ (Kerins, 2010), while rhythmically or mutually unfolding sequences are representing the opposite: in need of time and slow or long edits.

Kulezic-Wilson’s writings point out that replacing neo-romantic film music with musical sound design can fashion a new synergy between visuals and the soundtrack—a feature long requested by Kalinak (1992) and others to allow the necessary discretion for spectators to negotiate their own interpretation without an imposed, exclusive meaning provided by a production company. Reinstating a balanced, equal relationship between the soundtrack and visuals through the application of a unified soundtrack— a combination of sound design and music which are experienced as unity versus two distinct entities fighting for attention and audio-space—could indeed allow a semiotic synergy and prompt the audience to devise their own interpretation— regardless of the possibly Hollywood’s one-dimensional ideas might want to represent. However, how a re-negotiation of sound’s relative but denotative attributes might possibly be reached and how enough time for an ‘emotionally ambiguous soundscape’ (Kulezic-Wilson, 2008, p. 130) is to be found remains speculative. Many of Kulezic-Wilson’s examples seem to make use of a sound’s repetition over a longer span of time, resulting in sounds losing their source-bond²¹ and so being interpreted with a new meaning within the filmic context—eventually leading to the same predicament of filmic time dependency.

²⁰ On the other hand, limits on screen time it will provide a valid reason-d’être for a director’s cut and the release of an extra DVD.

²¹ Source-bond: see Denis Smalley and spectromorphology.

Another advocate of 'integrating' the various elements of a soundtrack is Walter Murch. His theory presented in *Dense Clarity—Clear Density* (2005) offers a different perspective on the integration and by extension musicality of sound. His practice-based approach proposes a categorisation similar to the colour spectra of a rainbow. The system does not only focus on the rhythmical aspects of sound, but consolidates timbre, pitch and meaning.

On the far left of the rainbow, violet represents encoded sounds needing some form of decoding (i.e. mediation of the meaning of sounds normally used for speech), and on the far right of the rainbow, red represents embodied sounds, which resembles music, understood in a direct way without the need of a decoding mechanism.

By themselves, most sounds are found in the centre of the rainbow, showing some musical element but also meaning (i.e. bird chirping which relates to the time of the day). But now, sounds can also be shifted along a rainbow's spectra according to their intended function (i.e. an expressive, vocal utterance, with an intonation suggesting what the words alone could not express, might end up closer to red). Murch's system seems flexible in the context of film sound practice. It seems to provide a defined support system for the successful application and mixing of sound when each unique element is assigned to a spectrum of the rainbow.

2.1.4 Summary

Change is happening in Hollywood—but seemingly slowly. This might be related to Hollywood first and foremost being an industry with interests protecting large monetary investments. Still, the rapid development of technology has decreased production costs and increased (national and international) competition.

Different approaches to the analysis of a soundtrack have been briefly discussed, mainly brought about by changes in the cultural-historical understanding of creation and perception of all sound as part of the soundtrack.

The following section will examine the distinct roles represented by each of the two soundtrack components, music and sound design.

2.2 Roles of sound and music in film

Film sound practice and its corresponding literature distinguish between the different roles of sound design and music. Roughly speaking, the former is meant to depict reality while the latter portrays emotions (Buhler, Neumeyer and Deemer, 2010). Practice and literature widely acknowledge that (unintentional) interchange can lead to confusion but also to interesting and provocative new interpretations (ibid.). The following sections will provide an overview of the roles and connected expectations respectively.

Since this thesis focuses specifically on the music for entertainment science fiction films, functions and roles of soundtrack elements will be examined in context of the genre in order to identify feasibility and drawbacks for sound-based compositions, techniques or its tools to supplement the narrative. Before each role can be discussed, the distinction between diegetic and non-diegetic sound will briefly be examined.

2.2.1 Diegetic and non-diegetic sound

The introductory chapter mentions that this thesis acknowledges the difficulty arising from disputed, incomplete or still missing taxonomies in academia and practice. Since the thesis' core question focuses on finding the potential strengths and issues relating to a practical application of sound-based music for Hollywood style entertainment science fiction films, the discussion surrounding diegetic/non-diegetic has to be considered. Difficulties encountered during the practical research and the consequential proposed solutions depend on the understanding and experience of the soundtrack by an audience.

2.2.1.1 Definition

The Greek word *diegesis* means 'told narrative' and is a distinction from *mimesis*, which is a 'demonstrated narrative'. Claudia Gorbman introduced the terminology to film music theory in 1987, when she adapted *diegesis* from

narrative theories of the Frenchmen Etienne Souriau and Gerard Genette. In her influential book *Unheard Melodies* (1987), she sought to explain and justify the presence and roles of music in the context of film. She declared *diegetic music* to be any music which is part of (i.e. present in) the narrative world. This implies that the source of the music is visible (e.g. a band playing on-screen) or at least plausibly explainable (e.g. music from the next room). *This defines non-diegetic music* as music which is added to the narrative (i.e. outside of the narrative world) to support, narrate or comment on the story.

Chion translated these expressions to film sound (see *Audio-Vision*; 1994), but immediately also acknowledged the valid critiques of academics and the difficulty of this binary distinction. He furthermore addressed a necessary differentiation between off-screen sound and non-diegetic sound: on-screen sound is equivalent to diegetic, but off-screen sound is not necessarily non-diegetic²². According to the definition, a sound would only be non-diegetic if it had been off-screen and existed outside of the story world (*ibid.*). Listing several examples for cases which outline the grey-area, he appreciated that there are many exceptions and instead proposes to consider the categorisations as 'interlocking sectors' (Chion, 1994, p. 78).

Although both books have been highly influential in both academia and practice, the terms diegetic and non-diegetic have led to a strange reception: controversial in academia (among others Stilwell, 2007; Neumeyer, 2009;

²² For example, the scene of a morning forest might show trees, while to the audience invisible birds chirp in the acousmatic background. The chirping of the birds is still part of the story world; hence, although the source is invisible, the bird sound is diegetic.

Winters, 2010; Yacavone, 2012) and—ironically—hardly noteworthy among industry professionals (Thom, 2007).

2.2.1.2 Diegetic fallacies

The non-diegetic fallacy: film, music, and narrative space (Winters, 2010) is one of many papers examining the difficulties which arise from Gorbman's deductions (see section 2.2.1). In summary, Winters critiques her assumptions as being based too much in literature and its corresponding levels of narration. When adapted to the soundtrack, Gorbman's definition removes non-diegetic music from the filmic space instead of allowing it to be a part and expression of the experienced film. He continues to demonstrate, that traditionally conceived non-diegetic music seemingly has an influence on and consequence for the represented characters, their actions and their world. The argument is that among other significations, the hero motif not only indicates the presence of the hero but seemingly also mutually influences and inspires the hero to influence or turn their fate²³.

In order to re-integrate music into meaningful film sound analysis, Winters suggests to consider the Russian tradition—with Bordwell's adaptations—of *syuzhet* (music/sound in the film) and *fabula* (the narrative constructed by an audience). He then links *syuzhet* with Frampton's *filmind*, which represents an

²³ E.g. *Indiana Jones (1981)*, *Saving Private Ryan (1998)*, *Lord of the Rings (2001)*.

intelligent personality of the film itself: the establishment of a self-reflecting narrative character with its own filmic reality, able to conveniently set the rules for the fictional world even outside of physical laws.

Music is then distinguished according to its function in the film:

(a) *extra-fictional music*: an attachment to the unfolding narrative, and

(b) *fictional*: all music is part of the film world. Winters' definition declares all sound and music within the timeframe of the film to be part of it. The film score is therefore not non-diegetic—something external to the film—but it is a proclaimed part of the film (see Figure 2).

Extra-Fictional	Fictional		
(attached to the story world; e.g. overture to <i>Lawrence of Arabia</i>)	(imagined by the 'filmind'; corresponds to syuzhet)		
	Extra-diegetic	Intra-diegetic	Diegetic
	Fabula (narrative space as created by audience; direct effect, because part of story)		

Figure 2: Adaption of Winters' (2010) proposed distinction between extra-fictional and fictional spaces.

This distinction seems closer to an audience's experience and expectations of a soundtrack in the cinema space: despite an awareness that a film score is added to the film ex-post and not part of physical reality, the score is not experienced as an addendum. Film music does not coerce a conscious incorporation; it is a subconscious reception, functioning as support to fully engage an audience in the experience of the film. This supports the deduction of his idea that music is part of the film experience, i.e. diegetic, and not

something randomly imposed onto the narrative. Additionally, in case of the science fiction genre, Winters' theory offers a convenient explanation as to why sounds can be 'heard' in outer space.

Consequently, Winters divides fictional music into three different diegeses (see Figure 3):

1. *Extra-diegetic*: music added to the fiction, but without physical embodiment; i.e. music, not subject to the logic of the film.
2. *Intra-diegetic*: music as part of the fiction (Gorbman defined this as non-diegetic for films of the Classical Hollywood period).
3. *Diegetic*: music which is experienced by protagonists in the story world (Gorbman defined this as diegetic for films of the Classical Hollywood period).

Terminology	Definition
Extra-diegetic	Music is not part of the story world, but added to the fiction. It may be a narrative tool or the film's reflection on/reaction to itself.
Intra-diegetic	Music is part of the fiction.
Diegetic	Music is part of the fiction and heard/experienced by the characters.

Figure 3: Diegetic music according to Winters.

For industry practice, Winters' suggestion to designate all sound as part of the fictional space seems plausible: at the mixing stage, all sound is equally evaluated in its ability to support the narrative (Rydstrom in Sergi 2002; Hillman, 2017). However, from the point of view of film sound practice, Winters' (2010) claim that a score interchangeably also influences a character and their

actions instead of merely offering clarifying information, seems a return to a speculative realm of ex-ante analysis.

The film score is conceived during the post-production process—after production has finished²⁴. Together with the rest of the soundtrack music focuses, among others, on the delivery and clarification of an interpretation of otherwise ambivalent or confusing visuals and the resolution of non-linear edits (e.g. time lapse, montage). Thus, the score aims to reflect, illustrate or capture the character's mood, developments and emotions. The question of music being part of the narrative or outside the narrative is negotiated through the question of 'whose point of view (POV) does the audio represent': the sound/music might be heard by the protagonist, someone else, through the POV of the audience or maybe even through a narrator's perspective (LoBrutto, 1994; Rydstrom, 2002; Thom, 2007).

The idea of an audience's suspended disbelief of reality can account for the believability of the presence of film music. Still, Winters' example (2010) of the American soldier being influenced by Édith Piaf's singing seems implausible given the standard approach to underscoring. His reasoning, that the music can affect or control a protagonist, seems speculative²⁵ and administered to the score after the release of the film.

²⁴ There are exceptions, when a composer is already involved as early as the production. Still—unless it is a musical for example—a composer writes the music about but not to influence the protagonist.

²⁵ Of course, there are genres for which this is an exception (e.g. animations, musicals).

Of course, academia is in the difficult position of retrospectively explaining decisions taken during the post-production process—without the luxury of access to the actual decision makers. Therefore, it has to be understood, that the original distinction between diegetic and non-diegetic is in the first place subsequent and supplementary.

To summarise, since this research strictly aims at practical solutions for the composition process with the goal to create an unequivocal, unified soundtrack and not the subsequent analysis of a filmic scene, Winters' (2010) definition embracing a fictional (i.e. total diegetic) space seems to be acceptable. His attempt at resolving the debate around the terminology might not be perfect, but his proposed ideas are close to Hollywood practice. Music, just like any other aspect of filmmaking, becomes an 'artistic' expression, representing the illustrated narrative and its arousing affect in context while focusing on emotional relationships and submitting an understanding and mediation of the narrative and its intention(s).

Therefore, Winters' theory of fictional space has been adopted as practical outline for the diegetic/non-diegetic sound world and to eventually allow the conception of a theoretical working framework for the thesis.

2.2.2 The role of sound in Hollywood films

Rydstrom, a successful Hollywood sound designer who follows in the footsteps of Randy Thom and Walter Murch confirmed (in Sergi, 2002) that practice

rather focuses on the distinction between sound describing the fictional space (i.e. sound design) versus sound commenting on the fictional space (i.e. music). His comment implies that all sound in film is assumed fictional and that sound design summarises sensory data describing and confirming fictional reality space (what is considered 'outside'), while music adds some element of fantasy or imagined (what can also be considered inner or mental worlds).

The sound designer confirms (ibid.) this approach to sound design, when he discusses the intro scene to *Saving Private Ryan* (1998). He reaffirms Spielberg's approach, that music in the intro would have made the scene emotional and so would have taken the audience out of the direct experience: 'Spielberg was very smart to know that having a score [...] would have taken away the subjective feeling of it' (Rydstrom in Sergi, 2002, p. 85), and continues that music has become a designator of fictional space and fiction because of the moments and ways in which it has been applied to film. Sound is used to define and demarcate reality while music establishes filmic experience of the abstract.

Without a soundtrack, most scenes alone would not be able to have the same depth or impact. For example, the visuals of a large object still lack a physical representation of dimensions and weight. Without sound it would also be difficult to draw or focus attention to specific details of the narrative or guide the audience along a story line. Therefore, when sound defines objects, identities spaces and environments, it provides meaning and works as a framework for the narrative and reality of the film.

Sound categorised according to the needs of the narrative as listed by Alten (2005) are:

- *Contextual sound*: sound emanating from a visible object.
- *Narrative sound*: extra meaning is attached to the objects to tell a story.
- *Descriptive sound*: sound adding auxiliary information to the scene in form of ambience or supplementary surrounding sounds.
- *Commentative sound*: sound offering an observation or reflection on the scene.

Within the categories of *contextual* and *narrative sound*, film sound theories further distinguish sound's roles to (Alten, 2005; Hollman, 2010; Winters, 2017):

- Define and set reality space (fiction versus documentary).
- Provide necessary information about the reality of the story (e.g. place, time, historical period; direction, movement, dimension).
- Provide information about the character (e.g. human, objects; signature sound).
- Provide focus by drawing attention to a particular storyline.
- Suggest a mood or feeling and changes in tension, pace or affect.
- Provide hyper-realism to define or enhance a story (i.e. emphasising or intensifying action/affect).
- Represent of symbolism or metaphor.
- Offer transition sounds and bridge scenes (i.e. whooshes) to connect otherwise unrelated items, characters, places or events.

Sound's role is further defined by its relationship to the visuals. This link will be explored in the subsections of 2.4 Soundtrack—image relationships.

2.2.3 The role of music in Hollywood Films

Music moulds moving images into a narrative, a tale or some other form of fictive reality. Without the music the on-screen visuals are rendered into a notion of real-life; a form of documentary which has lost its intention of being a fictive narration²⁶ (Chion, 1994). On the other hand, sound designer and re-recording engineer Gary Rydstrom observes that both, music and sound represent similar musical parameters: 'both [are] tonal, both have rhythms, they both eat up the track' (in Sergi, 2002, p. 81)—and still, film music is experienced differently from sound design.

First, music—an abstract sound—is a symbolic representation of a concept or idea. In this representative function it opposes sound, which can in general be identified as belonging to or emanating from a concrete object. Music's abstractness has enabled it to take on different roles in combination with visuals. Before the arrival of the 'talkies', music filled the emptiness of moving but otherwise silent pictures (O'Brien, 2005). During the time of silent movies (or silents) a pianist—or where affordable an orchestra—played live programme music, offering hints on how to interpret ambiguous scenes and to remove the ghostly silence of moving pictures (Lastra, 2000; O'Brien, 2005; Kalinak 2015).

Despite different technologies available in the initial days of film sound, it was laborious to edit sound printed directly on film and any retrospective changes were impossible or rather difficult to execute. Consequentially, recording sound for a film was easier when the story either consisted exclusively

²⁶ Which was also another reason to add music to silent films.

of dialogue (i.e. filmed theatre) or it was an uninterrupted vaudeville musical (O'Brien, 2005).

The music for the silents was compiled from famous classical, romantic/neo-romantic titles and mood music collections²⁷, which are leaning heavily on the aforementioned styles (O'Brien, 2005). After the arrival of appropriate recording technology (mid to late 1920s), new film music was written by composers educated in the musical language of the late romantic period of central Europe. With audiences accustomed to the music of the late romantic style it was easy to apply the same functions and techniques derived from opera and melodrama to the custom written music²⁸ (Lastra, 2000; O'Brien 2005; Kalinak, 2015).

Once appropriate recording and playback technology was in place, film music as a style started to differentiate itself from existing concert or operatic music. Since then, next to initiate emotion, mood or atmosphere of a scene, the score can provide a brief, invisible, narrative or emotional comment or it can be a short snippet of musical glue to connect scenes with each other. Scores additionally also function as an organiser of film time, regulating the feeling of physical as well as psychological time (Gorbmann, 1987; Buhler, Neumeyer and Deemer, 2010). It is always heavily influenced by onscreen action and the ideas, action or any other film elements as it attempts to express what the images seem to lack.

²⁷ E.g. Kinothek works by Giuseppe Becce, The Sam Fox Moving Picture Music Volumes and Motion Picture Moods by Ernő Rapée.

²⁸ See for example Korngold and Steiner scores from the classical Hollywood period.

Rodman (2012) points out that next to a general support of the storyline, the score has an ability to focus attention on narrative events which unfold over time and that it can additionally expand on visible action. As an example, he examines John Williams' title music for 'Lost in Space', and notes, that as an extra bonus, it manages to disguise the possible observation of the low technology—or at best ordinary special effects—of the show. In particular, a score simultaneously counteracts the artifice of sets and even manufactured narratives of the mainly B-films in its service as a signifier of dangerous or menacing situations (ibid.).

Composer Bernard Herrmann, whose idea of film music was somewhat more pragmatic, was another advocate for a score as a functional entity. In his eyes, film itself lacked the ability to associate emotion or set the mood (Smith, 1991). Dialogue alone might be insufficient to communicate the feelings of a character, so the musical score is used to substantiate the narrative. This enables a score—without overpowering the visuals—to shape the film into a complete piece of work and finalises its intention and interpretation. Herrmann is but one of many film composers who expressed that the score clarifies and even initiates emotion, mood or atmosphere of a scene and that it takes on the representations of emotional or psychological conditions or relationships (ibid.).

Still, the use of music can also have drawbacks. For example, utilising the typical sound-colours of a western orchestra or even applying pre-existing music to a scene can limit a score's ability to function as a signifier: a viewer

will always interpret the music according to their cultural background and own personal (possibly pre-existing) experiences and corresponding notions.

In conclusion, the film score is heavily influenced by the onscreen action and supplements the images with ideas they cannot depict by themselves. In its aims to support or drive the narrative it differs from concert music. While the latter always satisfies musical logic and development(s), film music subordinates to the logic of a given narrative and image edits.

Typical scores are short in duration and charged with leitmotifs or small cells representing the idea, person, object or emotion in the shortest amount of time. Buhler et al. (2010) distinguish furthermore a *foreground score*, which is loud and dramatic (e.g. chase music, battle), and a *background score*, which consists of narrative cues, mood settings and themes.

2.2.4 Summary

It is presumed that audiences desire formulas and tried-and-proven effects: details that bear instant, automatic signification and which may be “read,” and thus consumed, with ease and passivity.

(Gorbman, 1987, p. 106).

Gorbman’s quote expresses a universal ‘film truth’, speaking from the minds Hollywood’s production companies. Music has to speak to masses to ensure the future success of a film. The formulaic and similar use of in particular

music—the music was liked before, so it will be appreciated again—allows for quick and easy prognoses of a favourable reception and therefore distribution to a mass market.

Additionally, the constant re-use of similar music facilitates acceptance through the creation of familiarity and the recycled music turns into (genre) clichés which perpetuate quick interpretations. Furthermore, the formulaic combination of a specific type of score with a particular type of (action) scene expedites a swift understanding.

A film score's role is to represent the intention of the director—uttering the words between the lines and to clarify emotions which would otherwise be open for interpretation, and finally, the music is meant to shape time and disguise technical aspects of a film so it can be experienced as a coherent unity.

Furthermore, as has been discussed in the previous sections, the film score has been ascribed the role of emotional expression while sound design has been assigned the role of depicting reality space. This is a superficial definition and unfortunate delimitation which has been lamented by many sound designers. When music's and sound design's roles are closely examined it can be seen that their functions and abilities do overlap. Sound design, when not used in the 'hear-what-you-see'-reality depiction, can become a powerful ally for the narration as many experienced sound designers attest (LoBrutto, 1994; Sergi, 2002) and the following sections might confirm.

Moreover, sound design—and with it the in the literature so far lesser discussed style of sound-based music—could on the contrary even be more flexible and direct in its impact than traditional film scores (alone) as has already been discussed by Liz Greene, Danijela Kulezic-Wilson and Michel Chion for example.

2.3 Sound-based music and film sound

After centuries of dominance of musical parameters such as pitch, harmony and rhythm, timbre—or tone colour—has become the new focal point of manipulation or organisation from the mid-/late 20th century onwards. Many sciences (among others biology, neuroscience, music) researching the topic have attempted to define what constitutes timbre, but still have to agree. A working definition of timbre for this thesis has been offered in the introduction (see section 2.3.2).

For film music, the musical parameters of timbre, tempo (incl. rhythm), dynamics and harmony have been identified as the establishing and driving factors to initiate mood (among others Neumeyer and Buhler, 2001). The first three parameters set a framework for the perception of time, which broadly speaking influences human biological systems and memory, and by extension: emotions.

Pitch is relevant for the creation of a leitmotif, but by itself, pitch might not necessarily be able to establish a mood—apart from being used possibly in

combination with other musical parameters—in its extremes. However, pitch does affect as part of a harmonic structure²⁹ (e.g. happy or sad chord),

The following sections introduce *spectromorphology*, a term defined in EA music theories equivalent to timbre, and seek to explain a correlation which can be formed between EA music and film music theories if sound-based music and its tools are considered as supplement or substitute for the traditional film score.

2.3.1 Spectromorphology

Denis Smalley's *spectromorphology* (1986, 1997) expands on and practically simplifies Schaeffer's original ideas of 'acousmatic music' as proposed in the *Traité des objets musicaux* (1966). Smalley introduced *spectromorphology* in 1986 with the intend to act as a taxonomy for EA music composers to 'describ[ing] and analy[sing the] listening experience' (1997, p. 107). In 1997 he published a refined and expanded version of the descriptive language.

