INTRODUCTORY MUSIC OF THE SKYWALKER SAGA CHARACTERS
GENDER AND CHARACTER TYPE IN MUSIC INFORMATION RETRIEVAL ANALYSIS

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Master's Thesis
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University of Jyväskylä
Spring 2023

UNIVERSITY OF JYVÄSKYLÄ

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Title Introductory music of the Skywalker Saga characters Gender and character type in Music Information Retrieval analysis	
Subject Musicology	Level Master's degree
Month and year February 2023	Number of pages 35

Abstract

The influence of entertainment is not one-dimensional: entertainment does not only portray, but also constructs reality. This influence is not always explicit, and this hidden power is where the importance of studying entertainment lies. The way music effects our perception of other stimuli and gives us additional in-formation about the events of the film can be similarly invisible. Music is shown to in-fluence an audience member's perception of the events of a multimedia piece, but the audience member is not always conscious of this effect, attributing their view to other aspects of the film. Information on how this hidden power might influence us is critical to our media literacy, both on an individual and societal level.

To add to the body of knowledge on these subjects, the research questions for this work were as follows: What differences are there in the musical features of the introductory music of characters of Star Wars films by gen-der? What differences are there in the musical features of the introductory music of characters of Star Wars films by the character's status as protagonist or antagonist?

To answer these questions, values for 10 features of 30 excerpts of music were extracted via the MIRtoolbox. The excerpts were 10-20 seconds in length, and linked to a character by identifying their cooccurrence with the visual introduction of the character or by a track or theme being named after the character. One way ANOVA was performed, supplemented by the non-parametric Kruskal-Wallis test as needed, to see whether the mean and standard deviation values of those features differed between excerpts associated with male and female characters and excerpts associated with protagonists and antagonists.

The results indicate that excerpts associated with female characters had lower global energy and roughness, i.e. "loudness" and "dissonance". Also the variance of these features within a track was lower in excerpts associated with female characters. This effect persisted also when the excerpts of antagonists were excluded from analysis. Additionally, in the condition of all excerpts included, there was less variance in pitch within an excerpt in excerpts associated with female characters. Regarding character type, the variance of pitches within a track was found to be lower excerpts associated with protagonists than antagonists, when all excerpts were included. When analysing only excerpts associated with male protagonists and antagonists, no such difference was found.

Keywords film music, soundtrack music, music and multimedia, gender, protagonist, antagonist

Depository University of Jyväskylä

Additional information

Tiedekunta Humanistis-yhteiskuntatieteellinen	Laitos Musiikin, taiteen ja kulttuurin tutkimuksen laitos
Tekijä Saana Sutinen	
Työn nimi Introductory music of the Skywalker Saga characters Gender and character type in Music Information Retrieval analysis Skywalker Saga -elokuvasarjan hahmojen esittelymusiikit Sukupuolen ja hahmotyypin vaikutus musiikin ominaisuuksiin MIR-analyysissa	
Oppiaine Musiikkitiede	Työn laji Pro gradu
Aika Helmikuu 2023	Sivumäärä 35

Tiivistelmä

Viihde paitsi kuvaa myös muovaa todellisuutta. Ilmiö ei usein ole eksplisiittinen ja tiedostettu, ja tämä piilotettu vaikuttaminen tekee viihteen tutkimisesta erityisen tärkeää. Musiikin vaikutus käsitykseemme multimediateoksesta kuten elokuvasta voi olla samalla lailla näkymätöntä. Musiikin on todettu vaikuttavan katsojan tulkintaan multimediateoksesta ilman, että katsoja itse osaa nimetä musiikkia tulkintaansa vaikuttaneeksi.

Medianlukutaito niin yksilön kuin yhteiskunnan tasolla tarvitsee tuekseen tietoa näistä vaikuttamisen mekanismeista. Tällaisen tiedon tuottaminen motivoi tämän tutkimuksen tekoa. Tutkimuskysymykset ovat: miten musiikin ominaisuudet eroavat mies- ja naispuolisten hahmojen esittelymusiikeissa? Miten musiikin ominaisuudet eroavat protagonistien ja antagonistien esittelymusiikeissa?

Kymmentä musiikin ominaisuutta tarkasteltiin 30 musiikkikatkelmassa. Eri musiikin ominaisuuksia kuvattiin numeerisilla arvoilla MIRtoolbox-ohjelman avustamana. Katkelmien kesto oli 10-20 sekuntia. Katkelmat olivat yhteydessä elokuvahahmoon joko esiintymällä elokuvassa samaan aikaan hahmon ensimmäisen esiintymisen kanssa, esiintymällä hahmon mukaan nimetyllä raidalla elokuvan soundtrackilla tai sisältämällä hahmon mukaan nimetyn teeman. Katkelmat jaettiin ryhmiin hahmon sukupuolen ja hahmotyyppi mukaan ja katkelmien musiikillisia ominaisuuksia kuvaavien arvojen hahmoryhmien keskiarvojen eroavaisuuksia testattiin yksisuuntaisella varianssianalyysilla (ANOVA) sekä tarvittaessa sen parametrittomalla vastineella (Kruskal-Wallisin testi).

Naispuolisiin hahmoihin liittyvissä katkelmissa äänen voimakkuus (global energy) ja dissonanssi (roughness) sekä näiden ominaisuuksien vaihtelu katkelman sisällä olivat keskimäärin matalampia. Tulokset olivat hyvin samankaltaisia kun kaikki katkelmat sisällytettiin analyysiin ja kun vain protagonisteihin liittyvät katkelmat analysoitiin. Tämän lisäksi, kun kaikki katkelmat analysoitiin, äänen korkeus vaihteli vähemmän naispuolisiin hahmoihin liittyvien katkelmien kuin miespuolisiin hahmoihin liittyvien katkelmien sisällä. Äänen korkeus vaihteli vähemmän myös protagonisteihin liittyvien kuin antogonisteihin liittyvien katkelmien sisällä kun kaikki katkelmat analysoitiin. Kun analyysiin sisällytettiin vain miespuolisiin hahmoihin liittyvät katkelmat, äänen korkeuden vaihtelussa katkelman sisällä ei havaittu eroja ryhmien välillä.

Asiasanat

film music, soundtrack music, music and multimedia, gender, protagonist, antagonist

Elokuvamusiikki, musiikki ja multimedia, elokuvahahmo, sukupuoli, protagonisti, antagonisti

Säilytyspaikka Jyväskylän yliopisto

Muita tietoja

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1 INTRODUCTION

The aim of this work is to study the musical structure of music on soundtracks to gain understanding into how music participates in the forming the identities of the characters of the film. Specifically, the way in which the musical features change according to whether the piece of music is connected to characters of different genders or different status as protagonists and antagonists is of interest.

The influence of entertainment is not one-dimensional: entertainment does not only portray, but also constructs reality. This influence is not always explicit, and this hidden power is where the importance of studying entertainment lies. (e.g. McClary 2002). Among other things, entertainment and specifically in this case film and film music shape our perception of gender and gender roles.

The way music effects our perception of other stimuli and gives us additional information about the events of the film can be similarly invisible. Music is shown to influence an audience member's perception of the events of a multimedia piece, but the audience member is not always conscious of this effect, attributing their view to other aspects of the film (Thompson et al. 1994; Bullerjahn & Güldering 1994). Information on how this hidden power might influence us is critical to our media literacy, both on an individual and societal level.

As film music studies in general, this present work draws from multiple related but different fields of research. In addition to music and cinema, among the sources there are viewpoints from the fields of critical studies on media and social sciences. Additionally, music information retrieval is utilised as a part of the analysis process, and comes with its own terminology and point of view. Each of these fields provides a different framework and vocabulary, with differing, often implicit views onto the epistemology and the ontology of music. As is the case in all science, it is likely that some degree of different views and use of terminology will have to be tolerated.

As James Buhler (2014b) suggests, in the 21st century film music might not be quite the neglected art that it was in Prendergast's view in 1992. It is, however, quite a young and niche field of systematic academic study, compared to its related fields of studying music and cinema. The study of film music can be expected to be influenced by and draw from these related fields, and so it is also important to note that all research and theory of a related field might not be useful or appropriate for studying film music. As Annabel

Cohen (2001, 250) points out, it is crucial to evaluate how "music-alone perspectives" work in the context of audio-visual mediums such as film.

The Skywalker Saga, i.e. the original, prequel and sequel trilogies of Star Wars and the whole Star Wars franchise are widely distributed globally. If the idea of the two-dimensional influence of entertainment is accepted, it means Star Wars has constructed the reality of millions. As music has been shown to shape the perception of the events of the piece of multimedia, the music John Williams composed for the films has shaped the events and characters of the film in ways often hidden from the consciousness of the audience member. In this kind of wide influence lies the interest and significance of studying mainstream multimedia.

2 LITERATURE REVIEW

In chapter 2.1, general film music theory as well as the role of music in a multimedia piece is discussed. When considering the influence of music on the perception of the multimedia piece, the viewpoints of emotion and narrative (or semantic) cueing seem to reoccur among sources. The same division is adopted in chapters 2.2 and 2.3, with the interplay of the two viewpoints discussed in chapter 2.4.

2.1 Film and soundtrack music theory

For their article, Annabel Cohen (2001) defines film as the "narrative dramas characteristic of movie theatres, television and video with which most people are familiar as a source of entertainment", and film music as the music that accompanies those narratives as intended by the makers. Gorbman (1987) introduces the concept of diegetic music, i.e. music within the film's universe that the characters can hear, and non-diegetic music, which is what is commonly thought of as the 'background music'.

