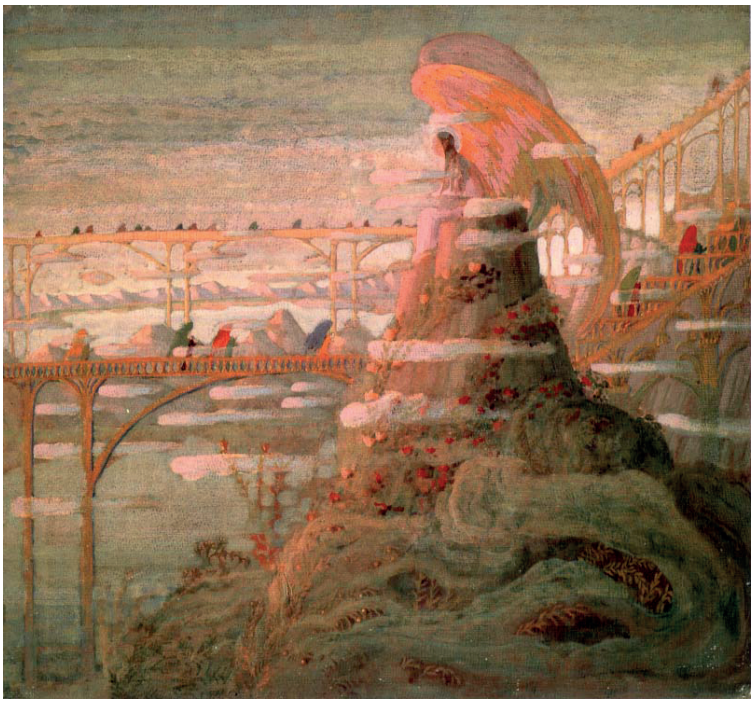
JYU DISSERTATIONS 177

Nerdinga Snape

Building Bridges

Exploration of Music Analysis Methods in Improvisational Music Therapy Research and Clinical Work



UNIVERSITY OF JYVÄSKYLÄ
FACULTY OF HUMANITIES AND SOCIAL SCIENCES

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Exploration of Music Analysis Methods in Improvisational Music Therapy Research and Clinical Work

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ABSTRACT

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Building bridges: Exploration of music analysis methods in improvisational music therapy research and clinical work
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In music therapy, where music is the principal medium of both expression and communication, the use of an appropriate musical analysis method for clinical material is of key importance. An effective approach to music analysis allows accurate assessment of the current state of a client, and adjustment of clinical methods in order to optimise treatment. There are currently a number of analysis methods available, but very little guidance regarding factors that are important in the selection of a specific method for a specific case. This dissertation explores common music analysis methods that are used in music therapy clinical work and research. The goals are 1) to establish how the use of various music analysis methods and the results they provide compare to each other, 2) to explore the factors influencing music therapists' choice, use, and opinion of music analysis in music therapy and 3) to explore computational music analysis in the assessment of depression. This dissertation is based on three studies (a mixed methods study, a qualitative study and a quantitative study), which resulted in four articles. Article I, triangulation of music analysis methods, introduces a novel approach to the classification of music analysis methods. Article II, grounded theory on the use of music analysis methods, proposes that professional freedom – tension between professional responsibilities and creative impulses – is a key factor influencing analysis and its methods in music therapy. Article III, computational music analysis in depression, and Article IV, computational music analysis and emotion in depression, establish a set of links between computationally extracted musical features, depression and felt emotions. Additionally, this dissertation proposes a set of recommendations for using music analysis for clinicians and researchers, and a comparison of the availability, accessibility, efficiency and relevance of various methods. As a body of work, the findings of this project suggest that data triangulation of musical and psychological measures shows the greatest potential for music therapy assessment.

Keywords: music therapy, aural music analysis, notation-based music analysis, computational music analysis, data triangulation

TIIVISTELMÄ (ABSTRACT IN FINNISH)

Snape, Nerdinga
Siltojen rakentamista: tutkimus musiikkianalyysimenetelmistä improvisatorisen musiikkiterapian kliinisessä työssä ja tutkimuksessa
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Musiikkiterapiassa, jossa musiikki on keskeinen viestinnän väline ja tunteiden välittäjä, tarkoituksenmukaisten musiikkianalyysimenetelmien käyttö kliinisen aineiston analysoinnissa on avainasemassa. Tehokas musiikkianalyyttinen lähestymistapa mahdollistaa asiakkaan kulloisenkin tilan arvioinnin ja kliinisten menetelmien sopeuttamisen hoidon optimoimiseksi. On olemassa lukuisia mahdollisia musiikkianalyysimenetelmiä, mutta toistaiseksi vain vähän ohjeita liittyen seikkoihin, jotka olisi syytä huomioida valittaessa menetelmiä kulloistakin tapausta varten. Tässä väitöstutkimuksessa tarkastellaan yleisiä musiikkianalyysimenetelmiä kliinisessä musiikkiterapiatyössä ja -tutkimuksessa. Työn tavoitteena on 1) osoittaa, millä tavoin useiden eri musiikkianalyysimenetelmien tulokset vertautuvat keskenään, 2) tarkastella seikkoja, jotka vaikuttavat musiikkiterapeuttien musiikkianalyysimenetelmien valintoihin, käyttöön ja asenteisiin, sekä 3) tarkastella ohjelmistoavusteisen musiikkianalyysin käyttöä masennuksen arvioinnissa. Tämä väitöstutkimus perustuu kolmeen aineistoltaan erilaiseen tutkimukseen (monimenetelmätutkimus, laadullinen tutkimus ja määrällinen tutkimus), joista on johdettu neljä tutkimusartikkelia. Artikkeli I, joka on musiikkianalyysimenetelmien triangulaatio, esittelee uuden lähestymistavan musiikkianalyysimenetelmien luokitteluun. Artikkelissa II esitellään ankkuroitu teoria musiikkianalyysimenetelmien käytöstä. Tutkimus ehdottaa terapeutin ammatillisen vapauden – ammatillisten velvollisuuksien ja luovien impulssien välisen jännitteen – olevan keskeinen seikka, joka vaikuttaa musiikkiterapeutin musiikkianalyysiin ja analyysimenetelmien valintaan. Artikkeli III käsittelee ohjelmistoavusteisen musiikkianalyysin mahdollisuuksia masennuksen musiikkiterapeuttisssa hoidossa, ja Artikkeli IV tarkastelee ohjelmistoavusteista musiikkianalyysiä ja masentuneen tunteita. Artikkelit III ja IV osoittavat erinäisiä yhteyksiä analyysiohjelmiston avulla havaittujen musiikillisten piirteiden, masennuksen ja tunteiden välillä. Väitöskirjassa esitetään suosituksia musiikkianalyysimenetelmien käytöstä musiikkiterapian kliinisiin ja tutkimustarkoituksiin, sekä vertaillaan eri analyysimenetelmien saatavuutta, saavutettavuutta, tehokkuutta sekä merkitystä. Kokonaisuutena tutkimusprojektin tulokset osoittavat, että musiikillisten ja psykologisten mittareiden aineistotriangulaatiolla on suurin potentiaali musiikkiterapeuttisessa arvioinnissa.

Avainsanat: musiikkitearpia, kuulonvarainen musiikkianalyysi, nuotinnosperusteinen musiikkianalyysi, ohjelmistopohjainen musiikkianalyysi, aineiston triangulaatio

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LIST OF ARTICLES

List of articles not included in this dissertation, but written during doctoral studies that had indirect influence on this work:

A. Letulė, N. 2016. An assessment model for the musical material produced during the course of music therapy. In Casa Baubo 2º Seminario Internacional de Jazz y Musicoterapia, 64-83. ISBN 978-84-608-2928-7.
B. Letulė, N., & Ala-Ruona, E. 2016. An overview of the music therapy professional recognition in the EU. Specialusis Ugdymas/Special Education, 1(34), 133-144.
C. Brabant, O., Solati, S., Letulė, N., Liarmakopoulou, O., & Erkkilä, J. 2017. Favouring emotional processing in improvisational music therapy through resonance frequency breathing: a single-case experimental study with a healthy client. Nordic Journal of Music Therapy, 26(5), 453-472.
D. Erkkilä, J., Brabant, O., Saarikallio, S., Ala-Ruona, E., Hartmann, M., Letulė, Geretsegger, M., Gold, C. 2019. Enhancing the efficacy of integrative improvisational music therapy in the treatment of depression: a study protocol for a randomized controlled trial. Trials, 20, 244.