The term *spectromorphology* is a combination of 'spectro', referring to the spectrum and spectral/timbral aspects of a sound, and 'morphology', which represents trajectory or temporal development of a sound or its spectral content.

²⁹ An exact pitch seems to be irrelevant as long as the harmonic structure is kept intact. For example, it is less relevant if a minor triad is in the key of C-minor or G-minor as long as its chordal integrity is untouched.

Spectromorphology proposes a perception 'and thinking in terms of spectral energies and shapes in space, their behaviour, their motion and growth processes, and their relative functions in a musical context' (Smalley, 1997, p. 124-125). As such, the language aims to describe a phenomenological experience of sound to eventually facilitate the musical communication between composer and listener.

In 2011, Manuella Blackburn elaborated on this taxonomy and reversed the procedure to propose a practical approach for composers in form of 'an illustrative guide to composition' (2011, p. 5).

The concept of *spectromorphology* is similar to timbre (see section 2.3.2) and divides sounds into sonic spectra and their natural or edited development over time. Blackburn suggests to employ visual representations of *spectromorphology* to 'examine the visual properties of a shape's movement, behaviour, interaction and occupancy in space' (2011, p. 13), and eventually how these analyses and drawings prior to generating material can become the departure point for composers to sculpt and shape individual events, gestures and textures.

According to Smalley's theory the two overarching descriptors for the combination of sounds are gesture (event; trajectory; experience of body and movement), and texture (soundscape; mixture of streams; experience of touch) (Smalley, 1997; Moore 2016).

2.3.2 Spectromorphology and timbre

As mentioned in the introduction, timbre can be described as one of the musical parameters, which allows recognition and attribution of a sound source. McAdams (1993) points out that the successful recognition and subsequent interpretation of a heard sound through its timbre depends on two complementing theories:

1. The experience of repeated, contextual exposure, which ultimately leads to the perception, identification and memorisation of the sound source (*information processing theory*), and
2. The significance bestowed on the sound by the cultural and biological environment (*ecological psychology*).

Regrettably, neither theory (or their combination) confirms that Schaeffer's ideal of *reduced listening* is—with a high probability—biologically possible. Notwithstanding, reduced listening can still be approached as a conscious method of listening, which can be learnt through exposure and schooling.

In 1994 Smalley related timbre to his theory of *spectromorphology*, concluding that '[t]imbre is defined as the attribution of spectromorphological identity' (p. 35). Concurring with existing research in the field of timbre that its definition is a vague and treacherous territory, he further elaborates that timbre is traditionally linked 'to the source and cause of a sound' (p. 35), acknowledging, that timbre is a pivotal carrier of attributes which define and identify an object. Smalley then continues to clarify the term *source-bonding* which is 'the natural tendency to relate sounds to supposed sources and

causes, [...] because they appear to have shared or associated origins' (p. 37).

However, *source-bonding* can be deceptive: if the source causing the sound is not visible, the source of the sound can become dubious. Film sound design (and especially the art of foley) is based on this flexibility of sound.

Still, for sound-based music in the context of film, *source-bonding* is a critical musical parameter which can evoke imagery, emotions and subsequently a possible narrative—it might be the consequential point for sound-based music's ability to ultimately be useable in the context of an entertainment film.

2.3.3 Spectromorphology, timbre and the film score

The significant musical parameters to evoke or affect mood or emotions are similar to the ones shaped in *spectromorphology* (i.e. sound-based music). In order for film music to influence emotions or create mood the parameters timbre, rhythm (internal and external; especially in regards to edits) and the sound's spatial information (e.g. spaces and spatial mixing) might need to be at the focal point of a composer's attention.

Timbre has proven especially versatile already during early cinema and TV. In monaural days, all three components of the soundtrack (music, dialogue,

sound) had to share the same, narrow frequency range³⁰ and composers had to be sensitive about spectral regions (i.e. occupied frequency bands) in order not to mask parts of the dialogue.

Therefore, the parameter timbre as expressed through orchestration was influential and refined early on and quickly became a trademark of the music composed for films in the studio era³¹. It was Bernard Herrmann, a composer who matured his craft at the radio, who influenced Hollywood's underscoring practice. Herrmann knew that he could in the most efficient way control emotions and direct mood through the manipulation of timbre. Together with Hitchcock he changed Hollywood's perception and application of orchestral scores (Smith, 1991).

The soundtrack for *The Birds* (1963) provides an interesting insight in the way Herrmann and Hitchcock approached film scores. In case of *The Birds*, the score entirely consisted of sounds derived from the *Trautonium*³² and were adjusted to the image in regards to tempo and dynamics. Emotions were not influenced with the help of a traditional score, but instead affected by the sounds produced by the electronic instrument which imitated realistic bird cries (Smith, 1991). Meanwhile, Herrmann provided dramaturgical advice for those sounds.

³⁰ In early sound films the frequency range was the same as for telephone (Holman 2002).

³¹ The different historical Hollywood eras are listed in the appendix.

³² Electronic instrument invented by Friedrich Trautwein around 1929, capable of producing a varied range of sounds.

According to Smith (*ibid.*), it was Hitchcock's view on film sound which transformed the traditional score into what is considered sound and that since then a film score stopped being regarded as music.

In the last few decades film composers have embraced computer-based workflows and integrated tools for sound synthesis or sound manipulation. For several film genres (especially action or suspense) a mixed approach of natural and electronic instruments has become standard.

While many film composers seem to make use of analogue hardware in combination with their DAW of choice, it seems that tools or programming languages which are common in the sound-based music composer's toolbox are not very common—if known at all. So far, it seems that the hardware-based software Kyma is among the few exceptions which is used both by sound-based music as well as Hollywood composers. Still, Kyma seems to rather be the weapon of choice of Hollywood's sound designers than its composers to allow the former's need for the flexible and pristine processing of sounds.

Although the use of electronic or the processing of traditional instruments has become more widely spread it seems that the use of sound sources with an implication of pitch has mostly been preferred by composers. Possible reasons for this preference will be discussed in chapters four and five.

The next section covers the question as to why timbre is able to function so well in the context of film.

2.3.4 Timbre and emotion

Film music's main function is to promote and assist with emotional impact as well as to suggest atmosphere and mood. Film music has to demonstrate an ability to quickly follow scene and mood changes for appropriate dramatic support. Timbre and rhythm have been identified as the most flexible musical parameters to fulfil this assumption.

Although this thesis recognises the importance of the emotional impact of timbre, exploring the topic of how it explicitly evokes or affects emotion would excessively expand the scope of this thesis. The following section attempts to provide a brief overview and framework for this research's argumentation.

The basic formation, perception and reception/interpretation of emotions is still debated in science (Barrett, 2018) and so is its relationship to music. Currently even less research exists about the relationship between the timbre of musical or non-musical sound sources and their respective emotive responses.

Additionally, the design of suitable research exploring timbre seems an equally difficult endeavour because of the primary struggle surrounding an appropriate definition of what exactly constitutes timbre. For example, a carefully designed study by McAdams, Douglas and Vempala (2017) using western orchestral instruments divided participants in two groups: participants with formal musical training and participants without musical training. However, participants' educational and cultural background³³, which includes

³³ See McAdams (1993), section 'Identifiable objects/reality'.

exposure and possible familiarity and affinity for the instrumental sounds (especially because of exposure), is omitted. Moreover, even if the various factors constituting and defining timbre or emotion are accounted for, many experiments exploring timbre and its emotional experience are based on the perception of musical instruments (with a focus on western orchestral instruments and with the inclusion of synthetic or digital instruments); only few studies include non-musical sound, and even less consider the timbral impacts of processed sound.

Notwithstanding, it can be concluded that although the term timbre and its implications is still disputed³⁴, latest neuroscientific studies have collected sufficient proof about the relationship between music and emotion to confidently state that timbre does affect the perception of emotion. This validates the practical experience of film composers and sound designers and scientifically confirms that besides harmonic content and the timing and tempo of cues, timbre/sound colour shapes the reaction in relation to the visuals.

Consequentially, timbre has been assumed as one of the main musical parameters influential on the image-sound relationship and the creation of

³⁴ Findings in neuroscience suggest that the perception and expression of emotion might not only depend on a conceptual understanding of the emotion, but also on the ownership of sophisticated vocabulary with a certain level of depth and an ability for further refinement. This suggests that the experience of emotion centres around the ability and detail of its expression in words; meaning, the more 'emotionally educated' a person is, the larger the emotional vocabulary, the more detailed the experience (Barrett, 2018).

meaning emerging from their synergy. Rhythm, pulse and tempo are additional musical parameters which equally produce a powerful effect when intentionally and appropriately combined with images.

2.4 Soundtrack—image relationships

The sound-picture relationship defines film through their mutual interaction and comments or provides insights into how to understand the visuals. This relationship has to be interpreted by an audience who, in the first place, passively experiences cinema.

A film score differs from songs or concert music in so far that it is subordinate to the narrative and image, and because it needs to demonstrate an agility to change direction at any moment, a typical cue is mostly composed from smaller cells/musical structures which represent an idea, person, object or emotion. To accommodate these requirements rhythm and tempo (or pulse) in relation to and accordance with the scene and its edits, timing (start/end points of the cue) and timbre have been identified as important musical parameters (Buhler, Neumeyer and Deemer, 2010).

The subject of timbre has already been reviewed in section 2.3 (including subsections); the roles rhythm, tempo and leitmotifs play in context of film will be explored in the sections below.

2.4.1 Tempo and pulse in film and in sound-based music

Rhythm (or tempo/pulse) in the context of film needs to be considered from various angles. For example:

- a. The rhythm of cuts (i.e. edits of the visuals; Gorbman (1987) calls this the diegetic rhythm),
- b. The innate tempo (i.e. pulse) of a scene without any edits, and
- c. The tempo the music itself needs to express or represent a particular mood³⁵.

The distinction between different tempi is an important one. As observed by Gorbman (1987) and Kerins (2011), the effects and implications can be far reaching: if the musical tempo compared to the tempo of the visual (and its edits) differs or is mismatched, the scene will propose a contrasting association or inconsistent temporal continuity. This has an immediate consequence on flow of the story telling and the viewing time³⁶ versus the psychological (i.e. felt) time. The latter can be unintentionally or artificially extended or shortened. Walter Murch, one of Hollywood's most influential video and sound editors, intimately understands the combined effect of sound and image. In support of this effect, Murch focuses on the importance of rhythm and tempo in filmic and musical edits in many of his talks and books (Murch, 2001; Koppelman, 2004; Ondaatje, 2004).

³⁵ Music styles representing certain types of moods relate to their stylised tempo. For example, sad music will probably rather be performed at a slow tempo, while high energetic action music might play at a faster pace.

³⁶ Viewing time might be chronological, but then there also is the chronological (i.e. logical) time of the film which might deviate from the chronological time passing in the cinema.

Karlin's and Wright's practical book (2004) dedicates a complete chapter to the importance of rhythm and hence advises aspiring composers to first establish a tempo in form of a pitch-less pulse for the scene. Only after having established a tempo-guide-track a sketch with thematic material should be worked out.

A further confirmation of the significance and even dominance of the musical parameters rhythm and tempo (including timing and hit-points)—and facilitated by both filmic continuity—are the structural constraints placed on film as a medium by the presence of sound alone. A problematic factor encountered during the transition from the silents to sound films in the late 1920s and early 1930s when directors had to learn how to deal with continuity issues caused by the presence of recorded sound on film³⁷.

For sound-based music, pulse and metre, just like harmony or melody seem to be another set of musical parameters 'to-preferably-be-avoided'³⁸ (Andean, 2020). Hence, not much has been written about the topic. A possible reason for the repudiation is a dislike for the rigidity imposed by a pulse and metre.

Acousmatic music practitioners' aversion is a peculiar occurrence, however. Rhythm is innately part of gestures (sources which suggest a rhythm and tempo; trajectory), movements, textures and levels of density (see

³⁷ Prior to sound printed on or synchronous with film, a sense of time-elasticity allowed film-makers to flexibly go back and forth between different times and places (Gorbman, 1987; O'Brien, 2005).

³⁸ Hybridisations of EA and so sound-based music born in the last few decades from blends with popular dance styles are for obvious reasons exempt from this preference.

Smalley, 1997; Andean, 2020), and, together with at least a small trace of metre, rhythm is a musical and spectromorphological parameter necessary for the organisation of sound in accordance to time (i.e. a musical composition).

According to Andean (2020), composers concede to the presence of intrinsic rhythmical structures in gestures and textures and acknowledge an abstract knowledge or ability to distinguish a pulse and to some extent even metre³⁹. He furthermore proposes a practical and advantageous distinction between *chronological time* (chronos) and *experienced or psychological time* (kairos) and suggests that either distinction of time is part of an interplay between expectation and the opposites of tension and release (ibid.).

Mauro (2006) and Thaut (2005) offer possible explanations for the seeming disregard for the presence of rhythm and metre by sound-based music composers. However, at the same time, their explanation renders the attempted avoidance of rhythm futile: it seems that finding or identifying rhythmical structures might be a biological imposed function on and of the brain and, although the human brain apparently not only searches for patterns and rhythms in the incoming data, in essence it inversely also imposes these structures on our perception (Andean, 2020).

In Hollywood, the passing of time is generally represented by music. Only occasionally does a Hollywood production use sound design to suggest chronological or perceived time. In these rare cases sound design tends to be organised in a rhythm indicating a clearly recognisable tempo, which also

³⁹ Although it might have been a 'free' tempo, but still, a beat to be conducted.

tends to result in a sense of metre implied by the applied sounds. However, with audience steeped in the entrainment of clearly divided roles between sound and music of blockbuster films the question turns to an audience's ability to recognise the audibly musical results of the sound (design) as (sound-based) music or if the sound will instead become a distractor—or even the cause for misinterpretation.

Sound will need to be considered in the context of a narrative, the film edits and their timing, and eventually the resulting synergy.

2.4.2 Image edits and synchresis

The soundtrack plays a key role in the accurate perception of a filmic scene, depending on the application of an appropriate sound to convey and clarify a possible interpretation or feeling (Chion, 1994). While sounds by themselves are not necessarily emotionally charged, an interpretation can be suggested into a projection of visuals which is or cannot be portrayed by the images alone. For example, a simple test of playing a scary film without sound quickly proves less distressing than with sound.

In order for sound design to fulfil its assigned roles, it adapts and employs a concept well-known to sound-based music (i.e. spectromorphology; see 2.3.1): the detachment of a sound's perception and so interpretation from its source of origin, with an exclusive focus on its aural qualities before the sound is re-bonded with a (in-)visible object in the film. Moreover, without an ability to uncouple and subsequently re-attach a sound to a (new) object/picture

(with help of synchronisation), film sound design as a concept and eventually trade might not even exist. The ability to apply a sound to more than one object—or utilise the sound of one object for another one in a substitutive way (e.g. sizzling bacon for rain (Mott, 1990))—is an important assumption for sound design. The craft of foley for example is entirely based on the concept of finding suitable replacement sounds for the believable rendering of an object's/person's reality within the story.

The concept works through suggestion from or in combination with the visuals (Chion, 1994). As long as there is a congruency substantiated by synchronisation of sound and image the brain will form a plausible relationship between both. Chion calls this type of amalgamation *synchresis*: a 'sound/image synchronism, [...] forging an immediate and necessary relationship between something one sees and something one hears'⁴⁰ (1994, p. 5). The object's real sound can be replaced convincingly with a substitute sound, but ultimately it is the viewer who will make this connection and so subsequently also conceive an emotion.

Since synchronisation is important for sound design to work, Alten (2005) identified five different relationships between sound and picture: as long as sound is played in *parallel* (1) the audience hears what is being seen and vice versa; no element dominates the other. When *sound defines the picture* (2), it explains information which is otherwise missing from the visuals. On the other

⁴⁰ This relationship is, of course, also based on the cultural background or enforced through repetition (Chion, 1994).

hand, when *picture defines sound* (3), it draws attention to specific elements in the picture and narrative (e.g. with help of shot changes; close-up or zooming in/out). Both components *combined* (4) can lead to a more impactful effect/affect than either part alone but both elements can also be unrelated to each other and then act as a *counterpoint* (5), presenting unrelated information and suggesting meaning not inherent to the picture alone⁴¹.

These distinctions become important when sound-based music is applied to visuals as their unintended fusion can lead to misunderstandings in interpretation.

Paul Rudy advocates for the exploration of sound's ambiguity in film through this 'plasticity of sound, the separation of source and function, [and] the morphology of one sound into another' (2007, p. 10), and continues that sound's disentanglement from its source could be the ideal tool for film, 'designed to create [...] a layer-cake of ambiguity' (ibid., p. 10). His request, which is supported by many film sound scholars, could eventually result in the long-requested emancipation of sound allowing an audience to draw their own conclusion(s).

⁴¹ For more information on the relationship between visuals and sound reached through their synchronisation or a counterpoint treatment the author of this thesis would like to refer to Michel Chion's book *Audio-Vision* (1994), in which he exhaustively analyses all aspects of 'audiovisual illusions' and 'added value' (ibid., p. 5) created through *synchresis*.

On the other hand, Murch describes ambiguity as a tool to add depth to 2D pictures, to focus the story line as well as to help the audience understand through metaphor in his article 'Stretching sound to help the mind see' (2000). However, many directors and producers often fear this alternative sound aesthetic because it could lead to an unintended attenuation of the enjoyment of the film. Ambiguity calls for an active experience versus a passive one; plus, these sound-metaphors might be difficult to interpret by a mass audience composed of diverse cultural backgrounds. Hollywood films are produced for the world market after all. Atkinson (2007) confirms, that '[A]ll musical signification operates in relation to our embodied selves existing within cultural contexts' (p. 121), and so interpretation heavily depends on utilisation and manipulation of cross-cultural archetypes. Mass-consumption in a cinematic context leans on a specifically cinematic culturally conditioned audience: Hollywood cinema as a brand and a major selling point focus on comprehensibility by a broad, world audience (Behlil, 2016).

Spectromorphology in its attempt to classify and evaluate source material used for its compositions has taken on a pioneering role in the perception and classification of sound. Identification and categorisation of sounds according to spectromorphological attributes should prove valuable for sound-based music applied in the context of entertainment film. However, as indicated, synchresis will play a major role in the validation of usable sounds in the first

place. As framework for this thesis, a sound is assumed to only be viable when its (processed) result in its designated position within the film does not trigger unintentional associations through synchresis.

2.4.3 Meaning derived from leitmotifs derived from timbre

A motif can be considered the smallest musical unit to represent or communicate a musical idea. In a filmic context, a motif can additionally function without the need of a visual depiction. Film music adopted the technique from Wagner who was the first one to employ it on a grand scale to evoke the linked association through the establishment of a musical point of reference. Motifs can also be derived from instrumentations (one or more instruments or a blend of tone colours) to identify an idea or concept—this qualifies timbre to function as motif (famous examples would be the specific sound colour of the trumpet opening the Star Wars saga or the sound of the female voice for Star Trek).

It will be necessary to test the hypothesis of applying sound-based music to entertainment science fiction film with the use of timbre functioning as motifs or themes in the practical research. Hence, the experiments will need to test if:

- a. Leitmotifs can be appropriately constructed from sound-based music material and if these motifs are identifiable in this function.
- b. Leitmotifs can be further developed with the development of the narrative and if they can also support the action over the course of

a film without causing unintentional synchresis or sounding too literal or possibly even trite.

Sound-based motifs might by themselves already suggest an imagery. This can be used as an advantage, for example proposing a shared set of character attributes between the sounding material and the protagonist or scene; but it may as well be a disadvantage, if the sound-based material is without intention at the composer's end taken too literally by an audience.

2.4.4 Suggested imagery and narrative spaces

Sound-based music exhibits an inherent susceptibility to evoke imagery or extra-musical meaning in a listener. A film score is meant to represent concepts, moods or emotions which are otherwise difficult to express in words. As such it aims to wordlessly but directly communicate to viewers using clichés and codifications which are culturally conditioned through exposure and therefore silently understood by an audience familiar with cinema and its genre conventions.

The effects and consequences of intentionally or unintentionally suggested imagery has been explored in academia⁴² and sound-based music practitioners have embraced the style's dualistic nature. John Young's *Reflections on sound image design in electroacoustic music* (2007) champions the quality of sound's dualistic nature as a conceptual tool to offer 'properties

⁴² See among others Young (1996, 2007), Andean (2016).

of presence and physicality' and the 'indicative relationship[s] in consideration of factors such as the materiality of sound, spatial presence, colour, balance, inflection or the sense of tension and its release' (p. 32). He concludes, that the meaning materialising from everyday sounds is '[A] crucial force in the aesthetics and practice of electroacoustic music [...and] its fundamental ability to negotiate this synthesis of illusion and veracity' (ibid., p. 32). It is exactly this kind of analysing and thinking about sound where sound-based music and sound design practice overlap: the deep listening and subsequent placement of sounds by its designers and composers as well as sound's flexibility to plausibly represent an object without having emanated from the real object.

For film sound design, sound-based music and its relating theories offer an advantage to intentionally suggest or obviously identify a sound source with its semantic meaning and at the same time to derive moods and emotions from it. Since sound-based music is constructed from sounds, its suggestive imagery can be at a disadvantage where traditional music is the conventional, contextual expectation to represent emotional content. There is an inherent risk when blurring the demarcation of areas which have been ringfenced for easy and quick comprehension for decades as is the case for sound and music in the context of cinema. As a result, 'real-life' sounds used as source material for a composition—even with a focus and emphasis on their musical

parameters—can lead to confusion or misinterpretation(s)⁴³ caused by the evocation of its associated imagery.

More recent studies assembled and curated by Danijela Kulezic-Wilson and Liz Green (2016) analyse and advocate new and partially holistic ways of approaching soundtracks. However, general studies researching the effects of recognisable sounds used in a musical context in combination with visuals as part of an entertainment film are unfortunately still underrepresented.