Others have since addressed the diegetic divide critically. Lipscomb and Tolchinsky (2005) expand the definition. They propose that as the whole film soundtrack with the aspects that are traditionally considered non-music, such as sound effects and dialogue, diegetic and non-diegetic, is organised by a human, this whole auditory gestalt can be considered music. This viewpoint logically follows one of the most common definitions for music as sound organised by a human while challenging the traditional study of film music. (Lipscomb & Tolchinsky 2005.)

Winters (2010) points out the limits of the diegetic-non-diegetic divide, stating that as the concept of diegesis remains a complex and in many ways ambiguous subject, so does diegetic and non-diegetic music (Winters 2010, 224-225). As it can be argued that the film universe as the audience perceives it would not exist without the "non-diegetic" or background music and the information it provides, the term non-diegetic film music might not be a meaningful way to discuss film music (Winters 2010, 230). Winters also

quotes a view from Kassabian (2001, 42) that in categorising music by its diegetic status, music's role in producing the diegesis may get obscured.

While acknowledging the remaining degree of ambiguity and the limitations of the terminology, for the purposes of this work, the definitions of Gorbman (1987) and Cohen (2006) are applied. This is done firstly because it provides a meaningful way to categorise material, and secondly because the need for utilising computer assisted analysis is anticipated, which require music only audio to work in a meaningful way. Currently it seems that there is enough material in film soundtracks (the criteria for which is described in chapter 3.1.1) that can be categorised as non-diegetic, with exceptions or significantly ambiguous cases being rare enough for applying of this terminology to be appropriate. This will be re-evaluated if need arises at the later stages of the project.

The role and significance of music in cinema is under discussion in many sources. Some approach the issue via the axis of dominant and subordinate between picture and music (see e.g. Gorbman 1987; Prendergast 1992), while others discuss the possible functions of music in film. Both Cohen (2006) and Gorbman (1987) list different functions of film music (Gorbman also cited in Kassabian 2001, 40). If film music is defined as "music either directly composed or expressly chosen to accompany motion pictures" (Kalinak 2010, xiii), the traditional view of music as subordinate to picture (Goldmark et al. 2007, 2; Prendergast 1992) can be understood. This view puts soundtracks as an independent art form, as entities published as music-only albums, and concert versions of themes on soundtracks, in a peculiar place.

Cook (1998, 86) conceptualises this discussion in terms of viewing the music as constructing aspects of the film, including characters, rather than expressing things that are "already there". Buhler (2014a) notes that "the supplemental status of the soundtrack (and especially music) in much film theory has made it particularly susceptible to analysis based on gender". Gender, music and multimedia are further discussed in chapter 2.3.2.

2.1.1 The two-way impact of sound and picture

In their 2014 study, Costabile and Terman (2014) found music that's mood was congruent with the moving picture shown simultaneously to increase the audience member's transportation into the film's universe, as well as their film-relevant beliefs. Costabile and Terman propose that transportation might serve as an explanation for the increase of film-relevant beliefs. (Costabile & Terman 2014, 321-323.) Cohen also lists immersion as one of the functions of film music (Cohen 2001, 258). They also point out how it is curious that non-diegetic music, that is by definition not a part of the film's universe, seems to increase the sense of reality of that universe to the audience and not retract from it (Cohen 2001, 253).

Others have investigated the specific ways in which music might influence the perception of the audience. Thompson et al. (1994) found that the harmonic closure, i.e., ending on a tonic chord, made the ratings of experienced closure in the film higher among

their participants. When asked for reasoning for their rating, though, most participants attributed their decision to visual information and not the music, which suggests that the impact of music was implicit.

Bullerjahn and Güldering (1994) investigated the effect of music to perceptions of the content of the film, including emotional categories, genre and the protagonist's reasoning, by playing the same 10-minute clip with five different soundtracks to 400 participants. Their results indicated that music influenced their subjects' understanding of the plot and polarised the emotional atmosphere of the film for them. (Bullerjahn & Güldering 1994, 99, 116.) In their review of 24 different studies, among which were the work of Bullerjahn and Güldering (1994) along with Lipscomb and Tolchinsky (2005) and Prendergast (1992), Herget concludes that instrumental background music can convey information on a semantic level and therefore give extra information on the content of the film. This seems to happen more via associations that can be projected onto the film and thus influence the perception of the film. (Herget 2021, 22, 33-34.) The levels of emotional and semantic meaning are further discussed in following chapters.

This influence can also be seen in the other direction as well. Vuoskoski and Eerola (2015) found extramusical information to affect the emotions music induced in the listener. This study did not concern film music, but serves as a good reminder that the issue is more complex than merely music effecting the perception of the picture. Before a cinema-goer has heard a single note of the music of the film in question, they are likely to have some extra-musical information on the audio-visual piece they are about to see. (Vuoskoski & Eerola 2015.)

As seen in this chapter, research on the impact of music in multimedia (and vice versa) exists. However, while acknowledging that much of important groundwork has been done, Kassabian (2001) notes that there still are underanalysed aspects in this complex field (Kassabian 2001). Martin (2006) goes on to point out that while there is increasing knowledge of the mechanisms of multimedia, the power of music to manipulate cannot be assumed. Despite some effects being statistically visible, music can only facilitate certain effects in certain conditions, and does not lead to passive conformity (Martin 2006, 66, 70). This is congruent with the views of Herget presented above (Herget 2021, 22, 33-34).

2.2 Emotion in music and in film music

In the context of this thesis work, emotion might provide a way, additionally or as a primary framework, to word the effects of music. Investigating the emotions that music and multimedia either induce or are perceived to portray can be seen as one way of investigating the effects and power of music. Another possible framework is to approach the cues of film music from a semantic perspective, which will be further discussed in chapter 2.3.

2.2.1 Music and emotion research

Music and emotion is a vast and varied field of study. Only a small number of studies are discussed here.

Gabrielsson and Lindström (2001) approached the issue by an extensive review of studies on the impact on several structural elements of music, such as tempo, articulation, and melodic direction to emotional expression in music. They compiled the results into one table, and additionally placed the result in an adjective cluster circle model of Hevner (1936) (adapting the model from Farnsworth 1954, 98).

Sloboda and Juslin (2001) review different approaches to conceptualizing emotion. Hevner's model would fall into the first approach listed, the categorical approach. Of the next one, the dimensional approach, Russel's 1980 two-dimensional approach is one of the most researched, according to Sloboda and Juslin. (2010, 76-78). In Russel's model, emotions are placed on two axes, valence and activation (or arousal). It has since been critically evaluated and extended, for example by Thayer (1990), who expanded the model by dividing arousal into active and tense arousal. (Russel 1980; Sloboda & Juslin 2010, 76-78; Thayer 1990, 6-7.) Eerola (2011) investigated the reliance of such emotion models on musical genre by computer assisted analysis of musical features (see chapter 2.5).

2.2.2 Emotion and film music research

Both A.J. Cohen (2001) and Gorbman (1987) in their lists of the functions of film music list signifying emotion as one of them. Green (2010) calls this one of film music's most basic functions. Cohen goes as far as to state that based on the research reviewed in their article, music "provides one of the strongest sources of emotion in film" (Cohen 2001, 268), whereas Laurier et al. (2009, 263) describe film music as "music made to create emotions". Emotion words also come up in Tagg's visual-verbal associations (see 2.4.1 and Tagg 2006, 174-177). As the relationship of music and emotion has been widely researched also outside of the film music context (see 2.3.1), it could provide an angle with which to approach the implicit, abstract phenomenon of music in multimedia. Addressing emotion and film music directly, as mentioned in chapter 2.1.1, Bullerjahn and Güldering (1994) found that music affected the emotional atmosphere experienced by an audience member in a polarising way.

The ubiquity of film music was utilised in developing the Soundtrack110-dataset for studying music and emotion. Film music was chosen as it was deemed a relatively neutral stimulus stylistically, partly due to its assumed familiarity. Based on this familiarity, listening to these excerpts might induce "schematic memories". However, the specific excerpts they used were aimed to be unfamiliar to the listeners as to avoid "episodic memories" from the particular film the excerpt was from influencing the ratings of

emotions. (Eerola and Vuoskoski (2011, 23). Eerola and Vuoskoski (2011) used this stimulus to investigate two theoretical models for emotion, discrete emotions and the dimensional model discussed in the previous chapter, in the context of perceived emotions in music. Overall, they found high correspondence in ratings between the models, with the discrete model being less reliable when the excerpt was of an ambiguous emotion category. In addition to Eerola and Vuoskoski (2011), this dataset was employed also by Laurier et al. (2009) and Eerola et al. (2009) as well as Eerola (2011) (see chapter 2.5).

However, in their review of 24 empirical studies on film music, Herget also points out the ease of reducing music to its emotionalizing function, when the studies under review pointed also to the ability of instrumental film music to convey information on a semantic level (Herget 2021, 21-22).

2.3 Extramusical or narrative cues in film music

In addition to the conclusions of Herget (2021), many other authors discuss the semantic or narrative functions of film music. In their lists of functions of film music, both Cohen (2001) and Gorbman (1987) list narrative functions. Cohen mentions communicating meaning and furthering the narrative as the fifth and enabling symbolization of past and future events as the sixth function of film music (Cohen 2001, 258). Narrative cueing is the fourth function in Gorbman's (1987) lists and the communication of meaning is also discussed by Bullerjahn and Güldering (1994). This kind of semantic view to (film) music comes out in many sources. However, the field appears to be varied and an epistemological view, scientific tradition or explicit theoretical background in semantics is often hard to discern.