Author's contribution to the articles:

A. This author designed the study, analysed the data, interpreted the results and wrote the manuscript.
B. This author overviewed the literature and wrote the manuscript. Co-author EA-R gave feedback on the manuscript.
C. OB was the main contributor to the design of the study and data analysis, OL conducted the clinical work, SS assisted in data collection, this author performed the music analysis and wrote a part of manuscript about it.
D. This author was responsible for music and content analysis of the project and was involved in the development of the emotional regulation scale.

List of articles included in this dissertation:

I. Letulė, N., Brabant, O., Thompson, M., & Erkkilä, J. 2015. Triangulation of methods in assessing clinical improvisations. Musiikkiterapia [Finnish Journal of Music Therapy], 30(1-2), 25-47.
II. Letulė, N., Ala-Ruona, E., & Erkkilä, J. 2018. Professional freedom: A grounded theory on the use of music analysis in psychodynamic music therapy. Nordic Journal of Music Therapy, 27(5), 448-466.

III. Letulė, N., Paliulaitytė, I., Thompson, M., Navickas, A., Croucher, S., & Erkkilä, J. Under peer review. The effect of depression on musical expression: Computational analysis of referential and non-referential clinical improvisations.

IV. Letulė, N., Paliulaitytė, I., Thompson, M., Navickas, A., Croucher, S., & Erkkilä, J. Under peer review. The effects of depression on emotional experiences during musical improvisation.

Author's contribution to the articles:

I. This author was the main contributor to the study design, musical and verbal data analysis, interpretation of the findings and manuscript preparation. Data was collected by OL, heart rate variability was performed and written about by OB. JE and MT gave feedback on the manuscript.

II. This author was the main contributor to the study design, data collection, interpretation of the findings and manuscript preparation. JE gave advice on study design, questionnaire development and participant recruitment, whilst EA-R gave feedback on data analysis.

III. This author was the main contributor to the study design, data collection, interpretation of the findings and manuscript preparation. SC gave advice on study design, AN assisted with participant recruitment, IP aided in data collection, MT designed the app for data collection.

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ABBREVIATIONS

BDI	Beck's Depression Inventory
GEMS-45	45 item Geneva Emotional Music Scale
GEMS-45-LT	45 item Geneva Emotional Music Scale in Lithuanian
HRV	Heart Rate Variability
IAP	Improvisation Assessment Profiles
IMTAP	Individual Music Therapy Assessment Profile
MAP	Music Therapy Analysing Partitura
MIDI	Musical Instrument Digital Interface
MIR	Music Information Retrieval

FIGURES

CONTENTS

1 INTRODUCTION

Sound is a means of communication and self-expression that precedes language. Through cries and giggles babies communicate their needs and engage with the world around them. Later in life, we learn to verbalise and use this as the primary means of communication, as it has specific and well-defined meanings. But we also learn to use language in socially acceptable ways, for example, we tailor our language in order to avoid hurting people's feelings. Through music, on the other hand, we can use sound to freely give voice to all our thoughts and emotions without any censorship. This ability to engage with sound on an emotional level is what makes us so involved with our favourite songs and bands, and it can also be used by therapists as a tool to reach what is deep inside each of us.

When music is the topic of conversation, it is usually in a relaxed informal setting, because we tend to see music as an entertaining but essentially trivial part of life. Thus, by extension, it might seem that music therapy is not as notable a part of the modern health care system as psychotherapy because it involves music, which is not a *serious* activity. Additionally, verbal therapy can be seen as superior due to the easier means of rationalising the therapeutic process ("we talked about my childhood"), whilst the significance of musical activities is hard to capture verbally. Ansdell (1999) calls it the *music therapist's dilemma*: the problem of explaining musical processes to fellow health care professionals, who have no musical knowledge.

As health is our most valuable asset, anything that relates to health care is – and should be – highly scrutinised. And whilst the process of assessing efficacy is unambiguous in the case of pharmaceuticals, it is not so straightforward in mental health care, as it is so highly individual, and particularly complex in non-verbal psychotherapeutic interventions. Emotional states that are hard to capture with words can be expressed through sounds, and this makes music therapy a very effective therapeutic intervention and at the same time a very difficult phenomenon to monitor in an objective manner.

It is also important to remember that music therapy developed from clinical work, where practitioners noted how effective music was as a therapeutic tool and developed many different approaches and techniques of using it to work

with various client groups, and not because of a strong unanimous music therapy theoretical framework, or of an abundance of music psychology experiments suggesting therapeutic potential. As Ruud says (2016, p. 135), the future is likely to be even more complex:

> A paradigm of complexity thus attempts to balance different explanations or understandings where several influences or factors operate, some linked to music, some to relational circumstances, some to the context or situation, and not in the least, some to the personal interpretation of the individuals involved… If we project this contemporary situation into the future, we might also predict new integrative models coming, a further differentiation of theories, increased complexity, new tensions and conflicts among adherents of different paradigms, as well as new challenges from research based upon monocausal bids of how and why music affects us.

This project arose from an observation that there was an abundance of studies proposing methods of analysing music in music therapy, but a distinct lack of literature adopting those methods into research. Also, as music therapy is evidence-based practice, and Music Information Retrieval (MIR) provides the most efficient and objective means of gathering data, I wondered why there were not more computational music assessment tools. Consequently, after completing my Master's degree, I thought that I knew how my PhD should progress: during the next five years I would develop a computational music analysis method so that every music therapist around the world could access and use technology in their clinical work. Instead, during these years of doctoral studies I have come to realize that a standalone program with a user-friendly interface would still be futile if it lacks concrete direction on how to interpret the results. If I had followed my initial (entirely reasonable and coherent) proposal, I would have added to the abundance of methods that already exist and have not been widely adopted. Now, after finishing my PhD, it seems likely I will spend the rest of my career researching how to link music and clinical issues and maybe someday there will be enough evidence to form the basis for that software program for music analysis in therapy.

The main aim of this project is to explore music analysis methods in improvisational music therapy research and clinical work. More specifically, I research the use of music analysis in music therapy with the intention of providing guidance for clinicians and researchers on the selection of an appropriate music analysis method for their needs, as well as to aid the development of clinical music assessment methods. This research project seeks to address the following questions: how do the results of different music analysis methods compare to each other, which music analysis methods do therapists actually use in their clinical work and research, what factors guide their choices, and can computationally retrievable musical parameters of clinical improvisation be linked to emotional experiences? In exploring these issues, I aimed to build bridges between musicology (the study of music), MIR (computational technology) and music therapy (emotional experiences); between researchers (developing music analysis methods) and clinicians (applying those methods in practice); and between various (aural, notation-based, computational) music analysis methods.

This dissertation is comprised of four original articles based on three studies, which will be discussed in the following chapters. Chapter 2 will introduce theoretical background of the project: improvisational music therapy in general and various music analysis methods that can be used to analyse clinical improvisation. Chapter 3 will give an overview of the research aims and methodologies of all the studies. Chapter 4 will summarize each article in terms of research aims, methods and results. Chapter 5 will discuss the main findings of the project, present a summary of the challenges in triangulating music analysis methods, suggest recommendations for clinicians and researchers, acknowledge limitations and consider the relevance of the dissertation. Chapter 6 will present the conclusions.

2 MUSIC ANALYSIS IN MUSIC THERAPY

2.1 Improvisational music therapy

2.1.1 Music and emotion

Music and emotion is a major area of research in the field of music psychology. One of its main topics is the study of emotional responses to music by a listener. Music's ability to evoke emotions has been researched and documented from as early in human history as the writings of the ancient Greek philosophers (Bonde & Wigram, 2002; Garrido & Davidson, 2013) and it has been proposed that the ability of music to induce diverse emotions is one of the main reasons why people of all cultures and backgrounds engage in musical activities (Juslin & Laukka, 2004; Juslin, Liljeström, Västfjäll, Barradas, & Silva, 2008; Schubert, 2013).