For the framework of the practical research, the decision has been taken to disguise sounds to such a degree to be unrecognisable from their original object and so to prevent any semantic association. At the same time, the objective was to exploit any physical parameter which could be beneficial for a musical composition with the aim to represent a particular emotion or mood. Since the thesis focuses on science fiction, the range of emotional representations was rather limited in the first place. It also has to be pointed out that the thesis concentrates on a general mediation and application of sound-based music as score as a replacement of or substitute to the existing film music, and that the thesis's aim has not been a literal translation of emotions found in the original score.

⁴³ The misinterpretation can happen at several levels: general knowledge of the sound, familiarity with the sound, personal experience or history with the sound.

2.5 Spatial considerations—the mix

As indicated in the introduction, the (surround) mix—and with it by extension diffusion practice—cannot be covered in this thesis as the topic constitutes another and extensive field of study. However, because the spatial positioning of sound and music has such a strong impact on the experience of the soundtrack, a few important concepts will be addressed below.

Spatial considerations (e.g. the space an object occupies—i.e. its size, its position or movement in space and of course the room itself) is another set of important musical parameters when composing sound-based music. In general, many of these parameters are integral to the concept of timbre or spectromorphology, but can (and are) also considered separately during the composition process. Moreover, when sound-based music is performed, the musical parameter space converts through the use of *live diffusion* into a 'performing entity' who embodies a performance of sound objects.

Diffusion makes use of an array of available channels and can be carried out either as a pre-programmed (/matrixed) diffusion with precise positioning and spatial information or by 'moving the faders' on the spot. In either case, sound engulfs the audience and moves through the concert space in 3D, providing an experience of being a part of the propagated sound world⁴⁴.

⁴⁴ However, unfortunately, also this mixing technique has to recognise the disadvantage of the sweet spot.

Cinema began using surround spaces already in the 1940s when Disney experimented with 'Fantasia'. However, a flexible system was not established until the late 1970s when technology for surround sound formats was finally developed (Kerins, 2011).

In *Audio-Vision* (1994), a milestone book for film sound design, Chion extensively comments on mono and stereo mixes which were the norm for cinema (and TV) until the 1990s. Spatial mixing in mono and stereo and their relating consequences on perception provide valuable insights for the understanding of narrative concepts as well as their successful translation of a mono or stereo soundtrack. However, in the light of surround sound cinema, these conclusions can be considered outdated. The theories fail to capture the new rules dictated by the total volume of a room. Sounds of similar frequency ranges can be projected with less likelihood of masking effects than would be the case in a left-right stereo field. Additionally, more sound sources can potentially be placed in the surround field while maintaining clarity. This possibly but ultimately enables sound to represent the story with more authenticity.

As discussed in section 2.1.2, the digital revolution in the 1990s changed film making from the ground up and at the same time, new technology also revised the way soundtracks are created⁴⁵, mixed and perceived. 5.1 became

⁴⁵ Currently, films in mono or true stereo are either a consequence of budgetary restrictions or specifically mixed for TV, festivals or smaller, independent cinemas which

the norm from 1990s onwards and since 2012 Dolby has advertised Dolby Atmos, a new surround format allowing more flexible positioning and movement of objects in 3D space. In *Dolby and Beyond* Kerins (2011) confirms, that digital soundscapes have taken over spatial impressions and narrative dimensions. The digital revolution has modified cinema audiences' perception and reception of sound, sound design and subsequently also surround mixing. By now, filmgoers are used to being surrounded by audio. The extreme panning of sounds has become an ordinary event and where a mono or stereo mix previously attempted to guide and focus the audience's attention, the surround experience now strives to put the audience into middle of the spectacle. Moreover, surround sound has transformed events into a virtual reality of the main characters' 'experienced space' (Whittington, 1997; Kerins, 2011).

Now both, sound-based music and film soundtracks, aim at an immersive, direct experience of sound in space. For this to happen, the mixing engineer of a cinematic soundtrack has to treat all sounds and the music in the same way: either element is considered an integral part of the whole with a focus on the components needed in order to tell the story (Rydstrom in Sergi, 2002; Hillman, 2017).

The experience of cinematic space ideally leads to an experience of the narrative space—and in the case of science fiction to the experience of future

are unable to afford surround playback. Streaming services like Amazon Prime and Netflix have already made the transition to multi-channel mixes/streaming.

or outer spaces. Science fiction spaces and their sound worlds will be discussed in the following chapter.

2.6 Science fiction and its sound world

Gorbman points out that 'narrative cinema is purely a matter of convention' (1987, p. 1). This distinction is important in so far that an audience has been conditioned to hear and experience soundtracks in a certain way through genre and cultural conventions. The following subsections will elaborate on the expectations of the science fiction audience.

2.6.1 Famous science-fiction scores

Analyses of Hollywood science fiction scores tends to focus on milestone films such as *The Day the Earth Stood Still* (1951), *Forbidden Planet* (1956), *Star Wars* (1977), *Alien* (although technically a horror science fiction; 1979), *Blade Runner* (1982), the first three *Terminator* films (1984, 1991, 2003) and the *Matrix* trilogy (1999, 2003, 2003). Although mentioned occasionally, Jerry Goldsmith's extraordinary soundtrack for *Planet of the Apes* (1968) seems neglected in academic literature about science fiction soundtracks. Of course, there are many more influential science fiction films and their scores.

The following section is meant to provide an overview of developments and successful approaches for sci-fi soundtracks. At the same time, it is an attempt to identify possible reasons for Hollywood's slow approval and

adaption of new sound worlds which would have been most suited for the futuristic settings of the genre.

As mentioned, after the change to sound film, science fiction initially developed as experimental B-films. The low budgets might have been a blessing in disguise because studios exerted less control over the production in general. A possibly valid reason which would have allowed a slightly more flexible approach to underscoring.

Despite the low budgets, science fiction films were—within limitations—a play- and testing ground for new technology. Philip Hayward (2004) confirms that its score has been dominated by technological invention and sophistication, allowing artistic sound designers and mixing engineers to either work on a bigger, better sound quality, a more complex sound design and mix overall, or simply enabled intriguingly subtle soundtracks. Still, he also observes the peculiarity that sci-fi film music before 1945 was rather conservative in its approach.

Especially art music after 1900 discovered and embraced so-called dissonances (including 'noise') as musical source material⁴⁶. Experiments with new electronic instruments and new composition techniques such as dodecaphony, atonality and serialism were quickly initiated. Sharing similar roots with the avant-garde, science fiction films developed a curiosity which seems to have led to an initial acceptance of instruments and sound worlds (Hayward, 2004.). However, possibly because of the early pairing of visuals of

⁴⁶ See Luigi Russolo and the Italian Futurists (Hayward, 2004, p. 8).

aliens, horror or abnormal states with atonal, dissonant or electronic sounds, the new sound world became a source for the depiction of exactly the abnormal or unnatural, the threat, horror and dangerous alien (Leydon, 2004). Even the backing by several elite composers⁴⁷, who favoured the use of emerging composition techniques over the (ab-)use of prescribed obscuring and spoon-feeding solutions, could not facilitate a broader acceptance of the newly invented atonal composition techniques.

Schmidt (2010) reasons that there was a lack of learnt appreciation and that unmet satisfaction from what should have been the expected, harmonic-musical resolution prevented a wider adoption. Still, it is exactly this unfamiliarity which enabled atonal music—at least to some extent—to enter sci-fi and horror films: it was meant to conjure the threat of the unknown (ibid).

An example of early experimentation offering creative possibilities of new technologies is a scene from Rouben Mamoulian's adaption of *Dr Jekyll and Mr Hyde*⁴⁸ (1932): the strange sounds heard during the transformation seemingly evoked an idea of electronically manipulated tape recordings—although, tape was not invented yet (Hayward, 2004). The technique of tape editing was possibly first applied in the context of a science fiction film by Bernard Herrmann, who used it for *The Day the Earth Stood Still* (1951; Smith 1991).

⁴⁷ E.g. Adorno, Eisler, Stokowsky, etc. (Schmidt, 2010). Artists who favoured the Brechtian school of thought and who preferred an audience thinking and feeling for themselves instead of passively consuming a prescribed 'solution'.

⁴⁸ Martino Maximilian Paggi is the unaccredited sound designer for the film (imdb.com; accessed: 25.01.2016).

However, the first electronic instrument to truly gain fame was the Theremin⁴⁹, but because the film industry of the 1940s kept true to orchestral music the instrument was mostly hidden in a lush, late-romantic orchestration. The Theremin was soon exploited more and more for eerie scenes or abnormal psychological states, and by the time Miklos Rozsa won his Oscar in 1945 it had already turned into a cliché instrument (Hayward, 2004). The final breakthrough and acceptance as a cliché instrument for sci-fi arrived with its central use in *The Day the Earth Stood Still* (1951): Herrmann intricately merged its timbre with the narrative and dramatic mood and so finalised its perception with science-fiction (Smith 1991).

The first entirely electronically conceived soundtrack for a sci-fi film was the score for *Forbidden Planet* (1956; composed by Bebe and Louis Barron). Restrictions imposed by Hollywood's musician's union forced the producers of the film to label the Barron's work 'electronic tonalities' (Leydon, 2004; Wierzbicki, 2005). Both music and sound design were derived from recordings of electronic circuits, which—inspired by books of Norbert Wiener—had been custom built and pushed way past their limits by the Barrons (Leydon, 2004). The couple recorded the overloading and dying circuits on tape, which they then further processed according to early tape composition techniques (ibid.). According to Bebe Barron, music for the love scene was the most difficult to derive from the material and passages resembling long, harmonic content

⁴⁹ The introduction into mainstream cinema possibly arrived with the film 'Spellbound' (1944): Composer Miklos Rozsa had to find a new sound 'to convey the intense paranoia' as insisted by Hitchcock (Hayward, 2004).

had to explicitly be searched for in the created material so it could be added as sweeteners (ibid.)

Science fiction as a genre finally rose in popularity in the late 1960s and ascended into the ranks of A-films gaining access to larger budgets. Literature points out that Kubrik's *2001: A Space Odyssey* (1968) might have played an important role in this transition (Whittington, 2007; Konzett, 2010). In the 1960s, sci-fi films continued to extensively use the Theremin (and vibraphone), but similar to other genres began exploring alternative music such as jazz and pop music (or a blend).

After the breakup of Hollywood's studio system purely orchestral scores were slowly considered old-fashioned and it was only with the huge success of John William's score for *Star Wars* (1977) that the big orchestral sound, originally introduced by Korngold and Steiner, became popular again⁵⁰ (Cooke, 2008).

The transition to A-film status meant a more standardised approach to film making but also an adherence to stricter rules in regards to permissible content. This limited artistic freedom at least twofold: avoiding censorship and accommodating a widely understandable language for 'social communication' (Konzett, 2010, p. 114). The need for communication is another reason why shows such as *Star Trek* might have intentionally been

⁵⁰ Goldsmith's score for *Planet of the apes* makes use of orchestral sounds, but in—up to an extreme—unusual articulations, disguising the actual instrument.

scored conservatively using orchestra sounds⁵¹ (Lerner, 2013). Music was meant to sound exotic but not atonal—or in other words, weird (Konzett, 2010). Hayward (2004) also confirms that a too radical use of music alienates the audience. He argues that a recognisable music style allows for associations and hence interpretation of the audio-visual work (ibid.).

Sound design was in a similar predicament: where previously recognisable—because familiar—sounds could be used as feedback systems for mechanical (i.e. analogue) devices in order to know about the state of the device, now new but still comprehensible sounds emanating from digital technology had to be invented (Donnelly, Hayward 2013). But just like with music, not all sound design was meant to sound futuristic. For the first seasons of the sci-fi animation *The Jetsons*⁵² (1962, 1963), the sound designers tended to choose sound analogies of corresponding analogue counterparts to mediate a meaningful message recognisable to an audience of the time (Coyle, Mesker 2013).

Historically the next example of a sci-fi score entirely composed of electronic sounds is *Blade Runner* (1982; composer: Vangelis). It is an exceptional soundtrack entirely conceived with a synthesiser, the *Yamaha CS-80* (Sigman, 2008). While the soundscapes conceived by Vangelis are highly

⁵¹ 'Roddenberry told me [Jeff Bond], listen, I don't want any of this goddamned funny-sounding space science fiction music, I want adventure music.' (Bond in Lerner, 2013, p. 55).

⁵² Similar to the concept of the *Hanna & Barbera* animation *The Flintstones* (from the pre-historic past), *The Jetsons* depict a family and its troubles of the future.

elaborate, the electronic score is a simulation of traditional orchestral writing only; opposite to *Forbidden Planet* (1956) for example, the sound design for *Blade Runner* is kept traditional.

The choices made for sound design like *The Jetsons* (1962, 1963) or *Blade Runner* (1982) consequentially influence the selection of usable sounds for sound-based music in three ways: first, the choice of sounds enabling an understanding in the audience and to facilitate an appropriate experience has to be in accordance with the audio-language of the time; second, the sounds need to be deliberately chosen with an intention to become a suitable mediator of the unspoken words of a character or a scene (what Chion (1994) defined as 'rendering'⁵³) and third, the chosen sounds need to allow the intuitive distinction between sounds applied as sound design and sounds as part of the score in order for an audience to experience the sounds as music.

The latest addition to sci-fi milestones is *Gravity* (2013) which next to an unconventional sound design also goes far beyond the scope of traditional mixing (Mera, 2016). The film will be discussed in the section of works informing this thesis (see chapter five).

⁵³ In regards to diegetic sounds: 'The film spectator regogni[z]es sounds to be truthful, effective, and fitting not so much if they reproduce what would be heard in the same situation in reality, but if they render (convey, express) the sensations—not necessarily auditory—associated with the situation.' (Chion, 1994, p. 109).

To summarise, for an audience having been exposed to genre conventions and associations for a good hundred years of film history, a break in expectations might become a difficult undertaking. Still, several exceptions have proven that the 'extreme' can work, and, maybe rather the opposite can possibly attract an even larger audience. All sci-fi milestones are after all perfect examples for the successful use of unconventional composition techniques or instrumentation styles.

Especially Herrmann's score for *The Day the Earth Stood Still* (1951) can be taken as an illustration of how new sounds quickly forged the experience and established the cliché of otherworldliness. The score was—though strange in its sound—not only immediately accepted but also swiftly imitated by other composers.

2.6.2 Reality in science fiction

At this point, the peculiarity of sound treatment for a large amount of science fiction films has to be discussed: for the science fiction films taking place in outer space, the audible perception of sound is a physically impossible paradox. However, it can be assumed that for these science fiction films similar rules as for other fictional narratives apply: it is the fabrication of an illusion with the aim to entertain an audience (Whittington, 1997).

Moreover, advocates of cinema surround sound confirm that audible physical space and action, just like in other Hollywood films, is expected by the audience as much as it expects to hear sounds significant to the drama, which

function as explanations and drivers of narrative (Buhler, Neumeyer and Deemer, 2010). In the case of action films, the latter idea combined with digital technology gave birth to sound design's hyper-realism, an approach which has been employed in surround space to create a greater artifice ever since.

Compared to the sound-worlds springing from hyper-realism, only in exceptional moments is the dialogue panned to the sides or even into the rear speakers⁵⁴. Instead, dialogue is mostly mixed in the centre channel in fear of possible distraction or confusion of the audience (Whittington, 1997). To bestow a feeling of being in the same (emotional) space as the action, the surround channels are mostly used for atmospheres and music.

2.6.3 Science fiction and sound-based music

Unfortunately, few studies exist in sound-based music investigating the reception and acceptance of new sound worlds in a non-university audience. Robert Weale and Leigh Landy contributed to this strand of academia in a research finalised in 2014, where the reception of a sound-based music composition by an audience was compared to the intended objective of the composer. The study concluded in part that there was a direct correlation between the familiarity with a piece, respectively the style of music, and the level of acceptance as well as an ability to successfully interpret the music by a test audience.

⁵⁴ Added reverb does spread out the dialogue track into the sides. Combined with the camera angles, dialogue can appear as if it were indeed panned and siccoming from a specific direction.

This finding, specific to sound-based music, confirms earlier studies carried out in other areas related to music or (music) psychology, which focused on the relationship between anticipation, expectation⁵⁵ and human experience. These conclusions might also explain the acceptance and quick adoption of popular music and its linked musical language, both of which encountered less resistance to their use in sci-fi films.

When pop and rock began to distinguish themselves from other popular music genres in the 1950s and 1960s it sounded strange to the ears of audiences unfamiliar with the style. Still, although pop always makes use of familiar harmonies and timbres when used in science fiction films it attempted to be as distinct and modern as to suggest the future (Hayward, 2004). For an industry based on the medium film as an investment, it could be speculated that this approach might be reaffirming enough to embrace another new sound world without fearing the risk of alienating a multi-cultural mass-audience.

Therefore, this research will need to find and utilise clearly definable musical parameters which will be familiar to a cinema audience in order to facilitate comprehension as well as to reconcile with the style of acousmatic music. Chapter five will cover the findings of the practical research, where suitable parameters have been identified and applied.

⁵⁵ See David Huron: *Sweet Anticipation* (2006).

2.7 Literature review—conclusion

Unions and investors seem to have a strong influence on Hollywood's production methods and produce. Working in more than one designated position is impossible because it is prohibited to be in charge of more than one task. This means that in the context and under the time constraints of a blockbuster film a sound designer cannot be a composer and vice versa. On the other hand, collaborations between the sound and music departments have mostly been impeded by tight production schedules.

Furthermore, while technological advancements had been in place early enough for sound to play a more important role in films, it seems that Hollywood's aim at mass production and mass distribution needed to keep sound and music as simple as possible.

As it currently stands, while avant-garde artists and music technology staff at universities had major breakthroughs regarding tools and access to powerful computers to give birth to elaborate sound compositions, any influence on film sound in Hollywood has been minimal. Originally only creators of radio content moving to film and TV managed to influence the perception, production and quality of sound.

It seems however, that the arrival of digital audio workstations has levelled the playing field and drawn attention to the detailed processing of sound as well as positioning of sound in space.

Finally, reviewing existing film music literature has also uncovered that tone colour ('timbre'), its manipulation and sophisticated application in form of 'orchestration (or in the case of EA music, spectromorphology) seems to have been the secret tool of influential and successful soundtrack composers. Unconventional sounds have been used to establish the otherworldliness in science fiction films, either through the use of relatively unknown or unfamiliar sounds, traditional instrumentation out of context, particular dissonances or electronic processing of traditional sounds or instruments. Leading scholars in the field of science fiction soundtrack warn that aiming at the extreme estranges an audience rather than yielding the desired futuristic soundscape.

Historical recollections of how electronic instrument were perceived by contemporaries in the beginning of the 20th century might offer more insights into genuine reactions when novel instruments such as the *Theremin* for example were introduced. While humans are still afraid of the unknown—or at least approach the unknown with care and observant expectancy—it is doubtful to assume a similar reaction from an audience accustomed to the daily changes of the early 21st century.

It can be assumed that in regards to electronic sounds possibly an experience of perfect execution or production together with a perception of a perfectly defined sound or a relative unfamiliarity with processed sounds might still evoke a certain level of fear—a reaction which seems to stem from a mix of (a) inability to identify the source, (b) inability to identify with the movement executed by a human to produce the sound (for example the

theory about 'mirror neurons'⁵⁶; i.e. an ability to relate through empathy or imitation) or (c) lack of exposure (i.e. being unfamiliar with the new sounds).

⁵⁶ See: Marco Iacoboni: *Mirroring People: The Science of Empathy and How We Connect With Others* (2013).

3 Methodology

The following section will outline the by this research taken approach to apply acousmatic music composition tools and techniques in the context of blockbuster science fiction film in order to test their ability to function as a supplementing or substituting alternative to current composition practice as used by popular mainstream Hollywood composers.

The thesis is split in two parts: a theoretical examination and a collection of practical portfolio works. The compositions are meant to replace the original soundtrack minus their sound design track, and are to explore and demonstrate the practicality of an acousmatic music approach.

A theoretical proposition will be outlined and followed by the methodology for the practical portfolio.

3.1 Construction of a theory

[B]y means of some mysterious perceptual alchemy, whatever virtues sound brings to the film are largely perceived and appreciated by the audience in *visual* terms—the better the sound, the better the image.

(Walter Murch in Chion, 1994, p. viii)

The literature review first focuses on a possible explanation as to why acousmatic or sound-based music, which has been practiced roughly since the mid-20th century, has not been more widely used outside academic circles.

As it seems, mainly economic influences of Hollywood's film industry have shaped cinema on America's west-coast.

In its theoretical analysis the research also briefly examines the historical developments of the science fiction soundtrack to document how technological developments and scientific inventions shaped the approach to film making and consequently the creation of the soundtrack as a total. Following the technological influences will be an examination of the synergy initiated between a successful amalgamation and the resulting relationship of image and sound, which establishes and confirms the agency of a film.

Eventually, acousmatic music theories will be explored and cross-referenced to provide a foundation for the combination of its concepts with the roles of music in film to expose pitfalls but also opportunities. Simon Emmerson's *language grid* (1986) was the starting point for the *Association and Organisation grid*, a proposed theory for sound categorisation and possible decision-making tool for the emerging composer.

3.2 Practical approach

Images and sounds, like strangers who make acquaintance on a journey and afterwards cannot separate.

(Robert Bresson as cited by Walter Murch in Chion, 1994, p. xvii)

3.2.1 Reasoning for chosen films

For the practical segment of the research, different types of scenes from three example science fiction films were chosen for following reasons:

- a. Since the films have been published, waiting for a production to finish had been avoided, and the work on the soundtrack could immediately begin.
- b. The film's dialogue could—for the most part—be extracted to become a realistic guide track for the new music. (Having dialogue in place prevented the segments from radiating an impression of being a music video.)
- c. Existing music could be used as a temp track, and so replace the missing comments of the director to indicate the desired atmosphere for the scene.
- d. After completion of the re-scoring process, the original tracks could possibly work as comparison tracks to examine if the new score indeed works.
- e. Finally, specific works could be chosen, which were specifically designed for what is considered a typical target group for entertainment/blockbuster science fiction films.

3.2.2 Chosen scenes and their overall atmospheres

In general, a musical cue can be a rather short snippet of music (Karlin and Wright, 2004). The overall playing time of the combined music in a typical film can be less than half its total length (*ibid.*). For a typical science fiction or fantasy film—because of their fictional nature—the playing time is often somewhat more than half of the film's playing time (*ibid.*).