Wingstedt et al. also mention both conveying emotion and conveying information about the characters and situations as functions of film music (Wingstedt et al. 2010, 194-195). Based on their study they add the view that the "musical and visual expressions combine to form multimodal statements where the whole is certainly different than the sum of the parts" (Wingstedt et al. 2010, 193), which further illustrates the complex, multidirectional influences in multimedia.

In discussing film music's communicative function, Buhler (2014b) mentions the topic catalogues from the silent film era. In these codified manuals topics like locations or character attributes were described by either existing pieces of music or different attributes of music, such as meter or tempo. It is notable that these conventions seem to be somewhat arbitrary. The convention of their use and through that the audience's ability to recognise them seems to be more important than their accuracy.

In addition to utilising these conventions familiar to an audience, information might be conveyed by creating connections to previous events or themes (Green 2010, 83). One

technique popular in film music is the use of Leitmotif (see e.g. Gorbman 2000, Green 2010).

2.3.1 Leitmotif

The term Leitmotif, sometimes also seen in the German form Leitmotiv, refers to a practice of using a musical motif to refer to an aspect, for example character, place or event, of a dramatic work (Whittall 2001). It was first used in the context of Wagnerian opera, but is in wide use in contemporary art and literature, including film music and film music theory.

The concept of giving these kind semiotic cues or extramusical information predates the term Leitmotif and film as an art form. *Stile rappresantivo* emerged with the opera of Monteverdi at the turn of the 17th century, and means consciously "marking" or representing emotions with music. (See e.g. McClary 2002, 35). The existence of this kind of terminology points to a long-standing tradition of music carrying extra-musical meaning. In present day, as they might be named by the makers, Leitmotivs might serve as a reliable way to connect film music to a character or place.

2.3.2 Gender in music

Gender in music and in film or stage music seems to be most often approached by studied how women are portrayed. Susan McClary (2002) finds connections between low bass voice and the character being written as having a patriarchal authority position, and hesitant, unresolved melodies with a character of the shy maiden (McClary 2002, p. 44). It is notable that these connections exist not merely in the instrumentation, but in the register and the melodic structure of the music.

Tagg (2006) asked his subjects to imagine an image when music was played to them and describe the image. The associations the subjects voiced were then grouped. Tagg found that four of their eight test pieces were associated with femaleness and four with maleness, and the other descriptions given were very different between these groups. For example, the word "action" was associated exclusively with the pieces perceived male, and words like "sentimental", "kissing" and "harmonious" were associated exclusively with pieces perceived female. Tagg was also able to identify patterns in the musical structure of the pieces by these categories. For example, the pieces perceived male, in general, had a faster tempo, a shorter phrase length and a more angular, active bass line. Tagg also hypothesised some polarities of gender based on their other findings. Among them there are both things that can refer to structural attributes of music like fast male – slow female, dynamic male – static female, and things that are also referred to in emotion and music literature, such as active male – passive female and outwards male – inwards female. Some of these associations are also outright emotion words. (Tagg, 2006, 174-177.) Theoretically, Tagg's findings could also be investigated in the light of emotion and music research. Particularly interesting would be to place Tagg's findings of the emotion words associated with each genre on the dimensional models of Russel (1980) and Thayer

(1990). In examining the work of Tagg and Clarida (n.d., as cited in Kassabian 2001), Kassabian (2001, 18-20) also notices the exclusiveness of visual-verbal associations of music to gender.

Buhler (2014a, 367) discusses the practice of the "love theme" doubling as a female protagonist's theme. This practice can be argued to enforce the function of a female protagonist as the object of love to the male protagonist, thus centring the male protagonist.

While the studies described above show that it is possible to refer to stereotypical male or female behaviour (which the expression of emotion also is), it is notable that referring to the concept gender itself seems to be very difficult if not impossible. Buhler (2014a) is considering to which extent the soundtrack is enforcing the currently dominant cisgender, heterosexual discourse. Many studies reviewed here do operate within a very strict, exclusionary gender binary that often goes undiscussed. In addition to the soundtracks, a question of to which extent film music and music research does the same is prompted.

2.3.3 Antagonists and other ways of Othering

Here and after a character's status as protagonist or antagonist is referred to as character type. According to literature, music can also be used to convey information on character type. Green (2010) mentions specifically leitmotifs as important to defining and distinguishing a character. Quoting Scheurer (2008, 121), they describe the function of villain music as filling us (the viewer) with unease. The score, identifying and amplifying the character's drive and motivation, identifies the heroes and villains. (Green 2010, 89.)

Regarding the way in which the identification might be made, Buhler (2014b) refers to the extramusical connotations of certain kinds of music and instruments. The "othering" made in this way can, as Buhler argues, be traced back to colonial practices and stereotyping of non-European peoples. Buhler quotes composer Dimitri Tiomkin in 1951 saying he used a timpani beat to signify "Redmen being on the warpath", referring to a portrayal of native Americans. In addition to describing the adversarial nature of the antagonist, music is also used to clearly mark the antagonist as the "other" in a way that is understandable to a mainstream audience and not by music that would in any way be authentic to the real-life counterparts of the characters on screen. (Buhler 2014b, 211-213.) Gorbman (2000, 235) also recognises the stereotypical "Indian" music as repetitive pattern of four beats, the first one accented, on a drum. Gorbman traces this practice to European and later American practices in representing peoples seen as "primitive or exotic" as early as the late 18th century (Gorbman 2002, 236).

Scheurer (2008, 121) also recognises the use of rhythm and percussions as one of the conventions in scoring villains. Some other such conventions are discussed, such as minor-centred harmony, dissonant intervals in melody and a low register (Scheurer 2008, 120-121). Dissonant intervals in the melody are also mentioned by Kalinak (1992, 63) as a feature of villains' music.

In an intersection of the functions of conveying emotion and narrative cueing, the emotion of fear might be used as a narrative cue for a character's villainhood. Music might be used to amplify the threatening, scary atmosphere (see e.g. Bullerjahn & Güldering 1994).

2.4 Intersections and interplay of the two functions

While the divisions of the functions of film music can be helpful in organising information, none of them can be expected to be comprehensive of a very complex phenomenon. Ultimately any such division is somewhat artificial and can obscure other viewpoints if used as a sole framework. The different functions can interplay in complex ways that are hard to describe explicitly. For example, signifying emotion via music can be seen as a narrative cue itself. For example, sad music might build appropriate atmosphere for a scene, and communicate the gravity of the situation from a character's perspective. The aforementioned gesturing to the emotion of fear in music which might serve as a narrative cue for villainhood is another example of such overlap in the functions.

2.5 Audio analysis and Music Information Retrieval

Music Information Retrieval (MIR) is a multidisciplinary research area that is, broadly, concerned with managing vast collections of music and musical material (Futrelle and Downie 2002). In addition to research, MIR has many commercial applications, such as the recommendation systems used by streaming services such as Spotify and Deezer (Scheld et al. 2014, 129) and scanning and converting physical sheet music into digital scores (Burgoyne et al. 2015, 260). In addition to images of sheet music, MIR input can be symbolic formats such as MIDI, audio signal or different types of metadata, such as descriptions of music in catalogues or web pages (Burgoyne et al. 2015, 260; Scheld et al. 2014, 128).

An example of symbolic format MIR input, Luck et al. (2008) investigated the relationship between the emotional ratings and musical features of excerpts of music therapy improvisations on MIDI keyboards. Combinations of musical features extracted via the MIDI Toolbox (Eerola & Toiviainen, 2004) accounted for between 57 and 84 percent of the variance in participants' ratings of three dimensions (activity, pleasantness and strength) (Luck et al. 2008).

The Music Information Retrieval toolbox (henceforth referred to as the MIRtoolbox) for Matlab is concerned with the audio signal. It is a computational environment for musical feature extraction designed for both novice and expert users. It encompasses around 50 feature extractors and statistical descriptions. Most features can be decomposed into

temporal windows or ”frames”, the default length and overlap of which is set individually. (see Lartillot, Toiviainen & Eerola 2008; Lartillot, Eerola, Toiviainen & Fornari 2008.)

Music Information Retrieval has been established as a tool in music and emotion research. As mentioned in chapter 2.2.1, Eerola (2011) investigated the effect of dimensional emotion models on musical genre. Extracting features via the MIRtoolbox, they analysed the music of nine separate datasets (one of them being the aforementioned *Soundtrack110*) used in experiments based on ratings of the music in valence and arousal. They found valence to be difficult to predict across different genres, whereas arousal could more reliably be modelled.

Using the *Soundtrack110* -dataset, Laurier at al. (2009) investigated the relationship of reported emotions in music to musical features as extracted by the MIRtoolbox. They also sought to model the ratings of five basic emotions and found a positive correlation between the model and the ratings. The same dataset was also employed by Eerola, Lartillot and Toiviainen (2009) in predicting emotion from film music stimuli by multivariate regression analysis, with the model being able to account for 58-85 % of the variance (Eerola et al 2009).

Music Information Retrieval and computer assisted analysis in general are popular and growing areas of research as well as well used tools commercially. Among numerous applications, MIR might be utilised in detecting plagiarism (Dittmar et al. 2012), using streaming service metadata to produce information on music listening habits on a large scale (Epps-Darling et al. 2020) and automatic detection of Leitmotifs (Krause et al. 2020).