Studies have shown a wide range of emotions in response to music, including findings that music can elicit memories (Blais-Rochette & Miranda, 2016; Janata, Tomic, & Rakowski, 2007), stimulate neurochemical systems related to stress and reward (Chanda & Levitin, 2013), and can be used to successfully regulate emotions (Chin & Rickard, 2014; DeNora, 2000, 2013; Juslin, Liljeström, Västfjäll, & Lundqvist, 2010; Juslin & Västfjäll, 2008; MacDonald, 2013; Marik & Stegemann, 2016). Although the effects of music on emotions have been documented many times, it is not yet clear how the underlying mechanisms of this process function (Juslin, Barradas, & Eerola, 2015; Juslin, Harmat, & Eerola, 2014; Saarikallio & Erkkilä, 2007). Juslin and Västfjäll (2008b) suggest that emotional engagement in music is based on a variety of factors, such as brain stem reflexes, evaluative conditioning, emotional contagion, visual imagery, episodic memory, and musical expectancy, rhythmic entrainment and aesthetic judgment. This shows that music evokes emotions in a variety of biological, psychological and social ways, which makes this a complex research topic.

The majority of the studies in this field have examined the emotional responses of a listener to music produced by a professional musician or musicians. Musical emotions are then categorized into those that are perceived (expressed

by the music) and those that are felt (experienced by the individual) (Evans & Schubert, 2008; Gabrielsson, 2002; Schubert, 2013). Perceived emotions are considered to be related to musical parameters of the musical stimulus (Sloboda & Juslin, 2001), whilst felt emotions are more difficult to predict as they as they vary greatly according to individual differences (DeNora, 1999, 2000, 2010).

2.1.2 Psychodynamic music therapy

The capacity of music to convey emotion has been exploited professionally in the music therapy field, where; "a therapist helps the client to promote health, using music experiences and the relationships that develop through them as dynamic forces of change" (Bruscia, 1998, p. 20). In music therapy clients can listen to music, referred to as the receptive approach, or produce their own music, referred to as the active approach.

Psychodynamic music therapy (as well as eclectic or integrative approaches that incorporate psychodynamic theory) utilises the relationship between music and emotion for therapeutic purposes. Psychodynamic theory originates in Freud's psychoanalytical theory, Jung's analytical psychotherapy, Kohut's self-psychology, and Stern's interaction theory (Hadley, 2003; Kim, 2016). In the words of Austin (1996), psychodynamic therapy is "the creative process of exploring and integrating unconscious aspects of one's psyche" which "enables the client to become the unique self he or she truly is" (p. 30).

Freud introduced a topographical model of mind, in which personality is seen as a dynamic relationship between consciousness, pre-consciousness and unconsciousness (de Sousa, 2011). Psychodynamic music therapy, then, is exploring "dynamic processes within, an unconscious part of the mind, which has an influence on intrapsychic and interpersonal processes within and outside of the musical activity between the therapist and patient" (Metzner, 2016, p. 448). Music, "as pure experience in the here and now, as a mediator between unconscious and conscious awareness, and as a form of symbolic communication" (Austin, 1996, p. 41), enables clients to access the unconscious information and express it, through music, in order to integrate it into the conscious mind.

In this theoretical framework, music is interpreted from a position of referentialism (as opposed to absolutism), which is the belief that music is capable of communicating extramusical meanings (Meyer, 1956). Bunt and Pavlicevic (2001) hypothesise that in the therapeutic setting music can trigger *associative connections* to people, places and events; *iconic connections*, which link musical parameters to specific events or feelings; and *intrinsic connections*, which link emotional experiences with different aspects of music. Smeijsters (2005) suggests viewing music as amodal temporal and intensity forms, which indicate concurrent psychological processes. In this view, "the music therapist is the one who hears the musical process as a psychological process and makes arrangements to transform psychological processes in musical process" (Smeijsters, 2005, p. 80). Wigram, Nygaard Pedersen, and Bonde (2002) propose metaphorical interpretations for musical parameters, for example, that tempo represents a client's flexibility in his life, modality or tonality are expressions of emotion, texture represents ability to

cooperate with a leader, whilst rhythm signifies independence in the world. Consequently, there is not a single commonly accepted music therapy theory explaining how music is connected to emotional and psychological processes, but rather a variety of interpretations (De Backer & Sutton, 2014).

2.1.3 Clinical improvisation

Although there are many ways of engaging in musical activities in music therapy, this research focuses on improvisation – spontaneous music making – which stimulates simultaneous cognitive, emotional and physiological processes (Davis, Gfeller, & Thaut, 2008; Wigram, 2004). From a psychodynamic viewpoint, improvisation is perceived as a form of self-projection, thus containing extra-musical meaning such as associations, imagery, and metaphors (Darnley-Smith & Patey, 2003; Hadley, 2003). The aim of engaging in improvisation depends on individual therapeutic goals, but in general it is related to self-expression and nonverbal communication. This could be further differentiated into the development of specific perceptual, cognitive, or social skills (Bruscia, 1998).

Improvisation has been useful in working with various client populations (De Backer, & Foubert, 2016). There is literature on cases involving autism (Geretsegger, Holck, & Gold, 2012), eating disorders (Robarts, 2000; Trondalen, 2003), dementia (McDermott, Crellin, Ridder, & Orrell, 2013; Ridder, Stige, Qvale, & Gold, 2013), addiction (Albornoz 2011), neurorehabilitation (Magee & Baker, 2009; Tamplin & Baker, 2006), palliative care (Hartley 2001) and a variety of mental health issues (Gold et al., 2013). Therefore, improvisation is a versatile method that can be successfully used in the treatment of a wide variety of clinical issues.

Clinical improvisations are created by people with clinical issues, as opposed to classical improvisations produced by professional musicians. Music therapy clients often do not possess musical knowledge or specific musical skills (Wigram, 2004), thus the music they create is not considered a form of art with the primary goal of aesthetic appreciation (Aigen, 2005). Although lack of musical ability can result in "very simple sound forms" that lack clear metrical or tonal organization (Bruscia, 1987, p.5), it does not limit one's ability to express emotions and to communicate non-verbally, which is the primary goal in therapy.

Clinical improvisation in general is not restricted to a particular style or genre, but it can be more or less structured depending on the clinical goals. For example, in the Finnish Integrative Improvisational Music Therapy approach (Erkkilä, 2016), improvisations are free musically, but can often have a non-musical reference such as a specific image, relationship, or a story to improvise upon (Bruscia, 2001; Gardstrom, 2004; Keith, 2007). Wigram (2004) suggests giving a musical reference for the improvisation by creating a brief rhythmic, melodic or harmonic theme at the beginning of the improvisation. Another example of clinical improvising is the piano improvisation paradigm (ABA') developed in Denmark (Foubert, Collins, & De Backer, 2017), which is structured musically by two different accompaniment styles performed by the therapist: one is a repetitive bourdon in E Phrygian mode (A and A'), whilst the other one is dynamic in tempo, dynamics, and modal structure (B).

Finally, clinical improvisations can vary depending on the number of people involved: they can be a solo performance or a duet with a therapist or even a group improvisation, where musical interactions with the therapist or other clients play an important role. In individual music therapy, the most common way of improvising is in duet with a therapist, whilst in the group therapy setting the most common approach is group improvisation. Although solo improvisation is not as common a method in music therapy as interactive playing, it is utilised when clinical goals are related to identity and self-expression, rather than interpersonal communication and socialisation.