Apart from title and end credits, which generally need to fulfil different criteria from the rest of the score, and therefore have to be approached differently, science fiction music needs to be able to musically express similar—if not the same—atmospheres as can be found in action films: action and fights, tension, threat and occasionally romance.

Five different segments were chosen for each film. These scenes seemed to represent the main emotions expressed in the films best. Action is represented twice; once as a short cue and then as a longer cue to see if tension could be built up or maintained over a longer time.

3.2.3 Existing soundtracks as fictional screening notes

In earlier studies about film music the music was generally considered out of its context and analysed separately from what was happening in the images. In the last few decades, it has been recognised and acknowledged, that film music cannot be understood in isolation from its intended context (among others Buhler, Neumeyer and Deemer, 2010). Film—as a concept—is perceived by an audience as one product, and while image and sound can exist and convey meaning all by themselves, detaching either from the other would make as much sense as to analyse camera angles detached from the images of the film. Only the complete work carries and accounts for the narrative, signification and intended message(s) (Buhler, Neumeyer and Deemer, 2010), and hence, current practice analyses scores in combination with its corresponding images (ibid.).

Audio-vision (Chion, 1994) still seems to be the authoritative book about sound design analysis in its context. Chion (1994) suggest to listen to the existing soundtrack without the images for study purposes; then watching the image without sound, and finally combining both again. For films in mono or stereo this seems a valid approach to allow undivided focus from either medium and to understand how a soundtrack as a complete entity functions in its filmic context. However, in an era of multi-channel or surround mixes, image edits and technological (i.e. digital) advancements in sound treatment have become more mutually influential, and synergies and aesthetic perceptions between image and sound are lost if one is considered without the other (Kerins, 2011). The change to digital has transformed how films are made, seen and assessed, because edits have become quicker and long establishing shots with their corresponding sounds are not needed anymore to denote space and time (ibid).

On the other hand, in industry practice *temp tracks* are utilised to facilitate the communication between director and film composer and to quickly find and reproduce the expression of the music to match the images in a supporting way. Although, practice also knows pragmatic composers who prefer to watch the film several times in silence to intuitively derive an impression of the atmosphere expressed by the visuals. This latter approach seems to suitably enable the score to clarify or fill possible gaps the action cannot express by itself (Manvell et al., 1975; Karlin and Wright, 2004; Schiffrin, 2011; Buhler, Neumeyer and Deemer, 2010).

Since applying either mentioned method to the practical research would have meant deepening an already intricate knowledge of the existing soundtracks (which might also have resulted in copies of the original scores instead of musically new interpretations of the scenes), the composition of the portfolio pieces was approached similar to composers working on a new project. Eventually the knowledge of the original soundtrack was used to deduce instructions and clarifications about the intended atmospheres likely requested by the directors.

Originally all films were stripped of their original soundtrack. It was attempted to isolate the dialogue and the sound design tracks from the music for re-use in the reconstructions. Wherever the dialogue track could not be successfully extracted, voice talents were re-recorded instead.

Unfortunately, the sound design could often not be successfully extracted, and time limitations hindered a creation individual sound design tracks. The remaining sound design in the existing portfolio is an indication of important scenic moments which would otherwise be lacking in emotional or artistic expression.

3.2.4 Rescored films—pedagogical benefits

The three films were chosen for following reasons:

1. Dawn of the Planet of the Apes (DoPoA; 2014)

The first of the three example films. The intro seemed an easy and suitable testing ground for the implementation of aircraft sounds (i.e. flyovers) as musical instruments. It was the desire of the author of this thesis to experiment with the concepts of FFT-based instruments and convolution to create new sound worlds and so to 'dawn' the futuristic world in which intelligent apes take over the planet.

2. Star Trek First Contact (*STFC*; 1996)

STFC was the second out of three films to be partially re-scored. The film belongs to a slightly different generation of sci-fi films than *DoPoA* or *Gravity*. Just at the emergence of digital production, *STFC* is not only conceived in a different style—almost old-fashioned in its acting and filming—but also the music (composed by Goldsmith senior and junior) belongs to the last era of films before Hans Zimmer's composition style and production company took over Hollywood. The film was chosen to indicate if a sound-based approach might depend on the production style of the film.

3. *Gravity* (2013)

Gravity was the third and last film to be partially re-scored. *Gravity* was chosen because of its unconventional approach to the sound design in outer space (an only tactile perception of sound) and dialogue mix (in the surrounds). The latter would allow to explore mixing in surround—a for the author of this thesis new mixing strategy, which after an initial successful implementation, led to a remix of *STFC* in a quasi-Atmos format (i.e. including heights).

3.2.5 Testing Criteria and Substantiation of Successful Implementation

It was decided against testing the music with an audience. This decision was taken for the following reasons:

1. Limited access to a typical blockbuster audience.
2. A possibly too diverse socio-cultural background of an available audience might result in responses too broad to draw conclusions from given the limitations of a PhD research also including the creation of an extensive practical portfolio.
3. Unfamiliarity with the acousmatic music style in a test group could become an obstacle for the acceptance of this new scoring style and so lead to inapplicable responses.
4. Eventually, the departure point of this research was to test a feasible approach to composition using tools and techniques otherwise applied by an acousmatic music composer.

Instead, a set of criteria was chosen against which to test a successful realisation of score conceived from acousmatic music composition techniques or the application of its tools in the combination with visuals and in the context of a blockbuster sci-fi film⁵⁷. These criteria can be summarised as follows:

1. The cue has to represent the atmosphere or emotion of the scene and be able to build up or hold the tension for the duration of the scene.
2. Source material has to be usable in the familiar language of the for the genre typical musical language. This decision has been taken to introduce only one new factor to facilitate acceptance of the new sound world until a new language can appropriately be established.
3. To prevent misinterpreting music as sound design (i.e. possible source-bonding with or without presence of synchresis; e.g. sounds

⁵⁷ Detailed accounts of typical principles of action underscoring can be found in books about applied film scoring (e.g. Manvell et al., 1975; Karlin and Wright, 2004; Alten, 2005; Schifin, 2011; Buhler, Neumeyer and Deemer, 2010).

emanating from a beeping computer as sound design versus beeps as part of the music), the sound has to be clearly identifiable as music.

4. Finally, a literal semantic interpretation in case of recognisable sounds has been identified as undesired in the context of this thesis. This implies that sounds whose semantic meaning has been disguised through processing and from these derived musical instruments should demonstrate one or more of the main attributes needed for the composition in the language of film music (pitch and harmony, rhythm or rhythmical movement and timbre).

All portfolio pieces were tested against the above described criteria, and an examination of each re-scored cue will be offered in chapter five.

4 Theoretical Research

I've been using electronics for twenty-five years now. But I've never seen it as substitute for an orchestra. I believe it will someday be an accepted section in a symphony orchestra.

(Jerry Goldsmith in 1986 in Karlin and Wright, 2004, p.370)

4.1 Rationale

Current standard Hollywood scoring practice utilises the orchestra enriched with synthesisers, while sounds from every-day objects are generally reserved for the reality space covered by sound design. This research is an attempt to expand the commonly applied colour palette of the film composer, employing tools and techniques from acousmatic music.

Acousmatic or sound-based music is based on 'sound objects', traditionally not perceived as music instruments, and transforms these sounds from every-day objects into music. The complexity of the endeavour to compose music from sounds in the context of a soundtrack arises from the crossover or potential mismatch when interpreting a sound as an identifier of an object (sound design) instead of being the carrier of an abstract concept such as an emotion (music). Therefore, to ideally conserve the passive enjoyment of an entertainment film, sounds applied in the role of music need to be able to unobtrusively and clearly function in this role. The tools and techniques applied in acousmatic music composition seem to sufficiently allow for a 'disguise' of the semantic meaning of a sound source.

Of course, recognisable—and therefore technically as sound design classifiable sounds—exhibit musical qualities as well. Their utilisation in a musical role is practiced in form of the *integrated soundtrack* (see the writings by Kulecicz-Willson) for example. The advantage of this style is the direct employment of sounds which are part of or present throughout the soundtrack, which allows these sounds to take on a life and meaning closely related to the message of the film. A possible issue with the *integrated soundtrack* is that the audience might not perceive or take too much time to understand that sound has taken on the role of music. For an art film, this disadvantage might not pose an obstacle; in context of blockbuster films, a misinterpretation could result in a distracting experience for an audience. Additionally, for the *integrated soundtrack* to unfold as music film-time is needed—for a blockbuster, film-time is more expensive and in the production company's eyes preferably spent on extravagant visuals which seem to be the carriers of the spectacle—it often is too expensive to allow time for the soundtrack to unfold.

To overcome the drawbacks of misinterpretation and to be able to apply note-based scoring techniques (or even reintegrate note-based instruments at a later point), extensive processing of sound sources has been identified as a possible solution. An additional advantage of extensive processing lies in its ability to bring out inherent or external musical attributes of the sound or through the type of processing extrinsically imprints musical qualities (e.g. processing algorithm, convolution, etc.).

Simon Emmerson's language grid (1986) was the inspirational starting point for a possible theory to support and aid a composer to classify applicable source material, decide about the amount of needed processing and eventually options to organise the resulting sounds into a composition.

4.2 The traditional soundtrack

Traditionally, the work on a Hollywood soundtrack is split up into two parts: dialogue and sound (both are the responsibility of the sound department) and music (taken care of by one or more composers and their team(s)). This partitioning might not only have arisen from different technical workflows necessary to apply sound to film but it might also be the consequence of a conceptual distinction between abstract ideas and their representations (i.e. concepts) and on the other hand, a concrete materiality (i.e. reality, the literal expression of objects, situations or ideas; see Figure 4).

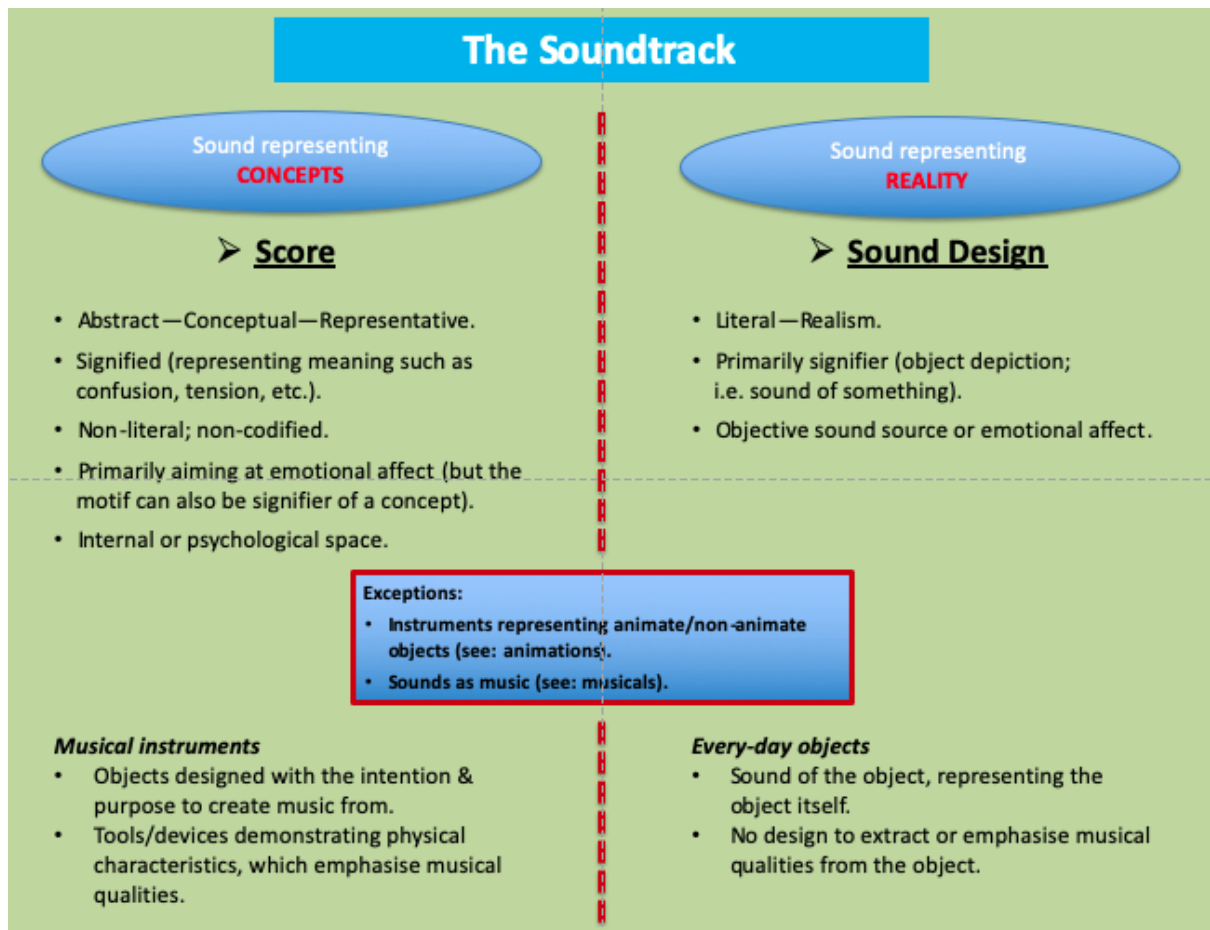


Figure 4: The traditional soundtrack and a comparison of the two departments responsible for film sound.

Concepts are represented by the score whose role it is to clarify and illustrate abstract ideas. The score is meant to signify what can otherwise not—or only with difficulty—be expressed in words and so the score is traditionally conceived from objects which do not hold an inherent meaning but on the contrary exhibit qualities which can be exploited for musical purposes. This allows music to encompass the representative, conceptual ideas of emotions and moods.

The score also provides supplemental information and establishes what can be considered the fictional space of a narrative by focusing on the use of

musical parameters such as pitch, rhythm and orchestration (i.e. timbre); either of which can be expressed with analogue or digital music instruments.

In animations or musicals, instruments can also be found in referential roles, which replace the actual sound through a gestural imitation or the catching of the action's hit-points⁵⁸ (e.g. dialogue could be imitated by violins or the wah-wah of a trumpet).

Reality is represented by recorded or designed sound and dialogue. Both aim at a literal—or at a minimum believable—depiction. Specifically designed to resemble real sounds (or sounds perceived as real) they primarily function as signifiers for non-/animated objects, movements and ambience through addressing the physical likeness of the object. While focusing on reality, sound design can nevertheless hold emotional information, too.

In accordance with their purpose in film sound, sounds applied in the role of sound design do not attempt to demonstrate or emphasise musical attributes or parameters. Except for musicals and cartoons for example, sounds from every-day objects represent reality or hyper-realism and so tend not to be used for the construction of music⁵⁹.

⁵⁸ As a representation of the corresponding frequency spectrum of the corresponding object or a simulation of its movement.

⁵⁹ Hyper-reality, depicting reality overly realistic, detailed, extreme or exaggerated but still plausibly, has evolved and taken over from 'reality' after digital workstations have become more common in the 1990s.

4.3 Traditional workflows

After initial spotting sessions, the soundtrack is generally approached by the two production stakeholders individually; exchange of executed work is barely possible (if at all), mainly because of time restrictions imposed by the postproduction process. This workflow tends to result in sound design and music 'battling' for the same frequency space. However, as established in section 2.2.1 about diegetic and non-diegetic music and sound, all heard sounds (including music) are heard or experienced as a part or a component of the soundtrack, which might justify the approach taken by mixing engineers to consider all sounds as part of the story space, describing the location, narrative or action. Both, music and sound, are equally treated and scrutinised in their ability to supplement or support the images (Hillman, 2017), and so, if both are indeed conflicting, one element will be mixed at lower levels or cut altogether at the mixing stage. Naturally, these cases lead to time consuming debates and disappointments.

Considering the genre context and its corresponding expectations the following premises and assumptions can be summarised for this research, which form the guidelines for the composition of sound-based music and eventual criteria against which to evaluate:

- From the creator's and the viewer's point of view, every sound used/heard in the context of a soundtrack is perceived as part of the story world.
- Sound together with the visuals co-establishes the narrative and so fabricates and defines the fictional space. Sound can be used to

construct a practical reality as well as evoke a particular mood (e.g. sound utilised as signifiers in a literal sense, but also as a carrier of emotion or emotionally important content/expression).

- Neutrality of expression of a sound is established by an intentionality of choice; e.g. sound for a documentary is chosen and intended as realism.
- A specific category of sounds—known as score or music—is meant to depict added-information for the fictional space. These abstract sounds represent the signified.
- In film sound, a crossover between the two areas of ‘aural’ and ‘mimetic’ already exists: abstract sounds take over semantic roles in cartoons/animations (e.g. music to represents objects or humans) and musicals (sounds from movements seamlessly transform into the music).

To facilitate sounds from every-day objects to function in the role of music compositional concepts as used in EA music might enable a maturation into a musical expression which can be applied to film sound. This alteration from EA music to a film soundtrack will be examined next.

4.4 Sound association and their organisation

Sounds used in the standard instrumentation (i.e. orchestration) of film music can roughly be categorised into orchestral sounds extended with percussion, ethnic instruments and synthesisers/electric instruments. Every-day sounds are generally reserved for sound design and are—if at all—only rarely integrated into a score (of course, except for cartoons and musicals). Acousmatic music

composition techniques and tools and through their application conceived sounds could expand the general sound palette currently utilised for scores.

Inspired by Emerson's language grid (1986) a modified grid for categorisation and organisation has been developed. The grid maps aural versus a semantic interpretation of sounds on its x-axis against principles of implementation (i.e. abstraction of organisational principles derived from the material) on its y-axis (see Figure 5).

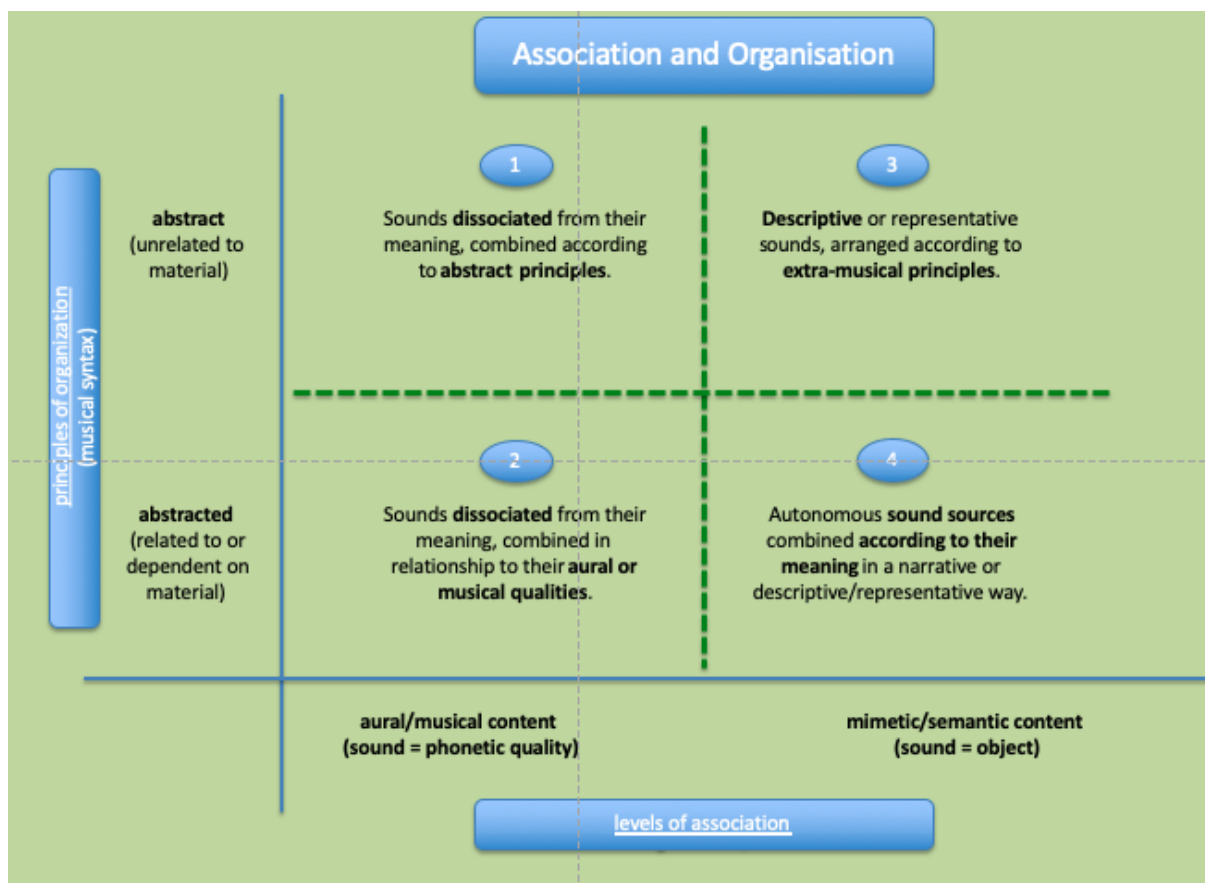


Figure 5: Levels of association and principles of organisation of sounds.

The quantification of levels of aural and mimetic discourses focuses on the difference between a musical versus semantic application of sounds (i.e. a

timbre attributes versus semantic properties and at the same time representational versus literal). For example, an aircraft flyover used for the sake of its musical qualities regardless of its semantic or implied meaning (i.e. without connotation) versus a literal depiction of an aircraft flyover (implied meaning of departure) or a symbolic meaning (e.g. departing on a new adventure in life).

The y-axis assigns applied principles of organisation (i.e. the used syntax to arrange the source material⁶⁰) derived from the associated meaning or levels of abstraction of a sound. An abstracted syntax derives the organising principles for the music from the source material; its semantic attributes influence if not determine the organisation into a composition (e.g. extraction of timbral characteristics and a following combination of source material according to these features; see soundscape compositions in EA music or backgrounds in film). For an abstract syntax, any derived organisational criteria or processes are unrelated to the source material (e.g. aleatoric or serial composition concepts; harmonic or melodic progressions, etc.).