3 THE CURRENT STUDY

The aim of this work is to study the structure of music on film soundtracks to gain understanding into how music, as a part of a multimedia piece, participates in the forming of the identities of the characters of the film. Research questions are as follows: What differences are there in the musical features of the introductory music of characters of Star Wars films by gender? What differences are there in the musical features of the introductory music of characters of Star Wars films by the character's status as protagonist or antagonist? A character's status as a protagonist or antagonist is henceforth referred to as character type.

3.1 The material

The material is the films and soundtracks of the three trilogies of Star Wars films, original trilogy in the 1970s, the prequel in the 1990's, the sequel in the 2010's. This trilogy of trilogies is occasionally referred to as the Skywalker Saga. Music for all nine films was composed by John Williams.

Williams, born in 1932, is one of the most prolific and well-known contemporary film music composers. His career in both film and concert music spans six decades. Until recent years, Williams has also had an active career as a conductor mainly in the United States. Williams is credited as the conductor on Episodes I-VII soundtracks, with Williams and William Ross credited as conductors on Episodes VIII and IX soundtracks (with Gustavo Dudamel as guest conductor in Episode VIII, Cooper 2015). (Hischak 2015, 902-905.)

Both Kalinak (1992) and Hischak (2015, 908) credit Williams and the first Star Wars film (that later acquired the subtitle A New Hope) for reviving and reinventing the use of an original orchestral film music score. In the years preceding the film, the trend had been towards using popular music in film scores. Additionally, the use of a neo-romantic large symphonic orchestra went against the expectation of futuristic, electronic soundscape of a futuristic sci-fi film. This neo-romantic style and the use of leitmotifs

have since become a staple of Williams' style as a film music composer. (See e.g. Hischak 2015, 908). This style and the use of leitmotifs spans the whole Skywalker Saga as well.

The Star Wars universe is well known and widely distributed in the western world and beyond, with the franchise being the second highest grossing film franchise world-wide. The films and their music are also critically acclaimed, with seven Academy Awards (including two for Original Score) out of 37 nominations as well as six Grammy Awards and a total of 15 nominations.

Table 1

Films included in order of their release date

Trilogy	Film	Year of release (U.S.)
Original trilogy	Episode IV: A New Hope	1977
	Episode V: The Empire Strikes Back	1980
	Episode VI: Return of the Jedi	1983
Prequel	Episode I: The Phantom Menace	1999
	Episode II: Attack of the Clones	2002
	Episode III: Revenge of the Sith	2005
Sequel	Episode VII: The Force Awakens	2015
	Episode VIII: The Last Jedi	2017
	Episode IX: The Rise of Skywalker	2019

The music included is from the official soundtracks titled The Original Motion Picture Soundtrack for all films except for one. Of Episode I, an Ultimate Edition that follows the score heard on the film closely, although does not contain the exact same takes of the parts as the film. As no applicable excerpts were found on the episode I Original Motion Picture Soundtrack and the Ultimate edition was available, the music for Episode I is from the Ultimate Soundtrack.

4 METHODOLOGY

Films and music excerpts included in analysis were be selected according to the criteria described in chapters 4.1 and 4.2. Numerical values for different musical features will be obtained with the help of the MIRtoolbox, which can then be compared, as discussed in chapters 4.3 and 4.4.

4.1 Film and character selection process

The three trilogies of the Star Wars franchise were selected for several reasons. First, the the films fall within the same genre(s) and are situated in the same film universe. The films also share the same composer, John Williams, by whom the music is also largely conducted. Additionally, all selected films have original orchestral scores of non-diegetic music, since music of a wider range of genre or instrumentation would be unlikely to be comparable. In other words, both the film universe along with its characters and the music selected are deemed homogenous enough so that analysis is likely to show the differences between tracks, and not reflect only the differences between film and music genres.

Because of its wide distribution and assumed impact on culture, mainstream film is of interest in this work. Star Wars was selected for its wide distribution, influence in popular culture and critical acclaim (see chapter 3.1).

To identify main characters and the times of their introduction, the films were viewed. Since diegetic and non-diegetic music serve different purposes (Gorbman 1987), characters whose introductory music is diegetic are excluded from the statistical analysis.

Non-human main characters, e.g. Jar Jar Binks of Episodes I-III and droids, were excluded as well, as the features of their introductory music might reflect their status as non-human in a significant way (see e.g. Buhler 2014b). This might interfere with interpretation of the results concerning gender or status as protagonist or antagonist.

Among the characters chosen following the aforementioned criteria, characters fell into three categories: male protagonists, male antagonists and female protagonists. The

absence of female antagonists was accounted for in the statistical analysis (see chapter 6).

4.1.1 Specific cases

Anakin Skywalker is considered to be a protagonist until being given the name Darth Vader in Episode III. This is considered the emergence of a new character, antagonist Darth Vader. Thus Anakin's introductory music is included of Episode III as that of a protagonist. Darth Vader's introductory music is excluded because of its absence on the soundtrack (see chapter 4.2.1).

Chancellor Palpatine's double identity as Darth Sidious is not revealed until Episode III, and those two identities are considered distinct characters until then. Protagonist Chancellor Palpatine is not considered a main character, therefore only the music of the antagonist Darth Sidious is included in analysis.

Queen Amidala has this kind of a double identity as well, only hers is regarding her status as a main character as opposed to her character type. In Episode I, the servant Padmé as she is first portrayed is not considered a main character. The revelation of her true identity in her audience with the Gungan Boss Nass also reveals her significance to the plot, changing her status to a main character. This is thus considered to be the introduction of the main character Padmé Amidala.

4.2 Music excerpt extraction process

Music is linked to the character by the following protocol. Primarily, a corresponding excerpt of music to the character's visual introduction (character's face seen on screen) on film is identified on the soundtrack. If one cannot be found, the secondary method is to identify a similar passage on the soundtrack, with minor differences from the film, such as a different solo instrument or the omission of a bar of music on the soundtrack compared to the film. As themes reoccur in multiple films and priority is given to excerpts analysed being as similar as possible to the one heard in the film, a passage can be selected from the soundtrack of another film. If one cannot be found, tertiarily music can be linked to the character by a track on the soundtrack being named after the character, such as track 3 Princess Leia's Theme on the episode IV soundtrack. If this tertiary method must be employed, a catalogue of character leitmotivs compiled by Frank Lehman (2021) can be utilised to identify a passage on the track that is also linked to the character in terms of a recognisable leitmotiv. If a character's leitmotiv is found on the soundtrack, that passage can in individual cases be used as a character's music. In such a case, the suitability of the passage is noted in chapter 4.2.1. If such a passage cannot be identified that character is excluded from analysis.

In other words, music that is closest to what is heard in the original multimedia piece, the film, takes priority. The music heard at a character's visual introduction is of interest because it is here considered to be the character's introductory music and can be expected to convey information of or correspond to the characteristics of that character (see e.g. Cohen 2001,258, Herget 2021. See chapter 2.3). In the context of this work, the point of a character's visual introduction is the moment the face of the character is first seen on screen. A recognisable, individual mask or face paint such as that of the character Darth Vader in episodes IV-VI was accepted as well as a face. As discussed in the previous chapter, a look-alike addressed by the character name such as Princess Amidala/Padmé in episode I or seeing characters as holograms such as Lord Sidious in episode I were not accepted as a character introduction.

The length of the music excerpts was dictated by the length of the visual introduction of the main characters in the films. The shortest introductions of main characters across the films were 10 seconds in length, which defined the minimum length of the excerpts. To keep the material sufficiently homogenous and thus comparable, the length of the music excerpts was capped at 20 seconds, even if the introduction of the character on screen was longer.

The excerpt length was also considered in relation to earlier studies. Luck et al. (2008) used excerpts of 60 seconds and Tagg (2006) used excerpts of 30-60 seconds. Both studies required subjects to rate or evaluate stimulus, which required a longer excerpt length. Additionally, excerpt length was not limited by other factors, such as other aspects of multimedia. Eerola and Vuoskoski (2011) limited their excerpts of what was in later studies referred to as the Soundtrack110-dataset to 10-30 seconds, with a mean excerpt length reported by Eerola et al. (2009, 622) as 15.3 seconds and a median length reported by Eerola (2011, 353) as 20 seconds. The mean excerpt length in this current work is 17.8 seconds and median length 20 seconds, which is very close to that of the *Soundtrack110*-set. Excerpt length used in this work is thus considered consistent with previous work.

Two characters might be introduced at once and have the same or nearly the same introduction music. A table of all the music included and method of linking character and music can be found in the table in appendix 1.

Excerpts were cut to the excerpt length and extracted via the audio software Audacity. No other modifications were made.

4.2.1 Specific cases

Princess Leia's introduction in Episode V is longer, approximately 60 seconds, but there is only 18 seconds of applicable music on the soundtrack, limiting the length of the clip to 18 seconds. Similarly, Padmé Amidala's introduction in Episode III is approximately 45 seconds, but only 10 seconds of applicable music was found on the soundtrack, limiting the length of the clip to 10 seconds. The third case is Kylo Ren's music in Episode VII. The

character's intro length is 20 seconds, and the length of the clip is 16 seconds since only that amount of applicable music was found on the soundtrack.

Even though the exact time of introduction of Darth Vader in Episode V is slightly ambiguous, the musical material corresponds closely to the start of the track 5 The Imperial March (Darth Vader's Theme). Whereas in the film the end of the theme is heard when Vader's recognisable mask is seen, followed by the background pattern of the strings, in the beginning of the track the background pattern is heard first, followed by the theme. This reversal of order is considered a minor enough difference for the start of the track to qualify for a link to the character according to the secondary method described in chapter 4.2. The same excerpt would also qualify for the tertiary method, which further supports its use.