2.2 Overview of music analysis in therapy

2.2.1 Importance of music analysis in music therapy

Music therapy research has traditionally used qualitative methods to explore audio and video recordings of clinical cases (Lee & McFerran, 2015; Wheeler & Kenny, 2005). Over the years, music therapists have developed a number of methods for analysing and interpreting improvisation (Bonde, 2005; Wosch & Wigram, 2007). In both clinical work and research, music analysis has been employed as part of assessment, which can be used for a variety of purposes (Hanser, 1999; Wigram, 1999). Waldon and Gattino (2019, p. 30) list five reasons to analyse the music in music therapy:

(a) diagnostic assessment (to obtain evidence to support a diagnostic hypothesis); (b) general assessment (to identify the general needs of the client from a holistic perspective and recommend relevant intervention); (c) assessment of music therapy intervention (to obtain evidence supporting the value of music therapy as an intervention); (d) assessment prior to treatment (to determine in the first two to three sessions a therapeutic intervention relevant to the client); and (e) assessment of effectiveness of treatment (to evaluate the effectiveness of music therapy near the conclusion of treatment).

In addition to being pivotal in clinical work, effective methods of music assessment are critical for the development and professional recognition of the music therapy discipline (Michel & Pinson, 2005). Erkkilä (2016, p.26) notes that:

The meaning of music, as an essential part of the therapeutic process and as an essential source of clinically-relevant information, is important. Therefore, we aim to develop ways of looking at improvisation from an analytical point of view by utilizing methods that are as objective as possible to gain a better understanding of something that is highly abstract in nature.

Indeed, it has been observed that "music therapy literature includes surprisingly and disappointingly few studies with a focus on music itself" (Bonde, 2016, p. 105). Since music therapy is a relatively young discipline that has devel-

oped primarily from clinical work by music therapy practitioners, the development of sufficiently objective assessment methods is an issue that, so far, has not been addressed (Wosch & Wigram, 2007). Whilst there is some research that deepens the scientific understanding of music in music therapy (Bonde, 2016a), "more and more rigorous research (quantitative, qualitative and mixed methods) is urgently needed." (Dileo, 2016, p. 159-160).

Music therapy literature that includes analysis and interpretation of music has often been subjective and does not report sufficient data to be replicable. Sabbatella (2004) carried out a music therapy literature meta-analysis and found that the majority of studies did not address data collection, measurement, evaluation, interpretation, or reporting in a consistent manner. In a literature review of research exploring the effectiveness of music therapy, Gregory (2000) found that 50.27 % of studies did not have any test instrument. In efforts to improve this situation some music therapy research journals have implemented more rigorous blinded peer review processes and request authors to follow conduct guidelines with regard to study design, result reporting, editing and publishing (International Committee of Medical Journal Editors, 2018).

2.2.2 Relevance of musicology and MIR to music therapy

Music analysis methods in music therapy are by necessity different from the music analysis methods employed in traditional musicology and from that typically used in Music Information Retrieval (MIR). This is because the music produced in therapy is very different from the art or popular music that is commonly analysed by musicologists and MIR. Music of music therapy sessions is produced by clients who do not usually have musical training and do not aim to produce something aesthetically pleasing, but rather to meet clinical goals. Nonetheless, the "musical features of clinical improvisations are very valuable phenomena in research" (De Backer, & Foubert, 2016, p.118), and music therapists can utilize methods that have been developed by musicologists and MIR in order to extract meaningful information from music.

Musicology literature has a wealth of information that is of relevance to the music therapy field (Ansdell, 1997; Lee 2000; Rolsvjord, 2006). One of the most important contributions of music theory is the distinction between the various identified musical parameters based on their capacity to form musical syntax. Meyer (1989) proposed the classification of musical parameters as either primary or secondary, where primary parameters have discrete, proportional relationships (e.g., the up-beat and down-beat of meter, or the tonic and dominant of harmony), and secondary parameters have relative changes (e.g., softer and louder in dynamics, or darker and brighter as a description of timbral change). Since secondary parameters do not form hierarchical relationships, their perception is instantaneous (i.e. one can immediately tell if the sound is louder or quieter), whilst primary parameters – because of their organizational complexity – take time to perceive, since, after hearing a single chord without context, there is no way of knowing if it is a tonic or dominant. This only becomes apparent in the context of surrounding chords.

Lee (2000) proposed a method of analysing clinical improvisations that is rooted in music theory: "Analytical questions that arose from my research: a) Is there a harmonic cell? b) Are there tonal centers? c) Are there melodic motifs or characteristic intervals? d) Are there rhythmic motifs or cells? e) Is there a metric structure? f) What are the characteristic textures?" (p. 158). In the music therapy context, however, improvisations can often be too chaotic to form musical syntax, and Lee's analysis method cannot be utilized. As Eitan and Granot (2009) point out, "while the perception and cognition of secondary parameters, even in a musical context, may be chiefly based upon general auditory experience (or perhaps even on innate tendencies), processing primary parameters relies chiefly on music-specific exposure" (p. 144). In some clinical cases primary musical parameters cannot be successfully identified or meaningfully analysed. For example if clients have very limited music-specific exposure or their condition significantly reduces their ability to improvise, secondary musical parameters become of key importance in music analysis.

Technological advancements in the fields of music technology and MIR have benefited both music therapy practice (Magee & Burland, 2008) and research (Streeter, 2007), as therapists are able to employ a wide variety of technologies in music making (Knight & Krout, 2016) and utilize technology in the assessment and evaluation of both clinical work and research (Hadley, Hahna, Miller, & Bonaventura., 2013). These recent technological developments have opened up opportunities for efficient and reliable data capture and analysis, and as Dileo (2016) notes in her reflections on the future of music therapy, the use of computational analysis of improvisations has become an important topic for music therapy research.

De Backer and Foubert (2016) identified the differences between manual and computational analysis methods in music therapy. Manual analysis methods are time consuming and depend on the subjective opinion of the assessor, and in the case of the notation based analysis, "are difficult to use when the music becomes complex, for example, when there is no clear meter, tempo, rhythm and/or pitches" (De Backer & Foubert, 2016, p.118). Computational methods, on the other hand, are objective, reliable and can process large amounts of data very quickly (Erkkilä, Ala-Ruona, & Lartillot, 2014), but have, thus far, been "often restricted to one study, not developed and validated by other researchers and not implemented in clinical practice". (De Backer & Foubert, 2016, p.119).

2.2.3 Challenges of the use of technology in music therapy

Although new technologies bring advantages in terms of reliability and speed of analysis, in the music therapy field they have yet to be implemented to their full potential. De Backer and Foubert note that "the fast development of Music Information Retrieval in the areas of music psychology, music cognition and musicology is in contrast with the slow developments within music therapy (2016, p.118).

Hahna, Hadley, Miller and Bonaventura (2012) carried out a study exploring the role of technology in clinical work. They found that the main difficulties in implementing computational tools in music therapy practice were the lack of

professional experience in the use of technologies, limitations in the workplace's financial and physical resources, and a belief that technology was not appropriate in music therapy clinical work. Perhaps the most surprising and worrying finding was that the majority of music therapists stated having no formal education in technology.

Another survey, carried out by Magee (2013), resulted in similar findings to Hahna et al., with additional detail: they found that clinicians in general would like to use technology in their practice if they were taught how. They found gender and age bias, since females and people born before 1970 were less likely to use technology. Therapists who did not consider technology appropriate for music therapy clinical work, listed reasons such as the importance of the vibroacoustic nature of music, that digital music was inferior to acoustic music, and that technology can be intrusive as it creates physical barriers between therapist and client and takes time to set up and use.

Streeter (2007) reported that training and professional development differs worldwide, and that technology courses, as a part of music therapy training programs, were more common in the United States than in, for example, the United Kingdom, which resulted in a global music therapy community with widely varying skills and competences regarding the use of technology. In the opinion of Crowe and Rio (2004), all music therapy curriculums should include courses on adapted musical instruments, music technology, electric/electronic musical instruments, medical technology, assistive technology for people with disabilities, and technology-based music/sound healing practices.