The below presented theory based on the *Association and Organisation* grid has been deduced from the practical work. During the experiential research it has become apparent that a theoretical framework was needed to allow the application of every-day sounds in a musical way without causing confusion in the context and reception of a fast-paced piece of audio-visual

⁶⁰ In Emerson's language grid, which analyses compositions in their historical context, these principles are either serial (abstract) or derived from the material itself (abstracted).

work (i.e. blockbuster film). A proposition and comparison of suitable organising principles for a score conceived of these non-traditional sounds (eventually instruments) is proposed below. The presented theory is expected to facilitate the decision-making process of a composer to allow a quick and suitable assembly of a soundtrack, which would be intuitively perceived as music.

4.5 Combination and inference

Acousmatic music deals with sound objects which are traditionally not intended—and therefore not identified—as music instruments. Applying these sounds to music in the context of an entertainment film poses a danger of misinterpretation. Sounds applied in the role of music can easily be misread because not only might an immediate visible connection to an object on screen be missing, but also because the same (or similar) type(s) of sounds are used for the sound design. Hence, this research evaluated each sound of an every-day object against the premise of its ability to be immediately and ideally subconsciously be identifiable in the role as music.

From the experiential research it has been concluded that a more or less extensive manipulation of sound removes its recognisability—or at least disguises it to such an extent that its semantic meaning is masked. Additionally, computer aided processing might expose intrinsic or extrinsic musical attributes/qualities (resonances, pitch), which can further be explored. The level of camouflage (in form of processing) and so the following categorisation

as a new musical instrument can then be supported by the *Association and Organisation* grid:

1. Typical music examples for quadrant one might be composed from note-based instruments—traditionally, tools which have been built with the intention to function in the context of making music—but also from sound-based music. In the latter case, the instruments gained from sounds not originally intended to function as musical instruments need to be able to express or to be combined with traditional instruments according to the intended abstract (musical) syntax to compose the music from and not be semantically identifiable (e.g.: traditional instruments or new instruments which are note-based, i.e. synthesisers).
2. Typical music examples for quadrant two might be composed from sound-based instruments—new instruments which have been developed with the intention to function as music, but which are not necessarily note-based and which possibly cannot be implemented in the same way as note-based music because of their musical or structural limitations. Additionally, these instruments ideally do not carry an inherent, semantic meaning but instead, can be combined or organised according to attributes (physically) intrinsic to the sound (e.g.: acousmatic music from sound objects).
3. Typical examples of music in quadrant three might again be derived from sound- or note-based instruments. Since semantic meaning is recognisable but intentionally ignored, mimetically perceived sounds could be used instead of instruments to compose music (see musicals), and vice versa, note-based instruments could replace the sound design (see cartoons; e.g. cello or wah-wah of a trumpet for a human voice, etc.).

4. Typical examples of music in quadrant four are soundscape compositions (environmental, soundscape or field-recordings⁶¹) or the ambiences and backgrounds in films. The structuring principles of both styles imply shared similarities of extracting musical parameters (i.e. rhythm, timbre and spatiality) to explore their narrative but potentially also musical potential.

All found source material for a composition could then be categorised into one of the proposed quadrants and possibly—as needed—further be processed (at least until the new application of sound has become familiar) to fit the predetermined premise of expressing the desired musicality without divulging a semantic identity or accidentally being misread as the sound of an object other than a musical instrument. Intention is of importance to choose, manipulate and apply the most suitable sounds for sound-based music. Their implementation—in accordance with their purpose—can be realised with abstract or abstracted syntax or a blend of both. Extensive manipulation could provide a practical solution if the sound's obvious extrinsic meaning is an undesirable by-product which renders the sound (too) recognisable as a signifier.

The possibilities provided by this categorizing of sounds regarding their level of disguise or identification applied to the compositional source material of a sound-based score are numerous. Within established but adaptable guidelines for the resulting score, a flexibility between aural and mimetic discourses could

⁶¹ For more information see <https://ears2.dmu.ac.uk/encyclopedia>.

be triggered which could prompt a rich exchange and expand possibilities for solutions and alternatives to issues encountered at a film's sound stage (see chapter six).

However, there are also disadvantages to the concept, which have to be considered before applying a sound-based score: next to spoiling the audiences' (genre) expectations, an inherent disadvantage to the concept is the brain's processing time to recognise, identify and conclude 'reality' from incoming data. This cognitive process might lead to sounds being intuitively assigned to an unintended category. While the brain can overcome a certain level of stimulation of incongruent combinations of sound and visuals, and identify visuals and their accompanying sounds still as plausible, too much processing time is needed to construct meaning if two stimuli are too incongruent. The longer the processing time, the higher the risk of the brain concluding that the sound does not belong to the film. This means that any object used as musical instrument has to cross over into the musical realm rather quickly in order to not distract from the story (and consequently pull the audience out of the experience).

This disadvantage, which has partially also manifested in my own findings (see chapter five and six), can be remedied by strongly accentuating musical qualities of the sound source before its intentional application—at least until the new musical language has become some form of 'standard repertoire'⁶².

⁶² It is a matter of acquainting the audience with the new musical language to shape new understanding through a mixture of familiarity and expectation(s) (see research by Huron (2014) or Landy and Weale (2014), and others).

In the meantime, the currently proposed solution is to clearly disguise sound objects' intrinsic information and to transform their timbral attributes. This will enable the processed sounds to clearly function as musical instruments.

5 Practical Research: The Portfolio Projects

I think the basic process of creativity is always the same.
You sit down with the blank page and you put things
down. Till you get the right thing.
(Jerry Goldsmith in Karlin and Wright, 2004, p.189)

Since action and suspense are the main carriers and driving factors of narrative in science fiction films, the demonstration scenes have been chosen because of their representational nature of the genre. Even psychological or horror science fictions focus their attention on emotions of (fast paced) action or suspense.

At the same time, this explains the restricted choice of emotional diversity in the application of musical expressions of the demonstration films.

The scenes have mainly been chosen according to their importance for the narrative of the film, but also to examine if the musical material derived from sound-based music can be sufficient to build up or hold tension for a longer amount of time, considering that a score itself can be considerably short compared to traditionally conceived music.

While action scenes cover a wide variety of durations, it is also important to note that these scenes are mostly interrupted, with gaps for sound design. This further confirms that action music composed of sound-based music has to be able to function within the narrative context in order to be viable in establishing tension or suspense: the sound-based material has to be flexible enough to denote an emotion within a brief amount of time, but also

captivating enough to provide enough musical material for film scores of longer durations where applicable.

Five different types of scenes have been chosen from each film (not necessarily in this order):

1. Opening titles,
2. Action (short),
3. Action (long; to sustain suspension and tension),
4. Emotional or intimate moment,
5. Dialogue.

Traditionally, opening titles prepare and manipulate the mood of a group of random people sitting in a dark cinema space. Easing these people into the narrative, the opening titles are also meant to present an overview and to set the stage of what is to be expected in the film.

For the purpose of determining the suitability of sound-based music as a new or supplemental type of film score, opening titles might possibly not be the most practical choice when used as traditional opening credits. The latter mostly consisted of a musical overview of the film. However, recently there has been a change in approach to opening titles, resulting in a decreased amount of available film time. Brief title sequences tend to immediately confront the audience with the story and *reality-space* of the film, a change, which might suit a sound-based scoring practice.

This type of underscoring has proven especially viable for films such as *Dawn of the Planet of the Apes* (DoPoA, 2014), capitalising on the blend of

sound design telling the story and sound-based music accompanying its emotional content.

The opening sequence for *Star Trek First Contact* (STFC, 1996) still follows the typical depiction of a heroic adventure in space. *DoPoA* for example, immediately starts telling the story—respectively summarising its prequel(s) and *Gravity* (2013) literally 'sucks' the audience into the emptiness of space in its brief opening, in a suggestion of the cold loneliness and danger space has to offer to humans.

Dialogue and intimate scenes reside at the other end of emotional expression in science fiction films. While both types of scenes are not necessarily featured in action heavy films, romantic scenes can be all but missing. However, the few dialogue scenes present important climaxes or impactful turning points for the drama or characters. These scenes have proven to be advantageous as evidence that sound-based music can indeed express deeper emotional levels and overcome their often-ascribed otherworldliness evoked by the otherwise sterility of technology.

In case of romantic or intimate scenes strings are traditionally reserved to steer the audience just at the right moments. Sounds on the other hand are reserved to substantiate and confirm reality as natural carriers of information. Exactly because this division of roles, the use of sounds for the score can have a potential to disrupt the relationship and purpose(s) originally assigned to their narrative meaning.

Even more so, in case of dialogues, the type of sounds as source material needs to be considered: the frequency spectrum of sounds can easily interfere with or mask the frequency spectrum of the human voice and so render the dialogue unintelligible.

In the following sections, each scene will be briefly analysed in regards to its meaning, dramatic intention and in which way the replacement score has been implemented in regards to the narrative.

In general, the author of this thesis does not wish to judge the quality of the original cues composed for the films. Instead, the existing film scores are considered substitute-comments for the intended emotion or atmosphere in-lieu of the instructions normally provided by a director or producer. It is expected that the substitute sound-based score will be able to at least get close to establishing the originally desired meaning and mood of the scene.

The following sections will describe how the sound-based approach was constructed and what possible pitfalls and strengths have been encountered. The practical findings will conclude with a brief examination of suitability and this viability.

5.1 *Star Trek First Contact (STFC)*

STFC is the eighth film in a series of films derived from the original *Star Trek* TV series of the 1960s and the second film including the crew of the 1980s pick-up series *The Next Generation*.

STFC elaborates on the second encounter of an invincible enemy, the Borg, by Picard and his crew as the cliff-hanger at the end of season three and its resolution in the beginning of season four.

The cliff-hanger saw Picard being abducted and assimilated by the Borg, who forced him to commit acts against Starfleet and humanity. The opener of season four successfully resolves the situation with an Enterprise crew able to free their captain and defeat the enemy.

Picard regrets for the rest of his life not having offered a stronger resistance. This is where the story of *STFC* begins.

5.1.1 Titles and intro

The opening sequence of *STFC* is typical for the time of its conception: starting with the studio's logo (*Paramount Pictures*), the title of the film is followed by the names of the main actors and key responsible people. The intro displays a collection of intricate fades: each name fades out into the vastness of space, which zooms in on captain Picard's eye—only to zoom out, revealing the enormous size of a Borg ship. The interplay of zooms seems to be a prelude to the interlocking storyline of the introduction, which shows a Picard reliving his past fear to seemingly waking up from a dream before being awoken by a communication from Starfleet headquarters.

5.1.1.1 *Original soundtrack*

Alexander Courage's well-known *Star Trek* fanfare opens the film, followed by a dynamic swell which climaxes in Jerry Goldsmith's majestic theme for *STFC*. The big and lush orchestration of the title music was composed and orchestrated in the traditional *Star Trek* fashion, confirming the heroic quest of the crew and with it, all of humanity.

Unsurprisingly, the title's score was conceived in accordance with the traditional *Star Trek* world view of heroic exploration and utopian ideals: contrary to the dark nature of the film it was composed in a pastoral but slightly melancholic tone with a strong anticipation of victory. Whereas the theme is a demonstration of the distinguished craftsmanship Goldsmith is capable of, the feel-good opening seems to remove the threat and horror the Borg as an overwhelming enemy represent. At the release of the film, critics possibly rightfully pointed out the slight misalignment for a film of such a threatening setting.

The music for *STFC* seems rather mainstream in its use of orchestral writing when compared to Goldsmith's impactful and for the time and genre unconventional orchestration for *Planet of the Apes* (1968). The instrumentation and typical genre clichés for *STFC* seem to focus almost exclusively on efficiency and effectiveness while being in line with standard Hollywood scoring. Given the situation Goldsmith found himself in (he was double booked because of a delayed postproduction for *The Ghost and the*

Darkness, 1996) and the subsequent support from his son Joel Goldsmith, the score is still impressive and surprisingly consistent.

5.1.1.2 Sound-based approach

The approach to the sound-based composition for *STFC* for this portfolio is the culmination of several different attempts at illustrating the onscreen action and conveying threat. The main decision of which mood to compose for was probably the most difficult one to take: keeping in line with the original soundtrack and composing a heroic theme or breaking with *Star Trek* tradition and writing a theme which reflected on the horror of Picard's experience as a Borg—and if following the latter direction possibly revealing and betraying the introduction's narrative intricateness.

The first attempts at rescoring the introduction displayed the heroism and grandeur of a 'trek in space', but fell short of portraying the darkness. Possibly because of expectations originated and prompted by current soundtrack practice and artistic world views—and even or especially twenty years later—a heroic, pastoral theme felt like an unsatisfactory solution.

On the other hand, adding the typical accompaniment for action scenes, drums and percussion, together with rhythmical-melodic runs as typically heard in 'Zimmeresque' soundtracks⁶³ (the current-language action score) in

⁶³ Hans Zimmer coined a typical action music of rhythmical runs in the strings in combination with strong drum grooves.

order to heighten the tension, felt misplaced. This type of scoring is part of the orchestral, note-based music language which this thesis aims to supplant.

Only later in the research a decision was made to supplement instead of substitute: through exposure—and consequentially conditioning—the current musical language in cinemas is known and works efficiently for film. Additionally, since an audience needs a certain level of familiarity with the applied musical language to understand and decode the perceived aural data, it eventually seemed that the solution had to be a mix of existing and new musical language. Hence, it seemed practical to keep the existing, familiar musical language while replacing the utilised sound world: replacing the instrumentation of the contemporary orchestra with sound-based instrumentation. Offering new sounds might facilitate the transition to a new musical language, while confronting the audience with new sounds and a newly invented musical language might have introduced too many changes. In this way, effortless understanding and a possibly quick acceptance of the proposed sound-world could be enabled.

The first attempts made use of *Izotope Breaktweaker*⁶⁴, a plugin enabling the composer to create glitch-like beats from samples and synthesised sounds. *Breaktweaker*'s usability in the creative context of *STFC* could have been a true advantage, if it could have been used to reliably trigger basic patterns. Sound design would then have had enough space to easily fit without adding clutter to the soundtrack. However, while the plugin demonstrated a satisfying

⁶⁴ <https://www.izotope.com/en/products/breaktweaker.html>; accessed: 15.12.2019.

quality of the resulting percussive grooves, it nevertheless has proven impractical for several reasons:

- a) A film score requires a flexibility in changes of tempo and metre in order to respond to the needs of the narrative (e.g. accommodating hit-points or last-minute picture edits). However, tempo and metre need to be permanently established before the composition process begins. Subsequent changes on offline processed (rhythmical) sound material can be difficult and time consuming to accommodate. Real-time processing has been heavy on the processing power of the computer or even caused the plugin (or computer at times) to crash.
- b) The plugin and its response are inflexible to catch or respond to hit-points.
- c) Unfortunately, the plugin needs a lot of processing power and tends to crash rather often. Additionally, it often does not respond well to changes in pattern or metre, resulting in silence.
- d) MIDI and tempo changes in *Pro Tools 12* have shown to be clumsy to work with, forcing a change to *Steinberg's Nuendo 8*, where the plugin tended to crash even more often.
- e) *Ableton Live 10*⁶⁵ re-wired into *Pro Tools 12* as the final solution showed promise. On the downside, re-wire caused timing issues, which would make consecutive work or corrections necessitated by picture edits arduous.

Additionally, from an artistic point of view, *Breakeaker* seemed to leave little room for chance during the initial state of experimentation—an important phase during which the composer finds the individual voice of the film—because each run-through results in the exact same outcome once the

⁶⁵ From now on referred to as *Ableton Live*.

patterns and their subdivisions have been programmed. Breaktweaker 2 has been released recently; it still has to be tested to see if this resolves the above-mentioned issues.

At the very end of the practical research, *Ableton Live* was discovered as a suitable and stable alternative to quickly and efficiently work with MIDI. Since *Ableton Live* offers only limited abilities to work with video⁶⁶, the software had to be connected in re-wire mode to another digital audio workstation (DAW). Unfortunately, in re-wire mode *Ableton Live* does not allow non-native plugins to run, and synchronising its MIDI output via timecode into *Pro Tools 12* where the plugins could be used again resulted in recognisable latency.

The only alternative stable enough for work to continue over days was to either program and export MIDI information from *Ableton Live* and run the virtual instrument from within the main DAW or to compose the MIDI and export its audio to be used in the DAW⁶⁷. However, at the time of the conception of the music for *STFC*, neither alternative existed in the composer's toolbox yet.

Consequently, the work was executed manually: copy/pasting each (small) sound, which in case of *STFC* manifested as a labour-intensive disadvantage. On the plus-side, this way of working offered a hitherto unknown level of control and an opportunity to shape each individual item of the resulting rhythmical pattern (or gesture) in a detailed way.

⁶⁶ This limitation of *Ableton Live 10* has by now been corrected.

⁶⁷ Note: these restrictions were encountered working in studios accessible to many researchers and students, where it is difficult to fine tune and keep the setup for an efficient re-wire mode constant. Re-wire on an individual system reserved for this work might work just fine.

While this way of composing worked neatly for *Gravity* (mainly because of the choice of source material and less tiny events), it was an unpractical and toiling process for *STFC*. In a real-world context—working against the tight deadlines set for entertainment films—this approach is impractical. Especially action heavy films, driven by many fighting scenes needing substantially more rhythmically based score and the consideration of necessary space for sound design impacts (including catching many hit points to enable the score to seamlessly merge with the sound design) would become an impossibility to score.

This is another reason as to why Hollywood composers use temp tracks and templates⁶⁸: both facilitate a score to be produced quickly and with proven results.

During the exploration of sound-based music as supplement or substitute to traditional sci-fi film score it became clear that any proposed solution would compromise itself if past and current underscoring practices, workflows and conclusions learnt from and facilitated by tight deadlines had not been considered.

In the meantime, suitable alternatives were found in plugins which have the ability to create innate rhythmical movement in sustained sounds: i.e. plugins which apply low-frequency oscillation (LFO), such as *MeldaProduction*

⁶⁸ Templates within a digital audio workstation (DAW), starting up with all the necessary virtual instruments, but also orchestration and style templates for particular emotions.

MRhythmizerMB (see Figure 6) and MWobbler, XFer LFOtool and Polyverse Gatekeeper for example.



Figure 6: MeldaProduction MRhythmizerMB.

Each plugin offers several options to shape audio material in interesting, rhythmical ways through changes in their control data (using automation) over time. But even here, the flexibility of quick adaptations to changes in a narrative put the score at a disadvantage: demands on changes in metre and tempo again led to timing issues. Computers with higher processing power might not

have these issues at all, but within the limitations of the working environment, the solution was to either render the effects of the plugin into the sound (offline processing) or accept the timing issues and use the plugin with the written automation, resulting in random and unexpected outcomes, timing issues or glitches (the latter was especially annoying in case of multi-channel material).

Rendering the sound material with the evolving parameters of the plugin's settings was indeed a viable solution, however only as long as no ex-post alterations to the material were needed. In case the composer decided to change details on the score (timing, tempo, pitch/tuning) or the picture editor/director recut scenes and so altered the timing of the visuals, this solution would lead to specific and fixed results, difficult to adapt at a later stage.

The compromise was to compose sound-based music based on drones and, topped up with brief rhythmical motifs (in the case of *STFC* derived from motor and machine sounds). The source material was designed and processed in *Ableton Live's Simpler* and further distorted with help of bit crushers and 'glitchy' plugins by *Glitchmachines*⁶⁹. Additionally, *Clatter*⁷⁰, a standalone tool programmed in *Max/MSP* by Peter Batchelor, provided enough usable, evolving, gestural motifs generated from the original samples.

Regrettably it was not possible to find a gesture generating tool which can be integrated in a DAW. A tool like this would allow the production of gestural material at the correct tempo to precisely match film-time.

⁶⁹ see *Glitchmachines: Fracture, Hysteresis, etc.*

⁷⁰ <http://www.peterb.dmu.ac.uk/maxClatter.html>; accessed: 15.12.2019.

Melodic instruments designed from the recordings of unprocessed sounds in early attempts led to trivial sounding compositions, particularly as these sounds were too recognisable and therefore identifiable as sound design. Any melodic or thematic use would therefore need a somewhat subtler approach, merging with the narrative similar to a radio play, while supplementing and not mimicking the visuals.

The last rendition of the introduction has satisfied the initial expectation of recounting the past and *Star Trek's* heroism while at the same time suggesting a hint of danger. However, it might indeed have been more advantageous to work with the original sound design from the series (e.g. original movement sounds of the Borg, the ship and of course voices) to more subtly recall Picard's affecting encounter with the Borg.

Unfortunately, cleaning up the existing sound design and dialogue more than the bare minimum to mark the rest of the soundtrack—or even constructing the sound design from scratch—would have led to a rather large deviation of the practical work. It was a regrettable decision not to construct a sound design track, because ex-post it revealed that the sound-based score would have indeed benefitted from the existence of the sound design.

The servo-motors function as melodic elements as well as percussive patterns and aim at implying urgency. The motor sounds were then combined in an *Ableton Live* drum rack (including a recording of a dry kick drum). Triggered in re-wire mode these sounds concocted an intricate, almost

complementary pattern when considering the randomly added rogue sounds from the gestures attained from the use of *Clatter*.

Together with the background drones the melodic fragments are meant to hint at the vastness and grandeur of space and *Star Trek*, while anticipating and reflecting on the events of the for Picard fatal encounter with the Borg in the last episode of the third season of the series⁷¹ instead of literally recalling the storyline.

The drones were derived from the same servo-motor sounds, and warped and 'stretched' with help of either granular synthesis (MGranularMB) or the repeated application of reverberation (algorithmic or convolution) in combination with resonator plugins or extended plugin chains in either *Pro Tools 12* or *Nuendo 8* (see Figure 7).



Figure 7: Example production chains for drone creation in Nuendo 8 and Pro Tools 12.

To conclude, the first attempts in structuring sound-based music in a rhythmical manner without creating unintentional meaning though accidentally catching synch points with the film/action has shown laborious. The intro is filled with technology found on a Borg ship, which meant that the

⁷¹ *Star Trek—The Next Generation: Best of Both Worlds, part I.*

for the sound-based music chosen sounds could as well have emanated from the spaceship. But this could lead to confusion of what was meant to be sound design and what was film score. In a science fiction film this blur might not necessarily pose an issue. However, with a long-standing *Star Trek* history the film needed a more traditional score.