The music heard at the introduction of Darth Vader in Episode III (here when Anakin is given the name by Darth Sidious/Chancellor Palpatine) is two repetitions of the start of the Imperial March -theme on low brass instruments, also the character theme of Darth Vader in the original trilogy (Lehman 2021, 9). A corresponding passage or a similar one with only minor differences cannot be found on the soundtrack. The soundtrack includes a track names "Enter Lord Vader". However, this track does not include this theme that is both the introductory theme in the film as well as the character's theme (Lehman 2021, 9). In the absence of a similar orchestration of the theme on the soundtracks, the music associated with Darth Vader in Episode III is excluded.

4.3 Audio analysis

Numerical values for different features of the music were obtained by MIRtoolbox, a Matlab toolbox for music information retrieval (Lartillot et al. 2008). A summary of the features included can be seen in table 1.

Table 1

List of musical features included

Category	Feature	Command/Operator	Notes
Dynamics	Global energy	Mirrms	
Rhythm	Tempo	Mirtempo	Additionally, tempi were assessed manually.
	Event density	mireventdensity	
	Pulse clarity	Mirpulseclarity	Additionally, pulse ambiguity was assessed manually.
Timbre	Attack slope	Mirattackslope	
	Brightness	Mirbrightness	
	Roughness	mirroughness	i.e. dissonance
Pitch	Pitch	Mirpitch	
Tonality	Mode	Mirmode	

In addition to MIR analysis, tempi were assessed manually. Manual and computational assessments were found to be conflicting in some cases. For uniformity, the manually assessed tempo was used in further analysis in all cases. The tempi were also noted as set, ambiguous, possibly double or half tempo or the excerpt containing more than one tempo. These ambiguities are a possible explanation for the conflicting manual and computational assessments of tempi. In addition to tempo, there are two additional measures of rhythm in the excerpts. Event density is the average number of events per second. Events are detectable surges or peaks of energy in the signal. Pulse clarity describes the rhythmic clarity, i.e. the strength of the beats (frequency of beats being estimated in tempo) (Lartillot et al. 2008).

The mean global energy is a measure of the "loudness" of a piece. It is computed as the root mean square (rms) of the amplitude. Attack slope describes the "sharpness" of the attack of the notes: a note that sounds very sharp or even aggressive has a steep attack slope. The value for brightness indicates the percentage of the sound energy in higher frequencies, in this case the threshold of higher frequencies being the default 1500 Hz. Roughness, or sensory dissonance, refers to the sound or twang called dissonance when several frequencies nearly but not quite the same are heard at the same time. Although based on the same phenomenon, this is different from how the term dissonance is used in music theory. In this work, pitch describes the mean pitch of the excerpt.

Because inaccuracies that were likely to have stemmed from double of half tempo detected by the MIRtoolbox analysis, the manually assessed tempo was used in the following stages of analysis.

The mean value describes an average of the value of all the individual frames. The standard deviation value describes the variance of the values through the excerpt. To obtain both of these statistics, each feature was analysed in shorter windows of time using the 'Frame' command. This decomposes the temporal signal into shorter windows of time chronologically. The windows may overlap. This distance between successive frames is called the hop factor.

Default frame length and hop (see Lartillot et al. 2008 for default frame lengths and hop factors) for each feature was used for all features except for event density. The default frame length for event density is 10 seconds with 0% overlap. It was changed into three second frames with 50% overlap, because 10 seconds is the minimum length of the excerpts. In addition to only giving one frame for those excerpts, which was deemed too little, the default frame length of 10 seconds caused the standard deviation within those 10 second excerpts to be 0, which would not have been meaningful to examine further.

4.3.1 Technical limitations

The excerpts are from different sources and originally in different formats, including cd and digital download. Additionally, they include music recorded in the 1970's, 1990's and 2010's with assumably very different technology. This is likely to increase noise in the results. The music from different sources includes all categories of characters approximately in the same ratios as the whole sample, and different sources did not show consistent or significant differences in testing. Thus, these limitations are expected to add noise in the results to some degree, but not systematically skew the results.

5 ANALYSIS AND RESULTS

The mean values and standard deviations of the features for each excerpt were imported to the statistical analysis program JASP. The data was screened for outliers and outliers for each feature by group (gender or type) were removed. The maximum number of outliers PER VARIABLE was two (7%) in all cases except for attack slope mean by character type, which had three outliers. Analysis of variance (ANOVA) was performed to determine if the means of the groups (female and male for gender and protagonists and antagonists for character type) differed.

The assumption of normality was assessed by the Shapiro-Wilk test for normality and the assumption of the equality of variances was assessed by Levene's test. In many cases, one or both assumptions were violated (Shapiro-Wilk $p<0.05$ and Levene's $p<0.05$). In such cases, the result of the non-parametric Kruskal-Wallis test (henceforth abbreviated as KW) is reported in addition to the ANOVA result. In all cases where assumptions were violated, the results of the ANOVA and KW results showed only minor differences. Only in the case of the standard deviations of global energy by character type one test showed a significant difference while the other did not (ANOVA $F(1,27)=4.579$ $p= 0.042$, KW $\chi2(1)=2.267$ $p= 0.132$ ns.).

Among the characters whose music was included were no female antagonists (see table 2 below). The presence of antagonists as a subgroup of male characters but not female characters and female characters as a subgroup of protagonists but not antagonists might cause the results to reflect the difference of character type when investigating the effect of gender and vice versa. Therefore, statistical analysis was performed in four stages, first gender including all tracks, gender on only protagonists second, then character type including all tracks and finally character type on only male characters. Despite the small sample size when either tracks associated with antagonists or female characters were excluded, these results offer a way to consider the effects of this imbalance in character identities.

Table 2

Number of excerpts in each group

	Female	Male	Total
Antagonist	0	12	12
Protagonist	9	9	18
Total	9	21	

5.1 Gender

Regarding gender, the average global energy (rms) was found to be lower in excerpts associated with female than male characters, as well as the average roughness. See table 3 for all results on the influence of the gender of the character when all excerpts are included.

The standard deviance of global energy (rms) within the excerpt was found to be lower in excerpts associated with female characters, as well as that of roughness. In other words, there was less variance within a clip in the clips associated with female characters in roughness and global energy (rms) than those associated with male characters. The standard deviation of pitch was found to be lower in clips associated with female characters than those of male characters.

The means for average event density, pulse clarity and brightness were higher in excerpts associated with female characters, but not significantly so. Similarly, the average attack slope, pitch and tempo, as well as the variance for event density, pulse clarity, attack slope, brightness, roughness and pitch were higher in excerpts associated with male characters, but this difference was not found to be statistically significant.

Table 3

Results: gender, all excerpts included

	Gender								
	Means				Results				
	f		m		ANOVA			Kruskal-Wallis	
Feature	M	SD	M	SD	df	F	p	χ2(1)	p
rms-mean	**0.03**	**0.01**	**0.05**	**0.03**	**1,26**	**4.26**	**0.049**	**4.35**	**0.037**
rms-SD	**0.01**	**0.00**	**0.03**	**0.01**	**1,27**	**9.97**	**0.004**	**6.97**	**0.008**
event density - mean	1.85	0.82	1.29	0.91	1,27	2.51	ns.	2.07	ns.
event density - SD	0.60	0.41	0.71	0.37	1,27	0.47	ns.		
tempo	68.22	12.46	75.33	16.87	1,28	1.29	ns.	0.74	ns.
pulse clarity-mean	0.16	0.03	0.15	0.03	1,27	0.78	ns.	1.50	ns.
pulse clarity-SD	0.05	0.01	0.05	0.02	1,27	0.23	ns.	1.39	ns.
attack slope - mean	5.41	0.51	6.28	1.88	1,27	1.85	ns.	1.39	ns.
attack slope - SD	3.21	0.67	3.75	1.15	1,26	1.69	ns.		
brightness-mean	0.26	0.06	0.22	0.08	1,26	1.13	ns.		
brightness-SD	0.08	0.03	0.09	0.04	1,28	0.60	ns.		
roughness - mean	**19.27**	**19.36**	**102.00**	**94.63**	**1,26**	**5.89**	**0.023**	**7.54**	**0.006**
roughness - SD	**22.88**	**19.82**	**154.06**	**140.56**	**1,26**	**7.62**	**0.01**	**8.00**	**0.005**
pitch - mean	416.52	89.95	431.01	109.01	1,26	0.11	ns.		
pitch - SD	**198.05**	**56.48**	**296.04**	**68.04**	**1,27**	**14.18**	**<0.001**		
mode	-0.06	0.15	-0.07	0.11	1,26	0.05	ns.		

As can be seen in table 4, when only excerpts associated with protagonists were included, global energy and roughness means were also found to be significantly lower in excerpts associated with female than male characters. Similarly, the standard deviance of global energy and roughness were lower in excerpts associated with female than male characters also in this condition. Standard deviations of pitch were not found to be significantly different in this condition.

Differences were found to be not significant for the following results as well. The means and variances within an excerpt of attack slope, brightness and pitch, as well as the variances within an excerpt of pulse clarity and event density, were higher for excerpts associated with male characters. The mean event density and pulse clarity were higher for excerpts associated with female characters.