This reluctance to adopt technology by music therapy practitioners and educators (Magee, 2006), offers an explanation as to why the development of computational music analysis tools has been prolonged, and as Stensæth and Magee (2016) note:

> Adequate and appropriate training in music technology related to clinical practice continues to be a need that remains unmet, with attention required for making technology accessible to a variety of learners. Technology needs to be included as a mandatory subject in many music therapy programs and curricula to secure that music therapists get sufficient training in the use of it. (p.150)

2.3 Examples of music analysis methods in music therapy

2.3.1 Classification of music analysis methods based on data

In this section, music analysis methods are considered based on the type of data that is analysed: auditory events, staff or graphical representations of auditory events or digital recordings, which can be captured as audio or MIDI files. Auditory events are analysed using aural music analysis, staff or graphical representation of it with notation-based analysis, and digital recordings with computational analysis in the form of MIR.

Aural music analysis is the most traditional and prevalent music analysis method in music therapy (Bruscia, 1987; Gattino, Jacobsen, & Storm, 2019). Aural music analysis can be performed manually, for example, using the *Improvisation Assessment Profiles* (IAP, Bruscia, 1987) or with the aid of technology, as in the *Individual Music Therapy Assessment Profile* (IMTAP, Baxter et al., 2007).

Notation-based analysis is carried out by transcribing music into either a staff (De Backer, 2008; Lee, 1996) or a graphical score (Bergstrom-Nielsen, 1993). Notation-based analysis can be performed manually or with the aid of technology by using music transcription software such as Sibelius, Finale, or Cubase for staff notation (Lee, 2000), or software such MAP (Gilboa, 2012) or *MaWii* (Benveniste, Jouvelot, Lecourt, & Michel, 2009; Benveniste, Jouvelot, & Michel, 2008) for graphical notation. It should be noted that the software mentioned here aids analysis but does not perform it. Sibelius, for example, displays MIDI information in the form of a staff notation, which is used as a means of data preparation for analysis to be performed by a researcher, as opposed to computational analysis, where the data analysis itself is performed by the software. MAP software, equally, requires manual input of music and speech data, thus it is a system of representing musical data graphically with the aid of technology, not analysing it computationally. Sutton (2001) notes that, although visual representation allows researchers to analyse various musical structures in great detail, it is not an accurate record of musical events in its entirety as representation captures only a select number of musical parameters. Staff notation is particularly time consuming and requires extensive expertise in music transcription and analysis (Gilboa, 2012), but also enables a very comprehensive examination of the "building blocks of improvisation as a means to better understand the intricacies of the process" (Lee, 2000, p. 147).

Computational music analysis methods utilize the frequency and amplitude information embedded in audio recordings, or the up to 128 different pieces of information captured by MIDI, to identify and analyse the musical parameters of an improvisation. Computational analysis methods are objective and efficient but currently lack ecological validity as there are very few studies utilizing it in music therapy (De Backer, 2008, Magee, 2014).

2.3.2 Aural analysis

2.3.2.1 Manual methods

There is a wealth of literature on approaches to analysing music aurally (Abrams, 2007; Baxter et al., 2007; Frederiksen, 1999; Forinash & Gonzalez, 1989; Gardstrom, 2004; Jacobsen, 2012; Keith, 2007; Mahoney, 2010; McFerran & Wigram, 2004; Scholtz, Voigt, & Wosch, 2007; Wosch & Erkkilä, 2016). This section will present five different approaches to music analysis to illustrate the variety. The first two are seminal works – Nordoff–Robbins' various assessment tools (Nordoff & Robbins, 1977) and Bruscia's IAP (Bruscia, 1987) – which have greatly influenced music therapy practitioners and researchers and laid the groundwork on how to observe and interpret musical data in clinical settings (Wigram & Jacobsen, 2019). Further methods discussed in this section are *The Individual Music-*

Centered Assessment Profile for Neurodevelopmental Disorders (Carpente, 2013) which was inspired by Nordoff-Robbins' *Tempo-Dynamic Schema* and *13 Categories of Response*, and Wigram's *Event-Based Analysis* (Wigram & Jacobsen, 2019), which is rooted in Bruscia's IAP. Carpente and Wigram's work is presented here because they represent new developments in music therapy assessment tools in terms of reliability of method and, at the same time, they build upon the work of previous authors thus ensuring the validity. The final method – IMTAP (Baxter et al., 2007) – shows development in the use of technology, where the outcome of aural analysis is documented using software developed specifically for this purpose.

Nordoff and Robbins developed various methods, such as *Indexing*, *Tempo Dynamic Schema*, *Thirteen Categories of Response* and three *Evaluation Scales* to analyse and interpret clinical improvisations (Aigen, 1998, 2014; Guerrero & Turry, 2012; Nordoff-Robbins, 1977). In the *Indexing* method, a therapist annotates audio or video recordings based on a client's expression in terms of tempo, melodic and rhythmic organization as well as with the therapist's musical interventions (Mahoney, 2010). *Tempo-Dynamic Schema* is designed to assess musical expressivity in terms of normal (i.e., similar to common musical practice) or pathological (i.e., inflexible or musically meaningless). *Thirteen Categories of Response* evaluates clients drum beating and a response to the therapist's piano playing, in terms of both musical and behavioural responses to various musical parameters (Nordoff & Robbins, 2007). *Evaluation Scales* assesses three competences: Child-Therapist's Relationship in Musical Activity (Scale 1), Musical Communicativeness (Scale 2), and Musical Response (Scale 3).

Bruscia's IAP (1987) consists of six profiles – integration, variability, tension, congruence, salience and autonomy – which are applied to a list of musical parameters – rhythm, tonality, texture, volume, timbre. Depending on therapeutic or research goals, one can analyse all parameters within one profile (e.g., rhythmic integration, tonality integration, texture integration etc.) or all the profiles within one parameter (e.g., rhythmic integration, rhythmic variability, rhythmic tension etc.). Each profile consists of five gradients, for example, integration profile is scored as 1) undifferentiated, 2) fused, 3) integrated, 4) differentiated or 5) over-differentiated; which is based on field-dependence and field-independence theory (Witkin et al., 1977), and in a music therapy context is interpreted as to how similar or separate and independent different musical parameters are to each other (Stige & Wigram, 2000).

The *Individual Music-Centered Assessment Profile for Neurodevelopmental Disorders* (IMAPND) (Carpente, 2013, 2019) was developed to assess a client's ability to engage in musical activities. The assessment is based on the frequency of responses, and it is scored on a scale from 0 (does not exhibit response) to 5 (consistently exhibits response). IMAPND consists of three scales. The *Musical Emotional Assessment Rating Scale* assesses clients' musical attention, affect, adaptation to musical play, engagement, and interrelatedness, and is scored for both the frequency of a client's responses and the support the therapist provides for the client in order to elicit the response. The *Musical Cognitive/Perception Scale* assesses how

well a client is able to react to, focus on, recall, follow, and initiate five musical parameters: rhythm, melody, dynamics, phrasing and timbre. The *Musical Responsiveness Scale* assesses a client's preferences, i.e. response with positive affect, perceptual efficiency (performance in perceptual tasks), and self-regulation (attention and availability for interaction), related to changes in tempo, dynamics, pitch range and attack. All subscales were reported to have the highest level of inter-rater reliability (Carpente & Gattino, 2018).

Event Based Analysis (Wigram, 1999, 2000, 2002, 2007) was developed for work with children with autism and other communication disorders. It is based on the autonomy and variability profiles from Bruscia's *Improvisation Assessment Profiles*, but Wigram suggests counting events and using descriptive statistics to score predefined clinically relevant categories. Wigram uses an event charting system, where he makes a mark every time he hears a relevant musical fragment (Wigram & Jacobsen, 2019). A maximum of three musical parameters is selected based on their therapeutic relevance and the individual needs of the client. In Wigram's experience, if a child chooses unpitched percussion instruments, then tempo, rhythm, volume, timbre and phrasing are the most common parameters, whilst with pitched instruments melody and harmony can be more relevant (Wigram, 2000). Based on Wigram's *Event Based Analysis* Jacobsen developed a method for screening emotional parental neglect - *Assessment of Parent-Child Interaction* – which was tested for robustness and had good validity and reliability scores (Jacobsen & McKinney, 2015).