On the other hand, a clear break might have functioned as well. Still, it seemed that a successful re-scoring in the latter case would have only succeeded with an introduction filmed in a slightly different way, allowing more space for a story told in sound design.

5.1.2 First encounter of the Borg on the Enterprise

Led by Picard, the Enterprise crew tries to get to main engineering to engage with the Borg, who have already started to take over the ship. Roaming through the corridors, the chief of security runs into the doctor, her staff and Lily, the injured civilian from 21th century's earth. The crew's efforts to gain access to the engine room end in Data's capture by the Borg and retreat.

5.1.2.1 Original soundtrack

The suspense of when or what exactly the crew might find in Enterprise's corridors is reflected in two rhythmical patterns (in irregular metres), which engage in a game of call and response and which are supported by soft woodwinds and low brass (threat). When the crew encounters the first signs of

the Borg having infiltrated the ship, the orchestration subtly changes to darker woodwinds, strings and falling brass glissandi.

The cue is briefly interrupted when Lt. Worf encounters the doctor who had to flee sickbay, but is picked up again when Picard carefully searches through the corridors. As soon as Picard sees the Borg, the cue changes to a higher key, implying a stronger urge to the situation, but still leaving enough space for punctuating sound design to additionally heighten the tension before finally stating the Borg theme.

The Borg theme is heard for a second time when both sides meet in front of main engineering. When the Enterprise crew fails to gain access to main engineering, a mixture of Borg motifs and *STFC* action motifs signal their retreat. By now, Picard and his men have to fight their way out, not without Data being captured and losing crew members to the Borg.

5.1.2.2 Sound-based approach

The material for the sound-based composition has been conceived similarly to the intro: the beat (7/4 metre), programmed in *Ableton Live*, uses percussive sounds to push the action forward. It is enriched with fragments of processed recordings of various moving objects (e.g. stone rolling down a pipe) or the previously used servo-motor sounds.

Short snippets from these recordings had been selected in *Ableton Live*'s sample player *Simpler* and were then modified with the software's filters, resonance and saturation parameter. Each snippet was part of a *drum rack*

and could be followed by an additional chain of plugins to further shape the sound and disguise—or distort—the original audio file (see Figure 8).

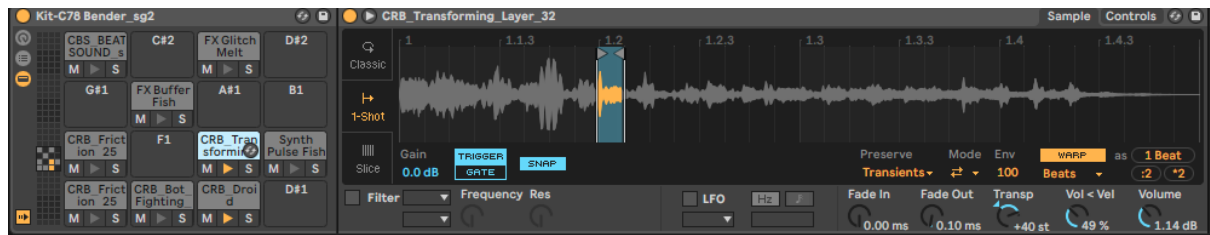


Figure 8: Motorised sounds in Ableton Live's drum rack using Simpler for STFC.

In order to quickly create rhythmical material but to allow a flexibility at later stages, LFO modulation was put to the test (i.e. *Poliverse's Gatekeeper*⁷² and *XferRecords's LFOTool*⁷³).

Gatekeeper (see Figure 9) showed more strength and produced better sounding results with more impact. Sadly, although the plugin was run at the same tempo as the session, the resulting audio tended to drift out of sync after approximately two bars. The time saved through the use of plugins was lost to extra editing necessary to fit the material back into the session's tempo. Although, at times this drift also produced an interesting polyrhythm—technically, when layered with pre-existing material the score developed into a polymetre—adding to the confusion of an imminent fight.

⁷² <https://polyversemusic.com/products/gatekeeper/>; accessed: 15.12.2019.

⁷³ <https://xferrecords.com/products/lfo-tool/>; accessed: 15.12.2019.



Figure 9: Polyverse Gatekeeper.

To conclude, *Simpler* in conjunction with *Ableton Live*'s drum rack has shown to be a valuable timesaver. It can be used to quickly generate snippets of beats which can be combined or re-cut at a later point in time in any DAW. Regrettably, similar drawbacks as with any other processed audio material applies: if the tempo track is altered after the fact, it is rather difficult and time consuming to modify the already processed audio clips. This leaves a composer at an inflexible and time-consuming disadvantage.

That the results of processed audio can be rather difficult to predict can be considered another weakness to the approach of manipulating recorded audio material. This is also the reason that a lot of acousmatic music composers produce a sizable sound library of processed source material before they start composing. Having to generate a new and suitable sound library able to perform according to the needed specifications of the project is a time-

consuming work, but time constraints and tight deadlines (often) prohibit the creation of extensive sound libraries.

Additionally, the library has to be ready and the composer has to be familiar with its intricacies at the start of the project. This also means that a detailed documentation (i.e. database) is needed for each piece of processed audio to allow quick retrieval and use. Documentation possibly also need to entail how to reproduce a processed sound in case ex-post alterations need to be carried out.

Furthermore, gestures cannot (necessarily) be processed into the audio edits as the tempo of the desired or needed movement will either not be known or might need to be flexible in case of changes (or adjustments/edits) of the video material.

Lastly, it has to be taken into consideration that the rest of the soundtrack (sound design and dialogue) has a strong influence on the perceived tempo and timing and finally on the tempo of the musical material usable for the film score

5.1.3 Data and the Borg Queen

After Data's capture by the Borg, he is introduced to the Borg queen, a new figure in the *Star Trek* universe. The queen's appearance, compared to the rest of the Borg, shows her as an at least partial individual, who directs and leads the collective.

Having reactivated Data's emotion chip and deepening his ability to feel human emotions, she has also added human skin to his cybernetic body. Mocking his futile and feeble attempts in copying human behaviour, she tries to tempt him to join the collective.

The scene ends in the ultimate trial for an android who just started exploring emotions: a romantic kiss between the queen and Data.

5.1.3.1 Original soundtrack

Musically the encounter between both cybernetic entities is introduced in dissonant horn and string clusters before the theme changes into a subtle string arrangement, enriched with alto flute runs climbing in pitch and seductively implying romance, substantiating the moment of the kiss.

5.1.3.2 Sound-based approach

The sound-based music has been created using parts of the intro's ominous soundscapes supplemented with short, almost randomly triggered sound snippets and fragments of percussive servo-motor rhythms, which are reinforced with buzzing delay lines (e.g. using multi-tap delay plugins) and some added reverberation for the tails to smoothen and blur transitions between the fragments.

The wave-like rise and fall of melodic elements and brief bursts of rhythmic components supplemented with these subtle delays suggest an audible

translation to the queen's probing of Data's intentions and will, challenging his integrity and the loyalty to Picard and the Enterprise crew.

5.1.4 Fight to destroy the dish section of the Enterprise

Captain Picard, Lt. Worf and one more crewman try to prevent the Borg from using the reflector dish of the Enterprise to send a request for reinforcements to the Borg in the future.

5.1.4.1 Original soundtrack

Goldsmith extensively wove the Borg motif into this scene. While the crew cautiously engages with the Borg, the score probes the situation in fragments, leaving enough space to intersperse sound design. The cue craftily plays to the different tempi of the picture edits and the action with the help of piano, string and brass drones.

A high-pitched string drone in decrescendo slowly takes over, and while it feels like the music itself is holding its breath, the audience is left wondering if the Borg still manage to turn their luck before the drone morphs into the pulsing sound of the dish. At the scene's climax (the release of the clamps holding the dish) the harmony follows the emotional state of the Borg, contributing to their consternation and last hopeless attempts to finish their beacon.

A perplexed Queen has to confess to have failed in their attempt when Lt. Worf destroys the beacon and the score rather abruptly cuts to heroic music.

5.1.4.2 Sound-based approach

It was possible to reuse some of the previously programmed drum grooves including a few subtle changes. A different plugin chain to change the beat's urgency for its final mix was also added. Although the latter option provided a quickly produced, compelling and steady rhythm, it also showed similar disadvantages as before:

1. Less flexibility for unobtrusive metre or tempo changes.
2. Difficulty to obtain essential gaps for the integration of sound design elements present in the picture while still composing a rhythm which makes sense or does not feel too scatty.
3. Difficulty to accommodate minor deviations in level of excitement of the narrative, because a steady rhythm can be too rigid and deviations too obvious.
4. Limitation posed on *Ableton Live* in re-wire mode.

Especially sad for this scene is, that possibly a lack of experience in sound-based composition practice limited a successful reflection on the scene. It was difficult to follow the action more closely, respectively heightening the threat for the crew, which led to an insufficient result when compared to the initial idea for the replacement cue.

As a conclusion, the translation of this particular piece did not meet the expectations of the author of this thesis to successfully translate the score into a unified soundtrack. It was decided to attempt a different approach for the next scene/film.

5.1.5 Argument between Lily and Captain Picard

When it seemed likely that the ship is lost to the Borg, Lily confronts a reluctant and revengeful Picard to abandon and destroy the Enterprise.

5.1.5.1 Original soundtrack

The dialogue opens being carried by the sound of the spaceship alone. Only when Lily compares Picard to captain *Ahab*⁷⁴ and Picard erupts in an angry and hateful monologue, fragments of the original theme appear in a counterpoint of woodwinds and horns. The excerpts are supplemented by a string drone in minor.

Simultaneously with his raving monologue the score slowly builds up, adding more strings and woodwinds until Picard revengefully confesses 'to make them pay for what they have done'—somewhat implying a 'to me'. When Picard smashes his gun into the cabinet, the cue stops to leave space for the shattering of glass—and possibly his desire for revenge.

Lily, completely unimpressed by Picard's action, calls him *Ahab* again before she realises the change in his attitude. Accompanied by an oboe, melancholically portraying his feelings of sadness and possibly remorse about the whole situation, Picard has a change of heart: his expression and attitude have softened when he recites the conclusive lines to *Moby Dick*. A surprised Lily confesses that she had never read the book and Picard, finally recognising the impossibility of their position, gives the orders to abandon ship.

⁷⁴ See: Herman Melville, *Moby Dick* (1851).

5.1.5.2 Sound-based approach

This scene's mood is shaped by the intro's mysterious but slightly hopeful soundscape-motifs, combined with glitched fragments of rhythmical metal sounds. The soundscapes add an essential amount of ambiguity to the discussion between Picard and Lily, vaguely allowing a proposition of a yet undecided Picard, simultaneously suggesting that Lily might still be able to change his orders.

The sparsely distributed metal hints at Picard's anger and irreconcilability without interfering with the dialogue. The sounding interventions were carefully stabilised with help of Zynaptiq's plugin *Morph* (see Figure 10), a flexible, clean morphing tool smoothly 'transitioning' in a balanced equilibrium between the rhythmical succession of motor sounds and a sparkling soundscape.



Figure 10: Zynaptiq Morph.

5.1.6 Conclusions

The film score to *STFC* was among the first attempts in this portfolio at applying sound-based music composition techniques to entertainment film. The

originally envisioned conceptual idea for the music was unfortunately not successfully translated into the soundtrack. The reasons for the desirable result could be:

1. Lack of a separate sound design track and time constraints on the creation of a new one; alternatively, limitations on successfully separating either sound design or dialogue from the existing cue.
2. Limitations in the currently available technology. For example, plugin to work with gestures within a DAW; timing issues in re-wire mode; technical limitations of available audio plugins; etc.
3. Limitations imposed and dictated by the chosen working environment. For example, *Pro Tools 12* and its—compared to other DAWs—underdeveloped MIDI abilities; automation cannot be applied when working with *Pro Tools 12's AudioSuite* (offline processing); sound files combining into gestures can be grouped but might better be rendered because of data-loss when these files are ungrouped again; etc.
4. Knowledge gaps in the toolbox of the composer in respect to technology facilitating the CPU heavy workflow of underscoring for film as well as the practical translation of ideas into a score.

To conclude, it might have been more practical—and possibly less time consuming—to create the sound design first, outlining the most important hit points. Secondly, it is advantageous to be clear about and set a fixed tempo track including metre changes first. It seems that only then can a score be derived so that a unified soundtrack can emerge from its individual components.

Unfortunately, at that stage of education as an acousmatic music composer, any material conceived sounded closer to *mickey-mousing*, respectively too literal, which rather suggested the genre of 'musical' instead of science fiction. Hence, for *STFC* is it inconclusive if the score could have been more integrated with the sound design.

5.2 Dawn of the Planet of the Apes (DoPoA)

Dawn of the Planet of the Apes (*DoPoA*) is part of a series of science fiction films revolving around humanity fighting for survival after having devastated the planet by handling technology irresponsibly. In case of the remake, the handling and ethics of biotechnology are questioned. *DoPoA* picks up after the spread of a virus, just before the first encounter with intelligent and empowered apes who are about to become the new ruling species.

5.2.1 Titles and introduction

The introduction to *DoPoA* is a brief summary of what had happened after and since the end of the prequel *Rise of the Planet of the Apes* (2011), when a virus escaped from a laboratory and decimated the human population.

5.2.1.1 *Original soundtrack*

The intro is a recapitulation of the prequel's (*Rise of the Planet of the Apes*; 2011). Its score, written by Michael Giacchino, strives to emotionally enrich the story with a feeling of intense sadness, desperation and hopelessness.

Before voiceovers slowly take over and dominate the narrative, the intro's theme, initially carried by a lonely piano, begins synchronised with the pictures. The transition between emotionally narrating music establishes itself when double basses merge with a low helicopter sound at similar frequencies and evolve into a low drone resembling a harmonic basis for the further development of the music. For the following repetition of the theme, the piano moves into a lower register, making space for the voiceover and a fade in of soft, high pitched but dissonant string clusters. A subtly and slowly added female choir enhances the main theme before the midrange is gradually filled with the rest of the orchestra's violins, playing a delicate and uneasy dissonance in long sostenuti.

While the visuals demonstrate more and more of the chaos breaking out, sound design elements increase in density and violent content as well. Slowly the cities' lights fade and at the desolate climax, darkness envelops humanity's fight for survival when the final reporter states, that 'soon there won't be anyone left'. The last repetition of the theme—again in solo piano—is, after a first statement, taken over by string orchestra and a glissando played by conch shells, when the title fades in.

5.2.1.2 Sound-based approach

The summarising intro with its succinct edits facilitates a similar approach for a sound-based score: concise sound design and affective music to complete the narrative visuals and the witnessing of unfolding events. *DoPoA*'s intro seemed the perfect first example for an adaptation of sound-based music for an entertainment film.

Similarly to *STFC*, the original 5.1 soundtrack had been recorded from the DVD with help of a multichannel audio interface enabling the extraction of the dialogue from the centre channel—the traditional carrier channel for the dialogues. In modern mixes, the score is generally sent to the surrounds, but unfortunately spill can be heard in the centre channel especially from applied reverberation. Since traces of sound design were also found in the centre channel the dialogue had to undergo an extensive clean-up procedure and some postproduction in order to be usable for the re-scoring process.

Izotope RX7 noise reduction tools and (by now) *Steinberg Spectralayers* were used to reduce unwanted sounds and music, leaving only a few artefacts which were hidden as much as possible in the new sound-based cue.

After this, a mixed methods approach to the recreation of the soundtrack was chosen: first dialogue, then ambiance and then the sound design for the moments attracting most attention, such as impact sounds or explosions. Subsequently the rest of the sound design and other details were added to smoothen the flow of the story.

Taking care of important parts of the narrative first and so establishing the mood provides a general feeling for and of the scene, eventually facilitating the process of composing music.

The re-creation of the intro was mixed in 5.1 surround as this is the current cinema standard⁷⁵. The atmosphere tracks were sent to all four surround channels to engulf the audience in a complete emotional experience. These atmospheric tracks, i.e. fireworks, reactor alarm and airplane flyovers⁷⁶, hold intrinsic pitches which could easily be re-purposed to function as source material for pitched sound-based music composition.

The material for the musical sound design was first cleaned up and then processed either with simple, customised tools programmed in *Supercollider* or VST plugins loaded into *Pro Tools 12* (in this case, mainly time and pitch shift plugins). The results were then spliced up and loaded into *Native Instrument's* sampler player *Kontakt 5*, which enables a user to custom design a playable keyboard instrument from a recorded sound.

Two sample instruments were built for the intro: one playing 'aircrafts' and another for the ticking of a clock. The instruments were then performed live to the visuals in regards to timing and pitch. Being able to play the sounds with help of a MIDI controller offers an improvement over the earlier taken copy/paste approach.

⁷⁵ It has to be noted, that it was also the author's first exploration in mixing in surround.

⁷⁶ All mentioned sounds were taken from the author's own sound library or programmed in *SuperCollider*. Only animal sounds were downloaded from the online library freesound.org.

Since samples when spread out over the keyboard detune relative to their original pitch, processed airplane sounds had to additionally be varied in pitch and speed to diversify the visible plane sounds as well as to simplify the creation of melodies with *NI Kontakt 5*.

5.2.2 Hunting and returning home

Accompanied by a thunderclap, Caesar's face appears out of the darkness left by the titles. What at first appears like the conclusion of the final days of mankind shows to be an interesting twist to the original of 1968: instead of apes having taken over the leadership of the planet and hunting humans, a deer hunt is launched, introducing Caesar, his (reckless) son and Koba, Caesar's right hand who cannot forgive how humans had treated him.

5.2.2.1 Original soundtrack

The hunting scene opens with thunder and rain in the forest, and clearly audible breathing and communication sounds of the apes. From this ambience emerges a female choir in a threatening, Ligeti-style tone cluster before a mysterious alto flute and occasional drum hits join the music. Supported by a crescendo in the choir the tension builds up until a timpani/bass drum roll and a brief final, orchestral crescendo together with Caesar's signal (a scream) releases the tension and begins the hunt.

Caesar's scream transforms into a choir in agony (still in Ligeti-style), which, especially without any added sound design, transforms the scene into a nightmarish event. With deer desperately running away, reality slowly returns with the slow fade in of sound design in form of trampling deer hooves.

When the apes corner their prey, typical Hollywood action score takes over: action strings (in triplet subdivision) supported by sustained brass and blended with timpani accents. The orchestral outro with a rather long fade out played in the high register of the violins holds the tension—expressing, that the danger might not be over yet. However, the music has faded when Caesar's son secretly sneaks away to engage the deer himself. The score only re-joins—with a long, dissonant glissando in the strings—when Caesar encounters the bear.

The music returns to a currently typical action score (albeit at a faster tempo) when Koba hurries to help Cesar against the bear.

5.2.2.2 Sound-based approach

The remake attempts to catch the same mysterious setting in the forest. Combined with a cluster of 'grinding' sounds (pebble rolling down a pipe, processed with banks of resonators), which swell and subside, the tension builds up to the moment when Caesar opens the hunt. At this moment,

rhythmical clusters derived from firework recordings⁷⁷ take over in a 5/4 rhythm, which interspersed with metre changes and breaks, follow the action.

Since *Pro Tools 12* is rather limited when working with MIDI, it was decided to utilise *Ableton Live* in re-wire mode again (for a discussion see *STFC*). The slices cut by an adjustable amplitude threshold in its sample player *Simpler* can then be performed live to picture or programmed in *Ableton Live*'s key editor, ultimately resulting in MIDI messages which can be easily configurable at a later point. To transform the originally real-world sounds even more, and to bring out their musical qualities, the results from *Simpler* were further modified with help of *Ableton Live* plugins (in this case *Resonator*) or after being re-wired into *Pro Tools 12* with an external plugin (here: *Izotope Trash*; a guitar amp simulator with a flexible, built-in impulse response tool).

After the underlying percussion was fixed, additional fine tuning of the audio was carried out using saturation and compression, and in order to provide some extra—evolving—tension, a multi-tap delay plugin was programmed with help of automation so that the delay lines produced a pulsating pattern.

The background soundscapes were derived from the same source material (fireworks and fire), using extreme feedback of convolution and algorithmic reverbs when set to 100% wet.

⁷⁷ Similar to treatments of music for *STFC*, the recordings were processed—this time with resonator banks—and slaved into *Pro Tools 12* as MIDI messages sent from *Ableton Live*.

To conclude, the generation of sound material was far easier and faster than for all of *STFC*. Utilising *Ableton Live*'s powerful MIDI capabilities allowed for a quick construction of sound-based musical material in the target language of film music. The processed results could also easily be placed in context or, surprisingly with only slight edits, effortlessly fitted in unintended or unexpected places.

However, now a practical knowledge gap in regards to dramatic underscoring became apparent. The arising situation was twofold: (a) how to adequately represent the desired mood and (b) how to heighten the emotional expression of the score. It seemed that electronically derived material still lacks a certain depth of emotional expression and so—possibly also because the music has to carry more of the emotional weight in a film with even less dialogue but heavy focus on character development—the predicament of processed music 'sounding too perfect' combined with a flawless technological execution, made the cue feel slightly sterile and cold.

Possible solutions for this drawback could be as simple as applying a more dynamic mix or finding a suitable tool that imprints its own colouring while it processes a sound (e.g. saturation, soft clipping, adding a little bit of reverberation, etc. or stronger colourations such as GRM Tools or Max/MSP). If the colour of the tool/plugin could be mapped to a certain type of emotion, the process itself could become an aural, emotional identifier.

Another practical workaround is to side-chain a gate to a (target) sound which exhibits the missing frequencies. The target sound receives the trigger for the gate from the (rhythmical) source patch, which misses the frequencies. In

this way, whenever the source sound opens the gate, the target sound is triggered and supplements the existing source sound. When carefully blended, both sounds can merge and complement each other.

A further disadvantage encountered during the composition of the cue is a thinning of the frequency spectrum when sounds are processed. Depending on the used process, sounds seem to lose either high frequency content or their ability to express 'weight'—speculatively, an issue caused by phase shifting. Especially with less weight and so impact, a sound is deprived of its strength to convey emotional depth. Sounds then have to be doubled and carefully re-balanced.