Table 4

Results: gender, only excerpts associated with protagonists included

Gender: only protagonists									
	Means								
	f		m		ANOVA			Kruskal-Wallis	
Feature	M	SD	M	SD	df	F	p	$\chi2(1)$	p
rms-mean	**0.03**	**0.01**	**0.04**	**0.02**	**1,15**	**7.47**	**0.015**	**6.27**	**0.012**
rms-SD	**0.01**	**0.00**	**0.03**	**0.01**	**1,16**	**11.65**	**0.004**	**7.75**	**0.005**
event density - mean	1.85	0.82	1.13	0.96	1,16	2.95	ns.	2.53	ns.
event density - SD	0.60	0.41	0.70	0.18	1,16	0.38	ns.		
tempo	68.22	12.46	82.78	16.72	1,16	4.39	ns.		
pulse clarity-mean	0.16	0.03	0.15	0.02	1,15	1.47	ns.		
pulse clarity-SD	0.04	0.01	0.05	0.02	1,15	0.37	ns.	0.04	ns.
attack slope - mean	5.41	0.51	5.88	1.95	1,16	0.49	ns.	0.24	ns.
attack slope - SD	3.21	0.67	3.41	1.00	1,15	0.23	ns.		
brightness-mean	0.26	0.06	0.29	0.11	1,16	0.51	ns.	0.02	ns.
brightness-SD	0.08	0.03	0.08	0.02	1,15	0.06	ns.		
roughness - mean	**19.27**	**19.36**	**90.47**	**61.28**	**1,15**	**9.86**	**0.007**	**7.79**	**0.005**
roughness - SD	**22.88**	**19.82**	**166.96**	**146.55**	**1,16**	**8.54**	**0.01**	**9.28**	**0.002**
pitch - mean	416.52	89.95	437.02	96.10	1,15	0.21	ns.		
pitch - SD	198.05	56.48	257.98	84.54	1,16	3.13	ns.		
mode	-0.06	0.15	-0.01	0.15	1,16	0.44	ns.		

5.3 Character type

When all excerpts were included in the analysis, the standard deviation of pitch was found to be lower in excerpts associated with protagonists than antagonists. As stated in chapter 5, ANOVA showed the standard deviance of global energy within the excerpts to be lower in tracks associated with protagonists than antagonists, but the Kruskal-Wallis test did not (see table 5). P-value of Kruskal-Wallis test was 0.12. The normality assumption was violated in the group of protagonists (p-value of Shapiro-Wilk for protagonists 0.025). As ANOVA is considered robust against violations of the normality assumption, the result can be read as either significant or non-significant.

The rest of the differences were found to be not significant. The average mean and variance of event density, variance of pulse clarity, mean and variance of attack slope and variance of brightness were found to be on average higher in excerpts associated with antagonists. Tempo and the mean pulse clarity, brightness and pitch were on average higher in tracks associated with protagonists.

Table 5

Results: character type, all excerpts included

	Character type								
	Means				Results				
	ant		pro		ANOVA			Kruskal-Wallis	
Feature	M	SD	M	SD	df	F	p	χ2(1)	p
rms-mean	0.05	0.04	0.04	0.02	1,28	2.03	ns.	0.40	ns.
rms-SD	**0.03**	**0.02**	**0.02**	**0.01**	**1,27**	**4.58**	**0.042**	**2.27**	**ns.**
event density - mean	1.59	1.02	1.38	0.84	1,27	0.39	ns.		
event density - SD	0.80	0.54	0.65	0.22	1,26	1.12	ns.	0.11	ns.
tempo	69.75	15.33	75.50	16.14	1,28	0.33	ns.		
pulse clarity-mean	0.15	0.03	0.16	0.02	1,26	0.44	ns.		
pulse clarity-SD	0.05	0.02	0.04	0.01	1,27	3.10	ns.	1.77	ns.
attack slope - mean	6.61	1.84	5.65	0.90	1,25	3.30	ns.	1.78	ns.
attack slope - SD	4.00	1.24	3.30	0.82	1,26	3.27	ns.		
brightness-mean	0.22	0.09	0.25	0.06	1,26	1.22	ns.	0.95	ns.
brightness-SD	0.09	0.05	0.08	0.02	1,27	0.54	ns.	0.16	ns.
roughness - mean	111.43	117.44	59.75	57.66	1,27	2.53	ns.	0.52	ns.
roughness - SD	169.65	161.98	74.52	93.89	1,26	3.90	ns.	1.93	ns.
pitch - mean	405.33	137.56	427.37	90.93	1,27	0.27	ns.	0.05	ns.
pitch - SD	**322.49**	**51.72**	**228.02**	**76.26**	**1,27**	**13.10**	**0.001**		
mode	-0.11	0.13	-0.04	0.13	1,28	2.04	ns.		

When excerpts associated with female characters were excluded from the analysis, no significant differences were found between excerpts associated with male protagonists and antagonists (see table 6 for all results). Tempo, the variance of attack slope as well as the mean pitch and brightness were on average higher for excerpts associated with protagonists. The mean and variance of global energy, event density, pulse clarity and roughness as well as the mean attack slope and pitch and the variance of brightness were on average higher for excerpts associated with antagonists.

Table 6

Results: character type, only excerpts associated with male characters included

Type: only male characters									
	Means				Results				
	ant		pro		ANOVA			Kruskal-Wallis	
Feature	M	SD	M	SD	df	F	p	$\chi2(1)$	p
rms-mean	0.05	0.04	0.04	0.02	1,19	0.22	ns.	0.0	ns.
rms-SD	0.03	0.02	0.03	0.01	1,19	0.03	ns.		
event density - mean	1.59	1.02	1.13	0.96	1,19	1.12	ns.	0.5	ns.
event density - SD	0.80	0.54	0.70	0.18	1,19	0.33	ns.	0.0	ns.
tempo	69.75	15.33	82.78	16.72	1,19	3.44	ns.		
pulse clarity-mean	0.16	0.04	0.16	0.03	1,19	0.05	ns.	0.0	ns.
pulse clarity-SD	0.05	0.02	0.05	0.02	1,19	1.17	ns.		
attack slope - mean	10.12	12.27	5.88	1.95	1,19	1.04	ns.	0.9	ns.
attack slope - SD	3.67	1.65	3.91	1.78	1,19	0.10	ns.		
brightness-mean	0.22	0.09	0.29	0.11	1,18	2.58	ns.	1.3	ns.
brightness-SD	0.09	0.05	0.08	0.02	1,18	0.20	ns.	0.1	ns.
roughness - mean	111.43	117.44	90.47	61.28	1,18	0.23	ns.		
roughness - SD	208.99	205.97	166.96	146.55	1,19	0.27	ns.		
pitch - mean	405.33	137.56	437.02	96.10	1,19	0.35	ns.		
pitch - SD	308.93	68.10	257.98	84.54	1,19	2.34	ns.		
mode	-0.11	0.13	-0.01	0.15	1,19	2.57	ns.		

5.4 Qualitative notions

In manual inspection, tempi were found to be unambiguous and unchanging on 8 out of 9 tracks associated with female characters (89%) and only 9 out of 21 (43%) of tracks associated with male characters. However, no significant difference in pulse clarity was found.

Upon listening to the excerpts, some results on event density and pulse clarity seem disproportionately high for some excerpts that play on very low frequencies, such as the excerpt for Snoke in Episode VIII. It is possible that the long wavelength of very low notes registers as individual events in MIR analysis. Further work is required to make reliable statements on this issue.

6 DISCUSSION

The research questions for this work were as follows: What differences are there in the musical features of the introductory music of characters of Star Wars films by gender? What differences are there in the musical features of the introductory music of characters of Star Wars films by the character's status as protagonist or antagonist?

To answer these questions, values for 10 features of 30 excerpts of music were extracted via the MIRtoolbox. The excerpts were 10-20 seconds in length and linked to a character by identifying their cooccurrence with the visual introduction of the character or by a track or theme being named after the character. One way ANOVA was performed, supplemented by the non-parametric Kruskal-Wallis test as needed, to see whether the mean and standard deviation values of those features differed between excerpts associated with male and female characters and excerpts associated with protagonists and antagonists.

The results indicate that excerpts associated with female characters had lower global energy and roughness, i.e. "loudness" and "dissonance". Also the variance of these features within a track was lower in excerpts associated with female characters. This effect persisted also when the excerpts of antagonists were excluded from analysis. In simple terms, this indicates that on average, excerpts associated with female characters were generally quieter and had less dissonance, and remained more consistently so throughout the track than in the excerpts associated with male characters. Additionally, in the condition of all excerpts included, there was less variance in pitch within an excerpt in excerpts associated with female characters.

Regarding character type, the variance of pitches within a track was found to be lower excerpts associated with protagonists than antagonists, when all excerpts were included. When analysing only excerpts associated with male protagonists and antagonists, no such difference was found. Additionally, a result disputable because of violation of the ANOVA normality assumption, the variance of global energy within a track was found to be lower in tracks associated with protagonists than antagonists when all excerpts were included in analysis.

As musical content is under analysis, results indicate trends in terms of musical structure and not what an audience member might perceive. The results do not indicate the intent of the composers in making these choices when composing or the extent to which they might be aware of the recurring features of the music according to the character's identity.

6.1 Results

6.1.1 Gender

Except for the variance in pitch, the results on gender were similar both when all excerpts were included and when only protagonists were included. Even though the number of excerpts included in the latter condition was small (N=21), this result supports the first finding and suggests that the presence of the excerpts associated to antagonists as a subgroup of excerpts associated with male characters did not skew the result regarding gender in a deciding way.