2.3.2.2 Technologically-aided methods

IMTAP is a software application for music therapy assessment of paediatric and adolescent clients (Baxter et al., 2007). It was developed to collect and manage the data from music therapy assessments into ten domains, one of which musicality. The musicality domain is assessed based on how frequently (0%, <50%, 50-80%, or 80-100% of the time) a client exhibited skills related to nine musical subdomains: 1) fundamentals (is alerted by music; expressed enjoyment of music; indicates desire to play/touch instruments; plays instruments when presented; explores instruments etc.), 2) tempo (e.g., demonstrated awareness of gross tempo changes), 3) rhythm (e.g., imitated a simple rhythmical pattern), 4) dynamics (e.g., demonstrated awareness of gross dynamic changes), 5) vocal (e.g., vocalized in response to a particular musical style), 6) perfect and relative pitch (e.g., played melodically in the tonality of music), 7) creativity and development of musical ideas (e.g., improvised melody to a given rhythmical pattern), 8) musical reading (e.g., played simple accompaniment using chord chart) and 9) accompaniment (e.g., vocalized and played simultaneously with a pulse).

2.3.3 Notation-based analysis

2.3.3.1 Manual methods

Lee (2000) developed a staff notation-based music analysis method, which incorporates elements from Schenkerian analysis. This analysis method is carried out in nine stages:

1) Holistic listening to the whole improvisation multiple times on multiple occasions to identify the most salient musical parameters;

2) Writing a narrative of therapist's reactions to the musical processes;

3) Transcribing client's comments on their own music;

4) Transcribing conversations with consulting musicians, psychotherapists or music therapists;

5) Transcription into notation of overall harmonic, melodic and rhythmical parameters in as much detail as time allows;

6) Segmentation into musical components based on musical phrasing and structure;

7) Verbal description of musical events;

8) Comparing musical events to data from client and consultants;

9) Integrating all the data to draw clinical conclusions.

Bergstrom-Nielsen developed *graphic notation* to visually represent clinical improvisation (Bergstrøm-Nielsen, 1993, 1999, 2009). Therapists are encouraged to develop an individual legend, where any symbol can be linked to a specific musical expression or interaction, especially those musical aspects that are therapeutically relevant, but cannot be captured using staff notation. Parker (2011) developed a method that combines staff notation with graphic and verbal notes, to capture 'musicotherapeutic objects'.

2.3.3.2 Technologically-aided methods

Gilboa and Bensimon (2007) created MAP (Gilboa, 2012), a technologically-aided analysis method that uses a standardized legend of instruments and performance characteristics as well as symbols for talking, crying, laughing and silence to annotate music therapy sessions. Although it presents data in a concise and systematic form, the use of the tool is based on the therapist's manual input of data.

MaWii utilizes the Nintendo Wii's remote haptic devices to generate and measure sound in music therapy (Benveniste, Jouvelot, Lecourt, & Michel, 2009; Benveniste, Jouvelot, & Michel, 2008). The handheld Wii controller is used to generate the sound, which can be on one of 12 timbres (two congas, two djembes, four cymbals and four marimba pitches) and five volume levels. This system represents a novel approach to generating and capturing sounds in music therapy, but as yet does not have built-in analytical functions. Consequently, it is classed here as a technologically-aided graphic notation method and not as a method of computational music analysis.

2.3.4 Computational analysis

The *Computer Aided Music Therapy Analysis System* (CAMTAS) was the first technology-aided analysis system developed specifically for music therapy, and was used to organize and analyse music and video recordings with the intent to assess a client's musical behaviour over a period of time (Hunt et al., 2000; Verity, 2003). CAMTAS had very few functions (played video and music recordings, had piano roll representation and could perform velocity analysis) due to the technological

limitations of the time. Hunt said "computers weren't running quickly enough for what we wanted to explore" (Streeter, 2007).

Music therapy Toolbox was developed to analyse MIDI recordings (Erkkilä, Lartillot, Luck, Riikkilä, & Toiviainen, 2004). The available analysis functions are based on register, tonality, dynamic, and pulse related musical parameters (Erkkilä, Ala-Ruona, & Lartillot, 2014). One can analyse either an individual track, or the musical interaction between therapist and client in terms of synchronicity, which is represented in the form of an imitation diagram (Erkkilä, 2007).

The *Music Therapy Logbook* system is developed to store and perform qualitative and quantitative analysis of audio and MIDI data (Streeter et al., 2012). Its available music analysis functions are duration, tempo, instrumentation, and interaction between client and therapist (Streeter, 2010).

2.3.5 Using quantitative data in diagnostic models

The aim of music therapy is not to teach a client musical skills, consequently monitoring musical activity alone is not sufficient to assess therapeutic changes. This needs to be performed in relation to clinical observations. Hammersley (2008) says "using data of different types can help us both to determine what interpretations of phenomena are more and less likely to be valid and to provide complementary information that illuminates different aspects of what we are studying"(p. 31). Research has shown that using both qualitative and quantitative methods in research – a practice known as triangulation – enables researchers to better validate results (Hussein, 2009). In music therapy, it can be used to explore the links between musical, physiological, and psychological processes. Erkkilä (2016, p. 28) notes that:

> An even bigger challenge for the entire music therapy community is understanding the meaning of musical behavior from psychological and/or physiological perspectives. There are various questions to be answered, such as how an illness affects musical behavior in general, whether the process of recovery can be detected in one's musical behavior, or whether there are diagnosis-specific patterns in musical behavior in the population.

Some studies have investigated physiological measurements, such as heart rate, respiration rate, galvanic skin response, oxygenation levels, and blood pressure, during music therapy (Crowe & Rio, 2004; Standley & Whipple, 2003), but these have not yet been linked directly to musical processes. Psychological measurements, one the other hand, have been successfully used in conjunction with musical analysis to link certain musical behaviours to clinical diagnoses. Luck, Lartillot, Erkkilä, Toiviainen and Riikkilä (2009) used computational analysis of MIDI recordings to predict three types of clinical diagnoses: intellectual disability, developmental disorder and neurological disorder. They analysed 216 improvisations by 50 participants and found that by using 43 computationally-retrieved musical parameters it was possible to correctly predict 80 % of diagnoses. Foubert, Collins and De Backer (2017) used computational MIDI analysis to predict whether improvisation was performed by a healthy participant, or a client

with borderline personality disorder. 28 participants performed one improvisation each in a dyad with a therapist. Analysis of intrapersonal timing (i.e., interaction between client and therapist) successfully predicted 83% of the borderline personality disorder cases.

3 AN OVERVIEW OF RESEARCH AIMS AND METHODOLOGIES

Although music, as the expressive medium, has a central role in music therapy, the music produced during therapy has not been sufficiently analysed in scientific literature. The first step in seeking to determine the reason for this was to find out what music analysis methods are available to therapists, and how the results of these methods compare to each other. Study 1 was designed to bring some clarity to these issues, and the first article documented its findings. Study 2 subsequently explored questions raised by the findings of Study 1: Why were so many different music analysis methods being used by therapists, what determined their choice of method, and how did they use music analysis during clinical work and research? The second article formulated the answers to these questions into a grounded theory. Study 3 was conceived and designed following the insights gained from Studies 1 and 2: that computational music analysis seems to have the greatest potential for objective assessment of clinical material, but it lacks quantifiable links between its results and clinically relevant issues. For Study 3, it was decided to explore the links between music and depression, as one of the most prevalent and debilitating illnesses worldwide which can be effectively treated with music therapy (Aalbers et al., 2017; Maratos, Gold, Wang, & Crawford, 2008). The third article investigated whether computational music analysis could be used to identify musical expression that was affected by depression, whilst the fourth article explored the links between the musical expression and the emotional experiences during improvisation of depressed and healthy populations.

The main aim of the present dissertation was to investigate music analysis methods that could be meaningfully applied in music therapy research and clinical work. The goals of the present work were:

- to overview various music analysis methods, and to see how the use of these methods and the results they produce compare to each other (Study 1, Article I);

- to explore the factors influencing music therapists' choice, and use, of music analysis methods in clinical work and in research (Study 2, Article II);
- to explore computational music analysis in the assessment of depression:
    - to establish which musical parameters could be used as a marker for depression (Study 3, Article III);
    - to establish a relationship between musical parameters and emotional experiences whilst improvising (Study 3, Article IV).