5.2.3 Conversation between Malcolm and Ellie

Malcolm and Ellie discuss the danger of going to the forest to negotiate with the apes while taking Carver, who had shot one of the apes. Malcolm collects a few belongings to take with him while Ellie points out the foolishness of his attempt to get permission to enter ape territory to repair the dam.

Malcolm eventually leaves to the mountains and enters the ape village.

5.2.3.1 Original soundtrack

The score in this scene is a reprise of the intro's theme and chords structure, both of which appear similarly scarce and open, tastefully leaving space for the dialogue. The piano is again the featured instrument, projecting an overall

feeling of sadness and melancholy about the deaths of so many people, but also a hint of hope to being able to communicate with Caesar.

When the music changes its mood, Giacchino focuses the audience's attention on the relationship between Malcolm and Ellie. Soft strings and clarinets introduce the delicate mixture of attraction and worry about the group's chances of survival under the circumstances. The orchestration makes subtle and efficient use of instrumental colours and their underlying emotional suggestions—at the same time, continuously and rather directly implying the mood as if pushing for an emotional reaction.

The music ends the scene in an almost typically operatic statement, consisting of a *sostenuto* in low strings, a plucked harp and a final bass drum hit which morphs into the thunderclap of the following scene—leaving the audience with a statement of 'this is it'.

5.2.3.2 Sound-based approach

The sound-based score begins with an evolving soundscape, supplemented with high pitched, glass-like and floating tones. Detached from substantiated reality the combination of both sound worlds suggests the hopes and ambitions of Malcolm and Ellie as well as an unpredictable future. A multi-tap delay plugin has been automated for this scene to allow the slow unfolding of a pulsating rhythm.

The pulse is meant to resemble Malcolm's steadfast decision to drive to the forest, gamble with a fateful encounter and uncertain but consequential

negotiations. The accompanying soundscape reflects on the pivotal emotion of hope in the yet uncharted outcome.

The sounds had originally been conceived as part of the processed material for the previous scene, but was—as mentioned earlier in the text—with minor adjustments, flexible enough to fit in various other places.

5.2.4 In the forest and meeting Caesar

The subsequent scene is the narrative follow-up of Malcolm's and Elli's conversation: a group of humans under the leadership of Malcolm drive to the forest where they hope to find Caesar for the deciding negotiations to get the permission to access the dam for repairs. Only Malcolm walks into the forest to find Caesar while the rest of the group anxiously awaits his return.

5.2.4.1 Original soundtrack

The scene begins with realistic sound design: rain, motor, tire sounds and the movement of wiper blades. Only after Malcolm leaves the car the music anticipates his astonishment of first traces of ape culture as well as his anxiety before the first encounter.

Once the music sets in, the original score changes between two chordal swells (orchestrated in the extremes of lowest brass and highest strings), while the sound design continues to remind the audience of the forest setting and

rain: creaking trees and heavy rain drops resonate with a ghostly environment until Malcolm stands in front of the gateway to the ape's village.

At this point sound design again has the lead at first until extremely subtle vocals (the same as in the opening hunt) begin to supplement the tense situation. More and more apes appear and break out in screams, announcing the human intruder. Accompanied by toms and timpani Malcolm, now a captive, is steered towards Caesar by apprehensive apes.

5.2.4.2 Sound-based approach

The soundscapes from the previous scene are being extended and expanded on. Automation on additional plugins is used to evolve the otherwise static soundscapes and so to maintain the tension during Malcolm's walk through the forest. When Malcolm hesitates at the gate, greeted by the first ape, the soundscapes slowly morph into an aggressive pulsating, randomly panned rhythm reminiscent of a Karplus-Strong string synthesis. The rhythmical soundscape together with its continuous crescendo (until Malcolm is thrown in front of Caesar) proposes that everyone's nerves are strained.

5.2.5 'Human work'—discussion between Koba and Caesar

Koba, Caesar's right hand, had suffered intensely through humans and the way he was treated as a test object in the laboratory. Unable to forget—or to forgive—he reminds Caesar of human's untrustworthy character.

It is a short scene with an underlying emotion of deep hatred and a minor threat of attempting to dethrone Caesar for trusting humans.

5.2.5.1 Original soundtrack

Ambience sounds of crickets and fire accompany this scene. Only at the end chords in high strings help to transition to the next scene.

5.2.5.2 Sound-based approach

Koba repeats the words 'human work' four times—each time getting angrier about Caesar considering peace with humans—before the communication changes to sign language, leaving the stage for the cue to fill-in the brief power struggle between Caesar and his trusted second in command.

The scene lent itself well to re-apply the siren sound from the intro. This time the sound was pitch shifted into a rather low register and sent to the subwoofer. The siren glissandi continue to rise and fall similarly to the body language of both apes—just like Caesar's expression translates to power and leadership and Koba's relates to anger and submission.

The pulsating electronic bass sounds are further supported by a medium high-pitched soundscape, again derived from a pebble rolling down a pipe. The soundscape is meant to represent the imminent danger for humans when Koba strongly questions his leader's judgement to trust instead of immediately waging a war against the humans.

5.2.6 Caesar shot

Caesar is shot by Koba who disguises and blames the deed on humans by conveniently presenting a 'human gun' as proof.

The scene is the turning point for the narrative: together with his accomplices, a vengeful Koba manages to successfully convince the rest of the village that Caesar's supposed death and the subsequent fire ravaging the village had been initiated by humans. While angry apes are rushing towards the city to lead a pre-emptive attack, the camera zooms out on a persuasive Koba, slowly turning Caesar's son against his father's vision of peace between apes and humans.

5.2.6.1 Original soundtrack

The score develops from subtle string and mallet accompaniment in quarter note pulsation, before the mallets are taken over by tubular bell hits and supplemented with a sixteenth notes rhythm in the toms. Both help the rest of the score to accelerate and push the tension forward.

A short orchestral crescendo announces the following danger before a rising string glissando—in typical tension underscoring—takes over to accompany a Koba, pointing a weapon at his leader and shoots. The shot echoes alone in the dark at first until tubular bells and a bass drum take over to seal Caesar's fate: he falls off the tree and apes break out in confused screams.

The bass drum continues to provide an unrelenting beat before dissonant brass-swells (in extreme low and extreme high registers) convey the apes' rising anger caused by confusion and fear.

After Maurice (the orangutan) tells the humans to run, the theme reserved to represent the aggression of the apes and for fights, is played in full. The CD, where the score can be appreciated in more detail lists the title as '*Monkey See, Monkey Coup*'. This piece of score is a perfect example of film music disappearing in the chaos represented through the sound design.

When Koba picks up Caesar's devastated son, clustered vocals slowly fade in until they dominate the score and the images—chaos in the ape village, devastation about the loss of leader and home and an anticipation of further human decline.

5.2.6.2 Sound-based approach

The introduction to the scene was approached similarly to the original: a pitch-bent sound, enriched with threatening low-frequency rumble, introduces the deed. The leading sound element was derived from an extensively in length and character edited siren sound. In order to match the new setting to the timeline, one of *Pro Tools 12*'s pitch- and time-shifting tools was applied for quick manipulation. The DAW's pitch-shifting plugins are powerful for sound design post-production, but unfortunately restrictive when used in a more musical setting, where often rather extreme settings lead to undesirable artefacts.

Using a sample player to pitch shift the audio by assigning one sample to a large number of keys might be too inflexible. In *Kontakt 5*, any audio derived from extreme stretching begins to sound similar after a certain threshold is reached.

Furthermore, the siren sound had been conceived with an aliasing sawtooth generator, which when further processed, adds even more aliasing to the waveform. In the context of the intro these artefacts were almost inaudible and on the contrary, even desirable as they added an extra feeling of grit to the character of the sound. However, in this scene, the artefacts derived from further processing of the audio file became audible and posed a hindrance to their further use.

In order to keep a consistent sound language for the film, it was decided to not generate new material from a different waveform, but instead to clean up the audio with help of an EQ.

After completing the introductory sound, this scene became a cause of struggle. The search for the most suitable tool to express the mood and changes in emotions showed difficult, but since *Ableton Live* had been used to compose the music for the hunting scene, it seemed logical to continue with the same instruments and to improve on them.

Eventually, two more sample instruments were conceived from fireworks and gunshots. Both sounds by themselves could already be impactful percussive instruments when used as supplementing part to a percussion section, but in a sampler, they became even more powerful. Here it was

possible to easily tune their pitch and flexibly play or program a score. Unfortunately, it was difficult to blend the sample instruments after all: the formant structures deviated too much when played somewhat further away from their root pitch, and from a harmonic point of view, the material did not want to blend well.

Since it was attempted to keep the remake of the score within the realm of established film music language, it became clearer over time that it would be prudent to embrace the already existing and proven harmonic language even more. For this purpose, convolution tools were chosen to provide a practical solution. In this way, harmonic content derived from pad sounds could be imprinted on sound objects either functioning as impulse responses (IRs) or become the base material for resonant bodies. Any sound-based source material could immediately be harmonically matched to previously processed results.

To manipulate audio with help of IRs, *Ajax Sound Studio Cecilia*, *AudioEase Altiverb 7* and *Izotope Trash* were tested. The tonal centre for the new material derived from fireworks and tractor sounds revolved around the pitch cluster f, fb, ab and bb. After adding reverberation and subtly including a comb-filter effect with help of a return bus, the resulting sounds indeed exhibited the desired darkness and even some eeriness.

Having found a solution to keep the harmonic content consistent, the issue how to best generate gestures in accord with a timeline, which ideally and in addition is flexible as long as possible to accommodate the common last-minute changes in picture edits. *Cecilia* and *Clutter* had already been identified as pliable tools to quickly produce gestural sound material, but both programs are still at a disadvantage insofar that they can neither be run from within a DAW nor linked to a DAW's timeline.

With no other means to easily and quickly manufacture gestures in tempo with the scene, Bernard Hermann's style of composing a film score from smallest units proposed to be a solution. Similar to Lego blocks, the score could either be combined manually (see *STFC*) or the blocks could be triggered with help of a sample player. In case of *DoPoA Kontakt 5* and *Ableton Live Simpler* were utilised.

Short motifs or gestures have the advantage of holding an innate tempo which can even be different from the tempo of the scene. This attribute allows these small units to be a flexible and valuable alternative. These can be played over a drone, suggesting the tempo of the scene while adding or embellishing musical and emotional comments. Of course, it has to be considered, that composing a possible 'polytempo' might steer the audience in a different direction of interpreting the mood (e.g. confusion, chaos, disorder, messiness).



Figure 11: Pro Tools 12 track template example.

Finally, any creation of additional material (or instrument) at this stage had to be woven into earlier pieces, as otherwise the rest of the soundtrack would have ended in a disjoint collection of different colours and instrumentation. To allow for a quick mix of old and new material, an interesting alternative solution (even to convolution) was explored: project-based, user defined plugin chains (*track templates* in *Pro Tools 12*; see Figure 11).

Having a plugin chain in place and allowing it to be triggered by either an ambient sound with distinct impacts (i.e. fireworks) or a rhythmical beat seemed by far an easier and quicker way to generate fitting material. Although plugin chains are heavy on the computer's processing power, the bonuses of a preserved tone colour and especially flexibility to tempo changes offers major advantages.

In this case, the resulting effects-chains only needed some extra grit, achieved through the automation of intensity of a bit crusher plugin, slowly reducing the amount of resolution and so adding to the tension of the music.

5.2.7 Conclusions

It was perceived that this film was slightly easier to score. Firstly, ambience tracks, dialogue and partially also foley tracks had been in place before the composition process was initiated. Second, the emotions were slightly easier to

deduct and so also to score. Third, the ability to re-wire *Ableton Live* into *Pro Tools 12* has indeed positively facilitated the composition process, allowing the use of comparably more elaborate and easier programmable MIDI tools. Hence, especially rhythmical parts were generated quickly once a tempo had been established. Fourth, many sounds for the film have been conceived using *Cecilia*, *Clutter* and convolution tools such as *Trash* or *Altiverb 7* before being further refined with saturation or bit crushing plugins. Sounds and gestures after having been rhythmically conceived had an innate tempo, which unfortunately often resulted in many of the them dictating the tempo of a scene—and subsequently also follow-up scenes. On the upside, these sounds turned into flexibly interchangeable building-blocks throughout the whole film. Fifth, track templates (i.e. effects chains) are a welcome breakthrough. Effects chains render hard-processing effects into the audio unnecessary and on the contrary, allow for flexible changes until a scene has indeed been locked. Track templates led to an almost desperately sought after, fluid and efficient workflow in *Pro Tools 12*. Additionally, track templates become a form of detailed documentation of the composition process, saving valuable time wasted on documenting process chains. Unfortunately, running many tracks filled with plugins has the tendency to drain computer power. *Multi effect plugins*⁷⁸ functioning as racks for several plugins for the same software manufacturer can be practical alternatives.

⁷⁸ E.g. MeldaProduction *MXXX*, Native Instruments *Guitar Rig*, Soundtoys *Effect Rack*.

Finally, the translation of emotions into electronic music was still perceived as delicate. This might have been because the author of this thesis still perceives executions of electronic music sounding too perfectly and missing a human factor (imperfections, deviations in timing and movement, etc.).

Secondly, having available sound design and dialogue tracks readily available, together with a definite decision about tempo and clarity about mood for each scene, does have a major influence on the final solutions and compositions. Evolving, gesture-like motifs can then be composed against a timeline more easily.

5.3 Gravity

Gravity is the third film chosen to be partially re-scored to test the viability of sound-based music as score. The film was selected because of its modern and unorthodox soundtrack, validating a film shot and edited in such a way to lend itself perfectly for an unconventional approach to its film score.

The film concerns itself with the problematic situation around pollution and trash in space, and the from it arising difficulties for humanity and space travel.

Director Alfonso Cuarón wanted space to be as silent as it is by physical laws. All audible sounds and communication, experienced through radio transmissions, are heard only as tactile sensations from or through the astronaut's point of view the same way they would experience the sounds in outer space.

From this departure point, Cuarón explicitly instructed the sound crew to create a soundtrack close to reality. His decision, that the audience can only hear what an astronaut would be able to hear, technically also implied the eschewal of non-diegetic music. Practically, a film score is of course present in a Hollywood film and in this case, has taken over from sound design, mainly representing Dr Ryan Stone's emotions.

Additionally, the composer Steven Price was asked not to use any of the typical Hollywood underscoring conventions, which disqualified the use of action drums or percussion. Fortunately, he had approximately one year to experiment and find a new voice to score the action.

Price took his inspiration from the approach of the sound design crew. The latter mainly used pick-up and piezo microphones during production to capture sounds inside the astronauts' suits and to recreate the intimacy of their emotions when confined to smallest spaces. Consequently, he recorded orchestral instruments and manipulated these in the computer.

The final compositions were then panned and moved with or around the protagonists relative to their space—clashing from different directions at the audience and disorienting the listener to the same extent an astronaut in the situation would have been.

For the rescoring of *Gravity* the process of composing was initially approached in reverse: the music was conceived first and was even meant to stand on its own. However, it was quickly concluded that the otherwise silent visuals in combination with the sound-based score rather resembled a music

video of two people floating through space instead of an action film filled with suspense and threat.

While the carefully devised rescored music worked nicely with the images, it did not reflect the mood expressed through the dialogue. Additionally, the dialogue changed the tempo and experience of the scenes. Whereas the version solely based on a film score demonstrated a vastness of space, the inclusion of dialogue catapulted the visuals back into the genre of action film which seemed to demand a focus only reached through action-based underscoring. Hence, the dialogue, which could this time not be extracted from the centre channel, was rerecorded and mixed into the soundtrack to provide an indication of the narrative before eventually continuing with the cue as and where needed.

5.3.1 Titles

Gravity's opening title is made up of a few lines, which put the unfolding narrative into context: in space there is no oxygen to carry sound and therefore constitutes an inhospitable place for humans.

5.3.1.1 Original soundtrack

The accompanying score and sound design are short and concise, too: a blend of fast passing-by objects and an aggressive movement of air from what could be considered the re-entry sound, paired with an indication of the main

motifs (voice, strings, braam⁷⁹ as well as pulsating sounds) accompanied by a long, increasing in intensity glissando merging into a sucking sound only to end abruptly in the same emptiness as space.

5.3.1.2 Sound-based approach

The intro for *Gravity*'s remake was energetically following the outline of the original: a crescendo drone composed of sound design elements accompanying the introductory text and leading towards a perceived climax in form of immediate silence. The drone as well as motif are subtle variations of the cue repurposed from the landing scene at the end.

The musical elements were conceived from processed glass sounds; the sound design elements are processed sounds of a fire extinguisher and gunshots with some rumble in the lower frequency spectrum.

5.3.2 Space travel & Arrival at the ISS

After the space shuttle was hit by debris, Dr Stone and Mission Commander Kowalski assess the situation and attempt to reach the International Space Station (ISS) to use its shuttle to return to Earth. During their spacewalk Kowalski engages Dr Stone in conversation to ensure her survival, reminding her of why

⁷⁹ Braam: a term derived from its sound. A blend of low brass instruments, played as sforzando, stabbing sounds. At first introduced in trailers, braam sounds became famous through their extensive use in *Inception* (Nolan, 2010).

she would not want to give up. His probing results in Dr Stone sharing the event of how she lost her daughter.

When Kowalski recounts his good news/bad news story to entertain Dr Stone, the oxygen alarm goes off, signalling that the tank is running low. Their attempt to reach the ISS develops into a struggle, during which only Dr Stone manages to get hold of the station. Inertia pulls both out into space and Kowalski sacrifices his life.

5.3.2.1 Original soundtrack

For the long journey to the ISS, Kowalski plays country music ('*Angels are hard to find*', Hank Jr Williams, originally 1974) from within his spacesuit.

When Kowalski begins probing Dr Stone about her personal background, a synth pad slowly fades in. The country music abruptly stops when Dr Stone begins to recount the story of her daughter's tragic death. Stone's theme (cello and processed orchestral sounds) takes over to disclose her the pain of her inner world.

When the astronauts hit the ISS, the cue—as generally all the impact scenes—is dominated by pulsating soundscapes and *braam* type of sounds. The cue seems to adapt its tempo to the stress levels and the tempo of probably Dr Stone's heartbeat.

Just before Kowalski sacrifices his life to rescue Dr Stone, the cue changes its intensity. Action strings evolve into a melancholic string arrangement, which

takes the lead in the moment of loss, before a subtle mix of electronic and organic score returns Dr Stone to the ISS and Kowalski drifts away.

5.3.2.2 Sound-based approach

Sound-based music might not focus the attention of the viewer in particularly one direction. Instead it might leave a necessary space for a feeling—in this case of isolation in the vastness of space—to become a personal experience. In an attempt to leave exactly this emotional experience-space for an audience, sounds had been chosen which could potentially be found on a space station (e.g. metal, aluminium, cans) or which might represent the shattering of dreams and hopes (e.g. glass). The idea was to spark an association of the sounds' implications and so, to allow for an emotional connection with the storyline. Additionally, these sounds could potentially be used to morph between the film score and sound design.

In order to balance the inorganic sounds, a female singer was recorded performing the tones of a_b , e_b , d_b and b_b in a high register with a flexible microtonal intonation around the respective tonal centres. These recordings were then processed and layered.

Subsequently more motifs and themes were derived, resulting in a composition closer to an acousmatic music approach, but also in a rather dense film score. In case of a complete film, the score would have to be somewhat sparser in the use of motivic material to allow moments of breathing for the music and of course, the necessary space for possible sound design.

The scene itself can be split into three parts: a transition after the first impact, both astronauts travelling through space and finally them reaching the ISS from where they hope to be able to return to Earth.

The sound-based music of the first third of the scene still reflects on the past event of the impact and the shock and emotions both astronauts must presumably go through. At first the cue is dominated by processed vocal tone clusters, which unstably revolve around their centre. After the astronauts depart on their journey, more and more elements of sound-based scoring is gradually introduced, slowly taking over while the astronauts travel through space.

The journey through space is split into the segments: at first, soft, slow soundscapes represent the inner calmness of Mission Commander Kowalski after which processed glass sounds take over to depict Dr Stone's inner world.

The third section returns to vocal tone clusters. This time blended with sound-based material which also drives and merges with the action. Enriched with some impact sounds and in synchronisation with several edits in the images, the sound-based material provided enough tension to rhythmically support the action. This was also the first incident where sound-based events could possibly be identified as sound design.

The scene in which Kowalski decides to sacrifice his life was originally difficult to score. In typical Hollywood films strings take over to play the emotion. Extensive electronic manipulation of glass partially resulted in sounds resembling high pitched strings or their flageolets. When these sounds were

mixed in an such a way as to increase and decrease in intensity (like a succession of crescendi and decrescendi), the section began to mimic a living organism's slow, rhythmical breathing.

Two points of critique have crystallised from this attempt to rescore with sound-based music: (a) the score was lacking in emotional range, which seems to be oscillating between an average, while Hollywood style music is able to successfully trigger a full range of emotions. It is speculated that this could possibly be overcome with a different mix, which similarly to Hollywood music focuses on strongly emphasising the dynamic as well as the frequency range of the score. (b) As discussed earlier, the sound-based score potentially suggests sound design and leads to confusion or misinterpretation.

5.3.3 Conversation between Dr Stone and Kowalski

This scene plays inside the Soyuz capsule after Dr Stone escapes from the ISS. In her imagination Kowalski returns, who confronts her with her two options: fight and go back to earth or let go and die.

5.3.3.1 Original soundtrack

The scene opens with a similar soundscape as the intro (long glissando as a crescendo towards the moment when Kowalski opens the hatch). With him

being, the country music can be heard again—although this time, somewhat far away.

When Kowalski begins to shut down the systems and explains how easy it is to let go, the cue returns to Dr Stone's melancholic motif (glass-harmonica and cello) before sound design and reality take over again and Dr Stone wakes up to finally fight for her survival.

5.3.3.2 Sound-based approach

Similar to the original, the sound-based score reuses elements from the intro (soundscape-like motif) combined with motifs used for Dr Stone in the second scene.

The motifs are used to represent her state of being dazed and their rhythmical arrangement provides a feeling of tempo and urgency. Additional processed glass motifs symbolise Dr Stones' shattered and confused state of mind and the descending but short low-frequency sinewave glissandi illustrate her readiness to let go and accept her fate.