Lower and more consistent global energy and roughness for tracks associated with female characters are in line with some the findings of Tagg (2006). In their visual-verbal association experiment, Tagg found women to be associated with calm and quiet, and in the gender polarities derived from their results, music associated with women was described as slow, static, soft, gradual and smooth, as opposed to fast, dynamic, hard, sudden and jagged for music associated with men. However, the characteristics of music for different genders, such as faster average tempo, staccato phrasing (which a steeper attack slope might indicate), faster surface rate (which might be detectable as a higher event density) for music associated with men did not show significant differences in the current study. As opposed to this current work, Tagg uses excerpts of different musical styles and instrumentation, some of them being popular music and electronic instruments. The differences in style seem to be gendered as well, with rock and jazz being commonly associated with men and classical and romantic music associated with women. (Tagg 2006, 23-26.) The differences in styles are likely to affect the characteristics of music, thus limiting the comparability of this current work and Tagg's.

McClary's (2002) notion of pitch being used as a mechanic to musically refer to gender might have suggested a difference in mean pitches. No significant difference was found in this work. The means of pitches seem to be contrary to what McClary suggested, the mean pitch being higher for excerpts associated with male characters.

6.1.2 Character type

Previous research on depicting antagonists and "othered" characters has described the extramusical connotations of music, e.g. the recognisable drums in westerns that signify the presence of native people (see e.g. Green 2010, Scheurer 2008). This present work

sought to identify features of villains in the musical structure. However, only one of the features examined showed clear differences between protagonists and antagonists, and only when all excerpts were included in analysis.

Standard deviation of all features except for tempo and variance of pitch within an excerpt was higher for antagonists than protagonists when all excerpts were included in analysis. When only excerpts associated with male characters included, standard deviation was higher for antagonists in all features except for tempo, variance of pitch, variance of attack slope and the mean spectral centroid and brightness. Based on this there was more variety among the excerpts within the antagonist category than the protagonist category. This notion is congruent with an intuitive perceptive experience or listening of the excerpts: in the antagonist category, some excerpts such as the Imperial March that serves as the introductory music of Darth Vader in episodes V and VI have high event density, brightness, global energy, attack slope and roughness. Some, like the introductory music of Kylo Ren in episode VIII have very low values for those features. Both are intuitively recognisable as villain music, the first a dissonant, military-inspired sharp fanfare, the other an ominous choral mat with many open intervals. In these groups, they seem to exhibit some of the features of villains' music listed by Scheurer, the first the rhythmic element with high dissonance and a military connotation, the latter the low register and ominous air (Scheurer 2008, 120-121). When the means of the groups are analysed, these differences might affect in opposite ways, bringing the mean of the group close to the mean of the other.

Nevertheless, this rises speculation on if the essence of antagonist music in the Skywalker Saga lies in extremes. In light of the notion of causing unease by Green (2010), it can be asked if this tendency towards extremes relates to familiarity of musical material. It would be logical for protagonists' music to be more homogenous and in range most familiar to listeners and/or makers of the films, familiar music being generally the most pleasant to listeners.

However, this is a reduced view of complex material. The tendency to more variety in antagonists' music can also be due to different conventions in writing music for antagonists. Those differences presenting in more variance among the excerpts associated to antagonists could be coincidental. Also, the normality assumption as assessed by the Shapiro-Wilk test was not often violated in the antagonists group. While more variance occurred and the distribution of the values might have been wider than in the other group, the distribution was not completely concentrated on the extremes but closer to a normal distribution. A more focused inspection in the present material in relation to previous studies and more literature regarding the music of villains in the future might provide more insight. An investigation of different tropes or conventions in writing music for antagonists in particular is prompted by the discussion above.

6.1.3 Limitations in interpreting the results

The material is limited to one franchise and one composer. Therefore, claims concerning any other audio-visual pieces than the ones included in this work or film in general cannot be reliably made. The results might be indicative of patterns and conventions that might be in a wider use of the industry. Their implications to a wider range of works and the culture of the field in general should be discussed, but no certain claims cannot be made based on this work.

6.2 Method

The option to use real-life stimulus over pre-existing datasets likely increased manual work needed to complete the analysis with the viewing of the films and searching for the corresponding music on the soundtracks. The benefit of this approach is that it can provide a viewpoint closer to the actual experience of a listener and the actual impact of multimedia.

The wide distribution of the Star Wars franchise makes it an interesting phenomenon to study. If the view of the impact of media being bidirectional discussed in earlier chapters, i.e. media and art do not only portray reality but also participate in constructing it, it is reasonable to assume that films that are almost ubiquitous in contemporary popular culture have an impact on that culture. This also complicates its study. Many previous studies concerning gender in music are perception studies, but it is difficult to find subjects that would be unfamiliar with the plot or fan culture around Star Wars, but would be familiar enough with Western classical music. Those who are familiar with its style are likely to be affected by the plot and the participants a priori ideas of the films and the franchise. The advantage of work such as this current one in relation to perception studies is that aspects of well-known pieces of multimedia can be studied without the other aspects or the culture around a piece or a franchise affecting the results. Although complete immunity to this phenomenon cannot be claimed as the author was familiar with the films and their music prior to starting this work, computer assisted studies are affected by that to a lesser extent.

The same benefit could also be achieved by studying the sheet music of the excerpts. Using sheet music would also allow for other features of music to be investigated. For example, Kalinak (1992, 63) mentions dissonant intervals in the melody, not in harmony, to signify villainhood or oppression. Notation might be a simple way to approach issues like this, as notation is a familiar medium to many musicologists. However, this would require acquiring the sheet music or transcribing the music heard in the film. Acquiring the sheet music of the film soundtrack would be extremely difficult if not impossible considering the scale of a master's thesis. Transcribing the music and analysing the resulting notation would have the benefit of including only the music heard at the character's introduction without the need for the secondary and tertiary methods of connecting music

to a character used in this present work. However, if used for anything other than analysing clear Leitmotiv-like melodies, this would require time resources beyond the scope of this work. Additionally, sound effects and dialogue in the film might hinder or prevent accurate transcription.

Compared to notation, the kind of computer assisted analysis utilised in this work is relatively sensitive to changes in musical style. This is both an advantage and disadvantage. Accounting for differences in musical style, instrumentation and post production practices such as compression and equalisation can be difficult in notation, whereas these differences affect MIR analysis automatically. Conversely, dissecting these effects can be difficult. If the chosen material is very heterogenous, it is possible for the results to reflect the aforementioned differences more than the differences being investigated.

When discussing the benefits and disadvantages of different approaches, it is to be mentioned that these different options are not automatically contrary to one another but can be complimentary. Each approach provides novel information and a wider point of view on the same phenomenon.

As Herget (2021) points out, it is important to reflect on the level of the audio-visual material used and its relationship to the actual everyday experiences of audiences. In this work, the plot and visual content of the film and their interplay with the music is not discussed. While the scope of this work will not allow including such topics, the possible hindrances of only studying one side of a multimedia piece and such a complex phenomenon should be considered when interpreting results. In the future, the methodology of this current work could be utilised as a part of a wider work, studying the interplay of different aspects of multimedia.

In the current method, there is a level of subjective evaluation in the precise character introduction times and their lengths. The exact start and end times of the characters' visual introduction can in some cases be somewhat ambiguous. Additionally, for future work, the ideal excerpt length can be re-examined. Some of the excerpts were limited to 10 seconds by either the visual introduction of the character ending or applicable music being found on the soundtrack. Longer excerpts offer more musical material, but also open a way for more variety in the music. Including two very different passages are included in the same excerpts can result in the mean values for the features ultimately describing neither of these passages. In addition to the except length, the variety allowed in the excerpt lengths can be examined. It is logical for more variance in a feature to occur in longer excerpts, and the acceptable extent of this disparity should be considered, as well as if the disparity can be compensated for in the statistical analysis.

While examining music heard at a character's introduction is an accessible way to connect music to a character, a passage of music heard at the character's visual introduction does not only signify the attributes of the character but can also have a strong connection to the situation. For example, by listening, Han Solo's introductory music in Episode IV seems to share features with music linked to antagonists such as the timpani strikes, low register and ominous feeling. This might be connected to the plot and the dangerous and ominous situation the characters are in, Han being freed from the

carbonite but blind, unwell and still in Jabba the Hut's palace. Similarly, Padmé Amidala is introduced in Episode II during an attempt of her assassination that kills her decoy bodyguard. In both cases, the music heard at the character's visual introduction can be seen more as indicative of the dangerous situation the characters are in than the attributes of the character.

6.2.1 Technical limitations

As stated in chapter 4.3.1, the differences in the different recording practices of different decades as well as obtaining the music from different sources is expected to have caused noise in the data and might be obscuring some more subtle differences in the music. In future work, this issue could be alleviated by uniformity in material sources if possible and bigger sample sizes. However, when analysing material not produced specifically for the study it is probable that some fluctuation stemming from different recording practices, postproduction practices, file formats, distribution methods and many other issues will occur. Testing and correcting for these differences may be possible within limitations. Even music recorded within a decade and from a similar source is bound to have differences in recording practices, post production practices and musical style. As long as it is not systematically skewing results, the noise resulting from these issues must be accepted to a degree. This kind of work and research with specifically made material, the representativeness of which can be ensured, can be seen as complimentary to each other.