This dissertation included mixed methods (Study 1), qualitative methods (Study 2) and quantitative methods (Study 3) applied to data from various sources, to provide a multifaceted overview of the use of music analysis methods in therapy (Figure 1).

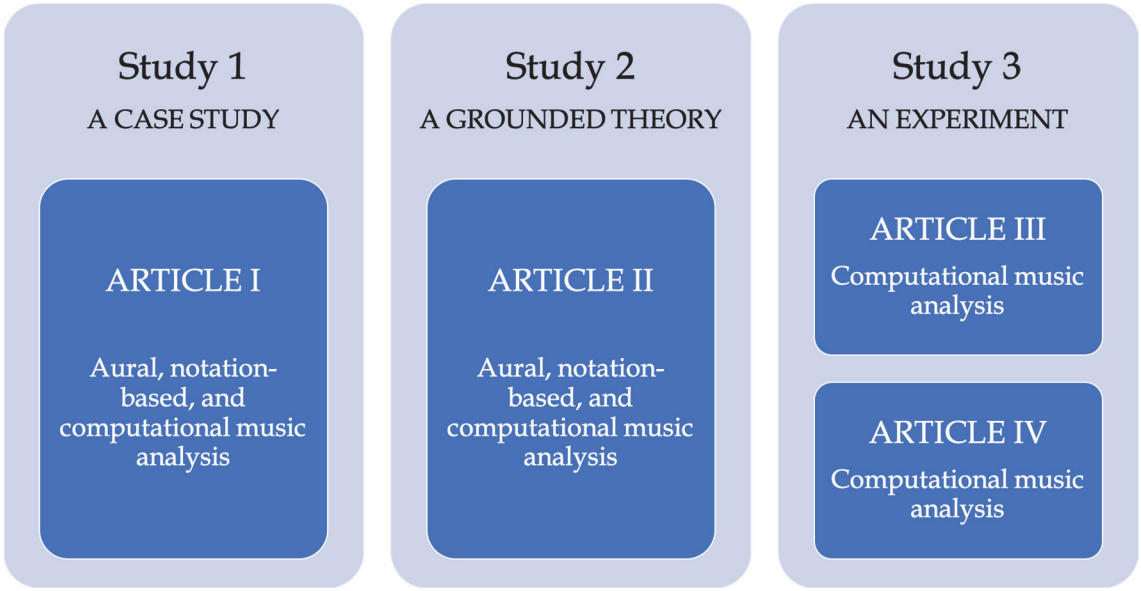

FIGURE 1 An overview of the articles included in the present dissertation.

In Study (Article I) three approaches to music analysis were reviewed (aural, notation-based and computational) and applied to a case study (single client, two improvisations). This research approach enabled this author to familiarise herself with literature on the topic and to see how these different methods compared to each other, both in the process of applying them to data and in the findings that they generated. From this study it became apparent that although there were many different analysis methods to choose from, there is a lack of literature on which method to select for a particular situation. Study 2 (Article II) was designed to find out which music analysis methods therapists used in clinical practice and research, what factors influenced the selection process, and how that music analysis was implemented. As there was no previous literature to base the study on, a constructivist grounded theory approach was employed to collecting

and analysing the data. Eight highly experienced music therapists were interviewed about their approaches to music analysis. With the knowledge and insights gained from Studies 1 and 2, an experiment was designed for Study 3, which generated the data for both articles III and IV. Non-referential and referential improvisations, GEMS-45-LT, and BDI scores collected from 20 depressed participants and 20 pairwise matched healthy participants were explored using computational analysis methods in order to relate parameters of clinical diagnosis, emotional experience and musical expression.

Choosing different methodologies (a case study, grounded theory, and an experiment with hypothesis testing and correlation analysis) for different stages of the research process enabled the exploration of the phenomenon from multiple angles and with various data types. Studies had progressively larger sample sizes: from one participant in Study 1 to eight participants in Study 2 to 40 participants in Study 3, expanding the generalizability of the findings. Regarding the music analysis methods that were investigated, three general approaches were presented in Study 1, the ways specific methods from these three approaches were being utilised in practice was documented in Study 2, whilst Study 3 focused on exploring only computational music analysis, thus narrowing the scope of the research.

4 SUMMARIES OF ARTICLES

4.1 Article I: Triangulation of music analysis methods

4.1.1 Background and aims

There is a lack of research in music therapy literature that triangulates music analysis methods. This leads to a lack of guidance on how to choose an appropriate music analysis method to assess clinical material. The aim of this study was to give an overview of various music analysis methods, and to see how the use of these methods and the results they produced compared to each other.

Triangulation employs "investigative strategies that offer evidence to inform judgments, not techniques that provide guaranteed truth or completeness" (Hammersley , 2008, p. 32). In a music therapy setting, researchers can triangulate qualitative and quantitative methods to analyse verbal, physiological, and musical data (Bonde, 2005) utilising between-methods and within-methods triangulation. In using between-methods triangulation, "mutual validation is sought" (McFee, 1992, p. 215) by combining different data types, for example interviews with music therapists, field notes, and observations of therapeutic process. In using within-methods triangulation, "data are built up from various perspectives" (McFee, 1992, p. 215) where multiple investigators are analysing the data, multiple theoretical frameworks are used to interpret the results, or data is collected from various sources, such as interviews with individuals, families, and communities (Carter, Bryant-Lukosius, DiCenso, Blythe, & Neville, 2014).

This study was aimed at early career music therapists and researchers, as well as experienced therapists who have not received specific training in music technology. Especially in the case of computational music analysis, it was considered important to clearly define the technological requirements and explain the differences between acoustic and digital instruments in terms of recording, what sort of data is embedded in MIDI and audio files, and to list commonly available software programs that could be used to record music in a clinical setting.

4.1.2 Methods

Participant: The participant was a 26-year-old student who reported experiencing intense depersonalisation (in her own words "I am observing myself as a participant of my life experiment"), stress, and tension. As this study was designed to give an overview of available music analysis methods and gain practical knowledge regarding the applicability of each analysis method in a clinical setting (as opposed to producing generalizable findings), it was decided that a single case study was a sufficient sample size. The participant received ten sessions of Improvisational Psychodynamic Music Therapy (IPMT, Erkkilä, Ala-Ruona, Punkanen, & Fachner, 2012) in a Music Therapy Clinic, as part of a music therapy training programme.

Triangulation: In this article two MalletKAT improvisations were compared: the first improvisation (session 1) and the last improvisation (session 10). These improvisations had been captured as MIDI data during the sessions. The sessions were analysed using both qualitative and quantitative methods in order to accommodate both between-methods and within-methods triangulation. In between-methods triangulation one seeks validation through the implementation of various analytical approaches. In this case study it was heart-rate variability measurements (low frequency and high frequency), content analysis of verbal transcripts, and three methods of music analysis (i.e., aural, notation and computational). Within-methods triangulation can be related to investigators, theories, or data source (Carter, Bryant-Lukosius, DiCenso, Blythe, & Neville, 2014). In this case it was multiple investigators carried out verbal analysis and notation analysis to avoid subjectivity bias.

Music analysis: The three types of music analysis selected for this study were aural, notational-based, and computational. Aural music analysis was performed using IMTAP (Baxter et al., 2007). The musicality domain (i.e., tempo, rhythm, dynamics, pitch, creativity, and development of musical ideas) was assessed on a scale measuring the consistency with which the client displayed these skills: 0% (never), <50% (rarely), 50-80% (inconsistent), 80-100% (consistent). Notational analysis, more specifically motivic analysis (Epstein, 1987), was performed on a score produced from the MIDI in Sibelius software. Computational analysis consisted of descriptive statistics generated from MIDI data (e.g., duration in seconds, Pitch Average and Pitch Standard Deviation, Velocity Average), and spectral data analysis of audio file generated from the MIDI (with Mir Toolbox 1.6.1., Lartillot & Toiviainen, 2007) using autocorrelation function, called self-similarity, which identifies points of repetition within the file.