5.3.4 Escape to Earth

Dr Stones manages to reach the Chinese space station where she takes an escape pod to finally return to earth.

5.3.4.1 *Original soundtrack*

Her flight to the Chinese station is again accompanied by pulsating, almost braam-like sounds, processed or synthesised pads, strings and this time also a hopeful rendering of a choir.

Once inside the escape pod, sound design originally takes over, before pulsating strings combined with pulsating synthetic soundscapes support the sound design, symbolically suggesting the urgency and threat of the situation.

When Dr Stone reaches out to contact Houston, the cue changes to resemble a hopeful outcome: unison strings and choir announce her successful return.

5.3.4.2 *Sound-based approach*

The sound-based score for the scene was again sourced from motifs of the second scene, which were either reused in their original state or further processed with the help of plugins or plugin chains (see track template; **Error! Reference source not found.**).

As demonstrated earlier, tools such as *XFer LFOtool*, *Polyverse Gatekeeper* or *MeldaProduction MWobblerMB* (see Figure 12 and Figure 13) or *MRhythmizerMB* generate rhythmical gestures and movement in a soundscape, which can add the necessary feeling of tension to the music. Including these tools with modified and time-variable automation data on the track, the composer is able to add subtle variations and adjust necessary changes to further heighten tension in the visuals.



Figure 12: MeldaProduction MWoblerMB.



Figure 13: MeldaProduction MWoblerMB, modulator 1 example settings.

Some of the constructed motifs started showing stronger colourations from several instances of processing and required treatment to remove their revealing nature. *Zynaptiq Unfilter* (see Figure 14) has proven a suitable tool to add clarity and remove the muddiness. Alternatively, saturation was added for

more brightness and definition. Several of the soundscapes needed phase decorrelation in order not to collapse the surround image. However, at times the careful application of EQ was enough to fix issues for either of the cases.



Figure 14: Zynaptiq Unfilter.

5.3.5 Conclusions

A proof of viability of sound-based scoring was meant to be achieved through the rescoring process of selective scenes. Since the original outline of the research was aimed at slightly different goals, a development of motivic material over the total span of a film was considered only late in the research. By this time the idea of leitmotifs from 'concrete' material had to unfortunately be neglected. Still, while the motivic material in *Gravity* does not necessarily develop in the traditional sense, it has shown that the initially conceived motifs could be suitably adapted and adjusted to other scenes.

Furthermore, compared to *STFC* with motifs composed from tiny events, *Gravity's* motifs were medium sized sound fragments, much easier and more

intuitive to handle in the workflow. Eventually it was also easier to reuse and move the motifs around the film to form the final score.

Constructing a custom instrument in *Kontakt 5* might have led to a quickly usable composition tool, but in case of *Gravity* with its comparatively larger motifs, this solution felt creatively constricting. Imitating a melody conceived though the piano roll would have sounded displaced. Pitch shifting the derived motifs seemed more intuitive and showed indeed more practical for these kinds of sounds.

All in all, the sound-based compositions for *Gravity* seem to generally satisfy the testing criteria while effectively conveying and reflecting on the action, tension/suspension and emotion/mood of the scenes. For a successful score the sound-based score might be too dense at this point, however. This could prove rather disadvantageous once a sound design track has been reinstated. Especially in the last scene (return to Earth) the sound-based score might overlap with much of the actual sound design resulting in a cacophony of sounds or it could lead to misinterpretations in regards to the intended meaning.

5.4 After-thought: the mix

When the topic for the research was conceived, the impact of surround sound on the composition of film music was still in its early stages. Live diffusion as practiced in the acousmatic music genre was mainly a performance of

moving sound around a concert space and less of a playback of a fixed medium. Discussing the influence a surround mix has for the conception and so the perception of sound-based music seemed to exceed the scope of this thesis. However, during the composition process it became clear that a score in stereo does not have the necessary space to unfold and demonstrate the same emotional depth as a score mixed in surround. The consequences for the composition—because of spatially positioning and spatial mixing—were far more influential than anticipated, and it might even be possible to infer that the spatial mix can be considered another effective sound-based music composition tool. Since these findings became apparent only late in the research a change in direction would have meant a different focus and specialisation for the researcher.

For future research into this area it is worth noting that sound-based sources can be somewhat richer in their total frequency spectrum which threatens to disqualify their usage in the fight for the already limited (stereo) frequency space. Exact spatial mixing and the availability of more than two channels empowers each sound event to be heard clearly—without interference or detriment on their or a dialogue's intelligibility. Subsequently Kerin's (2011) deduction can be confirmed and surround has entitled sound design to depict film space as a new hyper-reality.

6 Conclusions and Future Research

6.1 The research questions

The initial questions to identify roadblocks for the practical implementation of sound-based music in Hollywood style films could be resolved as follows. First, the style of sound-based music can be found in the role and functionality of sound design but not music in several instances. The reasons can be identified in the original definitions and roles of film sound design versus film music, the ways in which either was technically implemented and possibly also in the risk-averse industry and brand Hollywood represents.

Second, tastes and aesthetics are constantly changing. An exposure to and approval of varied electronic music and the popularity of trailer music has already led to changes in the scoring practice. However, it seems that sound-based music, because of its long-standing application as sound design, might need support from traditional scoring/instrumentation practices in order to be fully understood as music in the context of a blockbuster sci-fi.

The practical research questions could be resolved as follows: eventually all sounds could be considered equal in their ability to be used or function in a musical application in the filmic context, and a distinction between musical instrument and a common sound might be (a) an aesthetical choice or (b) a for a given context rather a practical definition. This thesis considers all sounds from which musical qualities or parameters can be extracted as practically usable to compose music for film. However, it has to be noted that the thesis'

focus has been on sounds recorded from objects which are not traditionally considered musical instruments (this in opposition to synthesised sounds, especially the ones aiming at the representation of known instrumental sounds).

Sounds can be practically applied as musical instruments if an intentional representation/meaning or emotion suitable musical parameter for the context can be extracted and expressed. Additionally, it seems practical if the results of the processed sounds demonstrate an ability to (harmonically) blend with supplemental sound material.

The only difference between sound applied in the role of sound design versus music seems the focus on the musicality of the sound-based source material as well as an intention to apply the sound in a musical role. Film time plays an important role in this case insofar as past and current examples of music based on sounds has mainly been applied rhythmically with a need for mentioned film time to unfold and be heard and interpreted in its new context. An additional disadvantage seems the need to actively discern the sound as music, which requires a revised approach to reading a film and its meaning. On the other hand, sound-based music can easily be adjusted with help of convolution and resonant filters for example. Since the use of the existing language of film music has shown valuable for understanding and its facilitation, it seems fitting to apply convolution to shape the sound of an object and morph it into musically harmonic material.

Sound-based music can lead to misunderstandings and it can do so especially in cultural circles not accustomed to the language of Hollywood blockbuster films or circles not familiar with the specific genre of sci-fi. The distinction between music and sound (design) in film seems foremost a practical one: music has been defined as the carrier of abstract emotion or fantasy, while sound design has been considered carrier of concrete information and reality. This is indeed a disputable distinction (sound can very well be a carrier of abstract emotion; e.g. sounds which are not visible or not in sync with the picture but providing a vivid impression of emotional content; hyper-realism). However, the focal point is the intention of a sound's application and the level of abstraction from its semantic meaning: is the sound a provider of information or the mediator of an abstract concept/emotion? As such, the sound of an object can be manipulated to express the necessary musicality and so the limitations can and have to be overcome during the process of composing the score, respectively when designing the new instruments. This means that sound-based source material has to be evaluated according to its emotional content and expression in a similar way as the currently applied orchestral colours of note-based music. The exact mapping of sound-based music qualities to emotions has been identified as part of a future research.

In a practical sense, the sound-based source material has to be shaped through a fixation and expression of musical parameters into a sound which will be recognisable in a musical manner. These newly derived sounds could refresh the known and clichéd sound palette and even become a signature

sound for a composer. Furthermore, they might even offer alternatives for an intricate but flexible way to tell a story.

Computer technology has changed rapidly in the last thirty years and many new tools are available to the composer. For example, it is no longer necessary to study music programming languages or own large, expensive main frames to process sounds to such a degree that they become unrecognisable from their source. Sounds can successfully and easily be processed with the plugins available in a DAW.

Time is of importance when working in the media industry. Sound-based music's practical usability depends on the level and depth of disguise needed for the sound to clearly work as music. Of course, a sound could also be applied in its raw format by extracting its musical qualities. However, in these cases the sound source/object is still recognisable and so can again become the possibly unintended identifier of a semantic meaning. On the other hand, applying session or style templates or plugin-chain templates might overcome the disadvantage of the time-consuming design of sounds and/or new instruments.

Furthermore, it has been found that the creation of performed gestures within DAWs to a timeline can still be considered an issue. This situation becomes especially apparent when the film is still edited: gestures can be adapted only with difficulty or result in time consuming tasks. The same is true

for the ex-post modification of harmonic or pitched audio material or MIDI information after the material has been committed/rendered.

This thesis is focusing on sound-based or acousmatic music, which since its inception has evolved into a style applying elaborate and intricate processing techniques to sound material⁸⁰. While popular electronic music has been borrowing many concepts from acousmatic music, Hollywood, apart from sound design and trailer music, seems to have—at least to some extent—neglected this style and its composition tools for scores. First and foremost, Hollywood is an industry with an established system, workflows and large investments bound to ROI. Investors and production companies hold-on to tradition and proven concepts, and unions protect financial interests of their members.

Furthermore, a possible acceptance of acousmatic or sound-based music might depend on the familiarity of a broad audience with the music style. Applying concepts of film music as a language and simply replacing old sounds with new sounds instead of additionally introducing a new way of understanding and interpreting the new sound world might facilitate approval and quick adoption. A further proof of this idea is the fact that a change in acceptance is already on the way through exposure of young audiences to

⁸⁰ Synthesised or synthesiser music has been applied in Hollywood from the mid-1970s onwards, but is not part of this research.

contemporary electronic music artists, who apply acousmatic music concepts in their music.

6.2 Summary

This research originated as the desire to conceive a score for (science fiction) entertainment film from exclusively sound recordings, which can possibly even be used by the sound design department to construct the story world. After an initial study of what is considered *musique concrète*/acousmatic music, it seemed that the style and its compositional source material could indeed lend itself to become a score for a blockbuster film.

Composing film music from sources which are not traditionally considered to be music instruments has resulted in a fertile and interesting sound-world for science fiction. However, its use has also proven partially impractical in the context of blockbuster films because of a potential to cause misunderstandings when a sound's intended role as music is misread or misinterpreted.

The concept of acousmatic music revolves around the idea of reduced listening: acknowledging the possibility of the object's recognition but exclusively focusing on its aural qualities. This requires a semantic decoupling, which, for several reasons, has proven rather difficult if not impossible. Biology might prohibit a type of listening for sounds which are unknown or if the

combination of a visible source and its sound are incongruent. Particularly in the context of blockbuster films, sounds (in or out of synch with images) will automatically trigger the brain to search for meaning. Furthermore, reduced listening is a learnt skill, opposing purely entertainment films as a medium for which the understanding of combined visuals and sounds needs to be a quick and preferably entail a passive decoding—ideally also without raising an awareness of film's artifice.

Initially all source material for the portfolio compositions was meant to stem from exclusively recorded, sound-based sources which could as well be part of the sound design. This restriction excluded objects falling into the category of 'traditional instruments'⁸¹. In an attempt to prevent unintended misinterpretations of recognisable source material, all audio was (heavily) processed. The loss of frequency content through the manipulation of the audio material was counterbalanced through the reintroduction of previously excluded sound sources (i.e. synthesised sounds demonstrating a clear overtone series and so possibly falling into the categorisation of 'traditional instruments').

Drawing from its semantic role in the context of film, music is meant to be the carrier of emotion. It is not bound to concrete ideas but instead can be constructed in such a way as to represent abstract concepts. While sounds not

⁸¹ Percussion instruments, having become a standard instrument in a 21st century orchestra, would fall into this categorisation as well.

stemming from what is traditionally considered a music instrument can as well be expressions of emotion, the sounds of objects have generally been reserved for a depiction of reality-space. However, in the context of acousmatic music, these objects' sounds can be transformed to such a degree that their semantic meaning is at a minimum disguised or at a maximum completely removed. Theoretically this enables any sound to become a carrier of an abstract concept as a traditional music instrument would be.

Structuring these sounds into performable tools redefines them into a 'music instrument'. These new instruments offer hitherto unheard, fresh and individual sound worlds which can become distinct for a composer (or sound designer) and even lead to a signature sound. At a minimum, the new sounds could counteract the clichéd application to emotions or atmospheres and instead provide new representations. Finding the most suitable aural qualities and extracting these from the sound of an object for later assembly or performance is the task for the 'instrument designer'. Recent developments in digital technology provide a wide range of possibilities to do exactly this: design instruments from objects which are/were previously not considered usable in a musical context.

The landscape of available technology to shape the spectromorphological content of a sound of any given object in order to promote its musical parameters has changed radically in the last few decades. Still, few tools have been integrated or can be wired into DAWs, because music styles based on spectromorphology are less occupied with the strict

adherence to rhythm or a timeline. A lack in the ability to flexibly compose a timed gesture which can adhere to the ex-ante edits of the images has been identified. The creation of a gestural motif can still be difficult against the backdrop of a timeline which perpetually changes throughout post-production. As a result, any adjustments after their initial introduction become time consuming exercises.

To fit the criterion of applicability in the existing language of film music, new instruments from objects would ideally satisfy existing principles of traditional music instruments. The ease of using an already existing language—as well as the advantage of its acceptance by a large audience—has become obvious during the work on the example films and additionally justifies the utilisation of existing harmonic and melodic systems. An ability to be tuned and express a moderately clear pitch to facilitate horizontal combinations (harmony) and vertical progressions (melody) is a requirement.

Designing instruments and their corresponding sound libraries can become a labour- and time-intensive task. Although the colouring caused by the processing tool is predictable, the outcome of running an algorithm on audio material can be rather unpredictable.

Tight deadlines in the entertainment industry would prevent a composer from having enough time to experiment with or even collect and refine a database from the material. In the hands of one person alone this might become an impossible task to handle. This implies that if a composer does not

wish to miss out on a custom-tailored sound library a personal sound designer would need to be employed. But not only the expenditure of time to design a unique sound library might become a disadvantage; the composer will need time to familiarise themselves with the library and the corresponding interface—at least suitably well—to compose music for the atmosphere or desired emotion.

Additionally, there is a notion shared with several audio engineers in the industry that digital (versus analogue) audio still exhibits a limited emotional warmth or depth. Acousmatic music, by definition a digital medium, additionally seems to rather emphasise an intellectual comprehension—the opposite purpose of film music, which aims to speak to instincts and emotions. With an overly perfectionistic cleanliness and perfectionism electronic music can be bestowed with an artifice and coldness, which seems to easier be applied to suggestions of threat and horror or the 'coldness' of machines and logic⁸². More research will be necessary to facilitate and implement an organic and natural flow in reproducible gestures and textures⁸³, which might promote a connection to natural motion and phenomena.

The practical work on the films revealed that for this type of music it would be advisable to have access to the dialogue as well as the sound design track.

⁸² Even after decades of developments, Bebe Baron's experienced difficulties to create a love theme from electronic/processed sounds still seems to ring true for EA composers.

⁸³ For example, the theory relating to 'mirror neurons'.

Without either there is a danger of (a) the music doubling what is already expressed in the rest of the soundtrack or (b) the score eventually is not leaving enough space for other elements of the soundtrack or (c) the film transforming into (an introspective) music video with a different expression than action.

Furthermore, the work on the portfolio has validated existing, time-saving workflows already applied by film composers. Firstly, deciding on a tempo (i.e. tempo tracks) and secondly, using 'instrument' templates instead of starting from scratch does save time and can additionally compensate for the time which is lost to the creation of a project's custom-tailored sound libraries. On the other hand, 'orchestral templates' might need to rather be grouped into 'sound' or 'motivic templates' in the case of acousmatic music.

Finally, examining Hollywood's production structures and business culture, it seems counterproductive to attempt to invent a new musical language while at the same time replacing the established language of film music. Instead, it seems more practical to adjust and incorporate acousmatic music composition methods to the traditional musical language of film. Firstly, film music—or generally narrative styles—are already efficient in their use of musical codes and audiences, exposed to film music as a language throughout the last century has developed an intuitive understanding of these musical codes. Secondly, a continuous exposure to—and so familiarity with—popular and electronic music has promoted a change in the perception of music in the media. The general population seems to already have begun to acknowledge and embrace sounds which were considered noise a mere

hundred years ago. A cinema-goer of the 21st century might be more accommodating towards new sound worlds once they are incorporated. An integration of more and more sound-based (i.e. sample-based) music in advertisement, games and in several contemporary film scores⁸⁴ demonstrates that Hollywood's industry has already started opening-up to new influences mediated by technological opportunity. The trend is further accelerated through cheaply and easily accessible tools which can flexibly and quickly process audio material. Now it is a matter of (creative) application and of integration into current film scoring practice.

6.3 Future research

At the outset of the study the topic of (spatial) mixing was not included because all works were meant to be delivered in stereo. However, during the research phase the surround format Dolby Atmos gained in popularity and eventually streaming services began requesting their deliverables to be mixed in surround formats as well. While the practical implementation of up and down-mixes into the various formats and standards is still causing problems in the industry, and a uniform playback cannot be guaranteed, it still seemed prudent to at least get some experience in the practicality of surround mixing and explore possible consequences of surround mixes have on the music itself.

⁸⁴ See scores by the late Jóhann Gunnar Jóhannsson for example.

The research into acousmatic music practice has demonstrated the importance of spatilisation in the field—although, the file format mostly ‘diffused’ live into a multi-channel array of speakers is stereo.

During the composition process it has also become evident that a higher number of channels provides more available space for a sound to exist and be heard without any interferences from other sounds or even phase cancellation issues. This enables it to aid to a clarity in narrative. A sound can also be positioned more precisely if desired as well as it has more available space to move in a clearly perceivable trajectory. Finally, multi-channel formats leave necessary space for the dialogue track to be heard clearly. The repercussions for the composer are significant in so far that the mix can become the decisive factor influencing the emotional perception and the impact of the music. This is of consequence given that the composer normally has little influence on the final mix of the soundtrack.

All emerging implementations and developments of Dolby ATMOS and surround sound as applied to blockbuster films point at the experienced 3D-audio-space as an important research field in the near future.

Additionally, the following research topics are proposed to efficiently adapt acousmatic music composition tools and concepts for film music:

- (a) Facilitation or development of missing tools and repeatable workflows for the:
 - Quick creation of unique and interesting sound material and its adaption to different pitches while conforming to the applied tuning system and audio quality.

- Flexible generation of (possibly extreme) gestures to a time line within a DAW (performability as well as composition of possibly gestures without creating audible artefacts but which can still be changed in the case of late picture edits).
 - Performability of newly generated audio material.
- (b) Thorough exploration of thematic and motivic development derived from sound-based material over the duration of a complete film.
- (c) Mapping of musical parameters in their ability to raise a distinct emotion and the following re-mapping to sound processing techniques, respectively acousmatic music composition tools.
- (d) Database system for quick retrieval of processed or generated material/motifs/themes.
- (e) Basic scoring and mixing templates adapted to acousmatic music tools and methods to at least allow consistency per scoring project.
- (f) Research on the (emotional) influence of spatial mixing with help of test audiences.

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Filmography

- 2001: A Space Odyssey (1968) Stanley Kubrik. Comp.: various.
- Alien (1979). Dir.: Ridley Scott. Comp.: Jerry Goldsmith.
- Blade Runner (1982). Dir.: Ridley Scott. Comp.: Vangelis.
- Dawn of the Planet of the Apes (2014). Dir.: Matt Reeves. Comp.: Michael Giacchino.
- Dr. Jekyll and Mr. Hyde (1931). Dir.: Rouben Mamoulian. Comp.: stock music (various).
- Forbidden Planet (1956). Dir.: Fred M. Wilcox. Comp.: Bebe and Louis Barron
- Gravity (2013). Dir.: Alfonso Cuarón. Comp.: Steven Price.
- Inception (2010). Dir.: Christopher Nolan. Comp.: Hans Zimmer.
- Interstellar (2014). Dir.: Christopher Nolan. Comp.: Hans Zimmer.
- Planet of the Apes (1968). Dir.: Franklin J. Schaffner. Comp.: Jerry Goldsmith
- Saving Private Ryan (1998). Dir: Steven Spielberg. Comp.: John Williams.
- Spellbound (1944). Dir. Alfred Hitchcock. Comp.: Miklos Rozsa.
- Star Trek First Contact (1996). Dir.: Jonathan Frakes. Comp.: Jerry Goldsmith and Joel Goldsmith.
- Star Trek—The Next Generation (1987-1994). Dir.: various. Comp.: various.
- Star Wars (1977). Dir: George Lucas. Comp.: John Williams.
- Terminator 1: The Terminator (1984). Dir. James Cameron. Comp.: Brad Fiedel.
- Terminator 2: Judgement Day (1991). Dir. James Cameron. Comp.: Brad Fiedel.
- Terminator 3: Rise of the machines (2003). Dir. Jonathan Mostow. Comp.: Marco Beltrami.
- The Birds (1963). Dir. Alfred Hitchcock. Comp.: Bernard Herrmann.
- The Dark Knight Rises (2012). Dir.: Christopher Nolan. Comp.: Hans Zimmer.
- The Day the Earth Stood Still (1951). Dir.: Robert Wise. Comp.: Bernard Herrmann.
- The Ghost and the Darkness (1996). Dir.: Stephen Hopkins. Comp.: Jerry Goldsmith.
- The Jetsons (1962, 1963). Dir.: various. Comp.: various.
- The Matrix (1999). Dir.: Lana and Lilly Wachowski. Comp.: Don Davis.
- The Matrix Reloaded (2003). Dir.: Lana and Lilly Wachowski. Comp.: Don Davis.

The Matrix Revolutions (2003) . Dir.: Lana and Lilly Wachowski. Comp.: Don Davis.