6.2.2 Limitations of the sample

The sample size in this work (n=30) is small. As discussed in previous chapters, this might have been a hindrance in terms of distinguishing the trends of music associated to characters of different genders and character types from the noise that is likely to occur. Due to the small sample size in general, the groups analysed were quite small as well, both male protagonists and female protagonists having 9 excerpts per group. The remaining group, female antagonists had no excerpts and was thus excluded from analysis.

The absence of female antagonists is in itself noteworthy. The supporting character of Captain Phasma in the sequel trilogy (episodes VII and VIII) is the only named female presenting antagonist of the series, with some unnamed personnel of spacecrafts in the original trilogy. The gender presented for other antagonist characters appears to be either male or ambiguous. The adversarial, disruptive nature of antagonists seems intuitively to be in line with Tagg's findings concerning the associations their subjects had accompanying the association to men, such as "threat", "disturbing", "shooting" and "disaster" (Tagg 2006, 25).

In many cases, the assumptions of the ANOVA were violated. It is possible that this issue stems from the small sample size, and violations of the normality assumption would decrease with a bigger sample size. However, to increase sample size, music from a wider range of films would have to be included. This, in turn, has the potential to increase noise

in the MIR analysis, as the inclusion of more multimedia pieces will include a wider range of musical styles and composing practices.

6.3 Notions on Star Wars

While some characters have their own track or theme (according to track lists or Lehman 2021), others don't. Most notably, in the original series, the Main Title and theme function as character themes for Luke Skywalker (Lehman 2021, 9). This positions the character at the centre of the film and the trilogy in a unique way (Kalinak 1992, 192).

The position and musical representation of the main female protagonist changes between the trilogies. In the prequel trilogy, episodes I-III, the love theme of Anakin and Padmé doubles as the character theme for Padme, a practice Buhler (2014a, 367) notes as common. In the original trilogy, episodes IV-VI, Princess Leia has her own theme, and the plot of the sequel trilogy centres Rey in a similar way as the previous trilogies centred the male protagonists Anakin and Luke. Despite this, Rey has her own theme that is both used as her introduction and alluded to in the soundtrack track name ("The Scavenger"). The reasons the makers had for not using the Main Title as Rey's theme can only be speculated. One might be the re-appearance of Luke at the end of episode VII.

As discussed in chapter 3.1, the big orchestration and neo-romantic style of the first Star Wars film was somewhat unusual or unexpected when the film was released. Considering its novelty at the time, the style has since stayed remarkably similar over the decades of Star Wars franchise and the Skywalker Saga films.

6.4 The gender binary and gender vs. femininity

The human main characters in the films included fall within the male-female binary, with no human characters with other or ambiguous genders. Addressing the subject of gender in this binary sense can rightfully be argued to perpetuate the view of gender as polarities of male and female and contribute to the erasure of the diversity of gender. the extent to which a soundtrack might enforce the "compulsory heterosexual code" (Buhler 2014a) is at the heart of queer theory of soundtrack music. Having to reduce the gender question into the exclusive categorisation of male and female and excluding any ambiguity for the sake of a sample size issue does not mean no ambiguity or diversity of gender exists in the films at all, not to mention in real life, the latter of which is bound to be influenced and formed by these portrayals in media.

Another issue when studying gender is the easy slip from studying gender to studying femininity. There simply seems to be more literature in how feminine characters are portrayed than masculine characters. This is not a novel issue in gender studies. The

history of academic gender studies is connected to the second wave feminism idea of female emancipation and later what was known as women's studies, which can be seen as a contributing factor. Studying femininity is naturally valid as well, as long as that is the explicit objective. Gender as a subject includes masculine and non-binary expression as well, and if a claim is made to study gender, these different expressions can be expected to be addressed as well.

6.5 Other applications and future research

The topic of this work is differences in music by the gender and type of characters. However, this approach could be applied to other ways in which the characters are differentiated. For example, this could be analysing and comparing the music linked to human versus non-human characters. The ways in which the musical content linked to characters of different identities differs has the potential to offer information on how different identities and ways of othering are portrayed in film. The intersections of non-human characters, other kinds of portrayal of characters as foreign or exotic and character type were excluded in this work due to the scope of a master's thesis. Further, more in depth work regarding these different ways of othering and their portrayal in film music might offer additional insight to modern film music. The possibility of different archetypes of writing music for antagonists discussed in chapter 6.1.2 also offers another avenue for future work.

As stated in chapter 6.2, studying a complex piece of storytelling multimedia from one limited and arguably narrow point of view only offers a limited understanding on the phenomenon. As stated by Winters (2010), the division of sound to diegetic and non-diegetic soundscapes has its limitations and can even be misleading, as for an audience member they are inseparable parts of the same viewing experience. The point of view and methodology of this work could serve as one aspect of multidisciplinary study of multimedia. MIR analysis of music might provide a way to describe the music to facilitate the study of the interplay of different aspects of a multimedia piece, such as of storytelling, visual aspects such as costuming and editing pace among many others, dialogue, sound effects and music.

In future work, the significance of the length of the excerpts should be examined. As discussed in chapters 4.2 and 6.2, a degree of uniformity in excerpt length is necessary to keep the results comparable.

Because of the limitations of the current method of connecting music to a character discussed in chapter 6.2, other methods for connecting music to characters or situations is warranted. Cataloguing Leitmotivs as demonstrated by Lehman (2021) is one possibility. However, this method is vulnerable to a circular argument by first declaring music to be a character's Leitmotiv and subsequently declaring music to be connected to the character because the Leitmotiv that was previously declared to be connected to the character

occurred. Perception studies are one frequently used avenue. However, as discussed in previous chapters, this method has its limitations in the case of well-known mainstream media, as extramusical aspects might affect the ratings of the music. If available, interviews of composers might be used to connect music to characters in the future.

If automatic identification of Leitmotifs as described by Krauser et al. 2020 could be done across the soundtracks, the Leitmotifs named after characters of the Skywalker Saga as identified by Lehman (2021) could be analysed in a manner similar to this work. This approach would eliminate much of the time-intensive work of logging instances of character introduction and identification of applicable music on soundtracks. This could be a way to include more music in total, perhaps uncovering differences in the music associated with characters of different identities that could not be shown here.

Additional information about the excerpts could be obtaining by investigating different statistics of the features, such as kurtosis or skewness in addition to means and standard deviations. For example, differences in kurtosis and skewness might be used to describe the distribution of sound energy across different pitches. Additionally, inclusion of more features might be considered.

In an intersection of Music Information Retrieval, music and emotion and gender studies, previous literature and the extent to which these fields and independent studies might support one another might be reviewed. For example, some insight into how different musical features are connected to gender might be obtained by comparing the results of Laurier et al. (2009) on the connection of musical features and emotion or Gabrielson and Lindström's (2001) review on multiple studies the same subject to the way in which certain emotion words and gender were connected in Tagg's (2006) visual-verbal associations to music.

For future work, melodies might be transcribed to supplement the computer-assisted analysis. In the context of character type this is particularly interesting, as multiple sources discuss melodic dissonance as an attribute of the music of antagonists (Kalinak 1992, 63; Scheurer 2008, 120). In this case as in many cases described before, there is potential in the methodology of this work and other methods and academic fields to support and supplement one another.

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APPENDICES

Appendix 1
Characters included in order of appearance, character genders and types and method of linking music and characters.

	Character name	Gender	Type	Method 1: Corresponding music on soundtrack	Method 2: Similar music on soundtrack	Method 3: Named track/theme	Reason for exclusion
Episode IV: A New Hope	Darth Vader	m	ant	1			
	Princess Leia	f	pro		1		
	Luke Skywalker	m	pro	1			
	Han Solo	m	pro				Diegetic music
Episode V: The Empire Strikes Back	Luke Skywalker	m	pro	1			
	Han Solo	m	pro				No music
	Princess Leia	f	pro		1		
	Darth Vader	m	ant		1	(1)	
Episode VI: Return of the Jedi	Darth Vader	m	ant	1			
	Luke Skywalker	m	pro				Intro time and music ambiguous
	Han Solo	m	pro	1			
	Princess Leia	f	pro	1			
Episode I The Phantom Menace	Obi-wan Kenobi	m	pro	1			
	Qui-gon Jin	m	pro	1			
	Padmé Amidala	f	pro	1			
	Darth Sidious	m	ant	1			
	Darth Maul	m	ant	1			
	Anakin (child)	m	pro				No music

Episode II: Attack of the Clones	Padmé Amidala	f	pro				Not found
	Anakin Sky-walker	m	pro				Not found
	Obi-wan Kenobi	m	pro				Not found
	Dooku	m	ant				Not found
	Sidious	m	ant	1			
Episode III: Revenge of the Sith	Anakin Sky-walker	m	pro	1			
	Obi-wan Kenobi	m	pro	1			
	Padmé Amidala	n	pro		1		
	Sidious	m	ant				Not found
	Darth Vader	m	ant				Not found
Episode VII: The Force Awakens	Poe	m	pro	1			
	Finn	m	pro				Not found
	Kylo Ren	m	ant	1			
	Rey	f	pro	1			
	Snoke	m	ant	1			
	Leia	f	pro	1			
Episode VIII: The Last Jedi	Poe	m	pro				Not found
	Leia	n	pro				Not found
	Finn	m	pro				Not found
	Rey	n	pro	1			
	Luke	m	pro	1			
	Kylo Ren	m	ant	1			
	Snoke	m	ant	1			
Episode IX: The Rise of Skywalker	Kylo Ren	m	ant	1			
	Palpatine/Sidi-ous	m	ant		1		
	Poe	m	pro				No music
	Finn	m	pro				No music
	Rey	f	pro		1		