Heart Rate Variability: HRV data can be used to reveal the state of the autonomic nervous system and the interplay between sympathetic ("fight or flight") and parasympathetic ("rest and digest") nervous systems. Data from a Suunto Memory Belt worn by the participant during improvisations was processed and analysed by Olivier Brabant using Kubios HRV 2.2 (Niskanen, Tarvainen, Ranta-

Aho, & Karjalainen, 2004). The specific measures used were heart rate, and power spectral analysis of low frequency and high frequency.

Verbal Transcripts: Verbal data analysis consisted of two parts; analysis of descriptive statistics based on the verbal data treated as a unit (i.e., duration of speech in minutes, number of words), and qualitative analysis based on line-by-line coding of the conversations between client and therapist (Hardy, Harley, & Philips, 2004). The participant's thoughts and feelings were explored by creating categories from the most salient themes in their speech, and these were compared at different points in the therapeutic process.

4.1.3 Results

The first finding of the study was that the participant improvised for longer in the last session (456 seconds) compared to the first one (380 seconds). The participant also talked more in the last session (17.6 minutes vs 7.1 minutes), said she was "more comfortable sharing her thoughts with therapist", was more relaxed as indicated by high frequency in HRV measurements (484 ms2 vs. 282 ms2), and was more comfortable sharing her thoughts as indicated by the transcript analysis. These findings, consistent in all three data sources, were expected in the therapeutic setting, and are supported by the literature describing the concepts of safe space and engagement in the therapeutic process (Austin, 1996).

The second finding was that the participant's improvisations became more complex. This is also expected amongst participants who are non-musicians, as with time the initial exploration of the instrument is replaced by the development of musical ideas (Bruscia, 1987). Descriptive statistics from the improvisations showed that pitch range decreased from C4-C7 in session one to G4-A6 in session ten. Thematic analysis showed that short motifs were developed into themes with less ostinato. Computational analysis showed greater spectral variability – the self-similarity matrix showed four main parts in session one, increasing to at least 11 parts in session ten. These changes were also reflected in analysis of the participant's speech, from "I was just playing whatever" to "it's summer and I would like to explore through the garden".

In applying triangulation of methods in this study, two challenges were encountered: 1) choosing appropriate methods and 2) combining the results. From the music analysis methods used, IMTAP was the least revealing. Although the results were in accordance with those of the other measures (i.e., increase in creativity and development of musical ideas), the findings were, on a global level, not sensitive enough to capture minor changes. Of the non-musical analysis methods, the qualitative data analysis was the most challenging to integrate with the musical findings.

Based on the experiences gained from applying these different music analysis methods to a case study, three recommendations were formed for future research. First, it is advisable to formulate a clear research question (Beckhet & Zauszniewski, 2012) in order to narrow down the research scope, because there are so many angles to music analysis, and not all will be equally useful in a specific

situation. Second, it is recommended to employ initial data exploration in order to select the most appropriate analysis method to answer the research question. Third, researchers are encouraged to look into the use of data management software that helps to manage large amounts of various types of data. In summary, I have found triangulation of methods and data a useful, yet complicated, approach in a music therapy setting. If methods and data are selected appropriately, it can aid decision-making regarding the therapeutic process, and offers opportunities to deepen our understanding of how musical, physiological and psychological processes are linked.

4.2 Article II: Grounded theory on the use of music analysis methods

4.2.1 Background and aims

Study 2 was motivated by the obstacles encountered while carrying out Study 1. After reading relevant literature and applying certain methods to a clinical case, it was still unclear as to why such a variety of music analysis methods had been proposed in the literature, and, more importantly, how to make appropriate selections from those. The aim of the second article was to explore the factors that influenced therapists' choice of music analysis methods in clinical work, education and research by interviewing highly experienced music therapists from various countries.

Grounded theory is an inductive approach, suitable for topics that are not extensively covered in previous literature (Daveson, 2016; O'Callaghan, 2016). Theory is built systematically by repeatedly collecting and analysing data until conceptual saturation is reached. The traditional coding paradigm (Strauss & Corbin, 1990) was employed as it highlights underlying processes by identifying the relationships between categories. Epistemologically, this study followed the constructivist tradition of grounded theory (Charmaz, 2006, 2008), which is based on a point of view that theory is not discovered, but rather generated by researchers and participants. The theory was constructed in 2017, and it is plausible that if this methodology were replicated today by a different researcher with different informants, the results might be quite different.

This study was aimed at music therapists at all stages of their careers. Although experienced music therapists were interviewed as the data source, the knowledge gained from this research is of benefit to beginner students as well as professional music therapists.

4.2.2 Methods

Participants: Eight key informants were recruited from Finland, Switzerland, Denmark and Belgium, all with a minimum of 10 years (avg. 24.5; SD 6.61) of

experience in psychodynamic music therapy, in clinical, educational and research settings. Key informants were selected based on research they had published, either in utilising existing music analysis methods, or developing new ones. I deliberately wanted to explore the diversity of approaches to music analysis in therapy, so I chose informants that had worked with various client populations and employed different music analysis methods in their work.

Data collection and analysis: This study employed constructivist grounded theory (Charmaz, 2006, 2014; Mills, Bonner, & Francis, 2006). I conducted this Study in three phases, therefore data collection and data analysis methods varied depending on the aims of each phase. The first phase – Exploration (N=1; 3 hr 30 min of interviews; initial coding) – generated salient themes on the topic and was used to design and refine the questions for the subsequent phase. The second phase – Theoretical Sampling (N=6; 6 hr 12 min; initial, axial, selective coding) – generated the main body of data, until thematic saturation was reached. The third phase – Refinement (N=1; 1 hr 15 min; and a conference presentation) – was used to clarify and validate the theory. Phases 1 and 3 were based on interactive, discussion-like interviews. In Phase 2, semi-structured interviewing was used, where the themes for discussion had been established before the interview process began.

4.2.3 Results

The results of the second study can be presented on three levels: the Summary (description), the Coding Paradigm (main analysis), and the Core Category (interpretation). These levels of analysis vary depending on the extent of abstraction involved in data processing: whilst the Summary is purely descriptive, the Coding Paradigm introduces some abstraction by generating categories and establishing the relationships between them, whilst the Core Category is the most subjective, based on one's best ability to explicate and conceptualise the phenomenon.

Summary of the experience of the key informants: they have worked in a variety of public and private settings (e.g., hospitals, schools, nursing homes) with neurological (e.g., autism, epilepsy, cerebral palsy, deafness, blindness, brain injury, intellectual disabilities) and psychopathological (e.g., depression, anxiety, bipolar disorder, schizophrenia, personality disorders, addictions) disorders as well as non-clinical populations. Some key informants mentioned well documented music analysis methods such as Improvisational Assessment Profiles (Bruscia, 1987), The Voice Assessment Profile (Storm, 2013, 2019), Music Therapy Assessment Tool for Awareness in Disorders of Consciousness (Magee 2019; Magee, Siegert, Daveson, Lenton-Smith, & Taylor, 2014), Vocal Timbre (Malloch, 1999), and Music Therapy Logbook (Streeter et al., 2012). Participants mentioned both primary (e.g., melody, harmony and rhythm) and secondary musical parameters (e.g., dynamics, tempo, timbre) when talking about music analysis, with rhythmical organisation and dynamics being the most commonly mentioned.

The **Coding Paradigm** (Figure 2) was used to identify concepts and their properties, group them into categories and establish the connections between categories by clustering the data into causal conditions, intervening conditions, action strategies, and consequences. In addition to the main categories that were established by Strauss and Corbin (Strauss & Corbin, 1990), two new key categories emerged in this study: client populations and theoretical understanding. Causal conditions (education, research, clinical practice) are the circumstances under which key informants were compelled to analyse music. Intervening conditions (continuous professional development, professional identity, environment) indirectly affect the choice of music analysis method. Client populations (clients' abilities and clients' needs) narrow down the available music analysis methods depending on the severity of the condition and the limits it places on available means of interaction. Theoretical understanding (model-based and context-based) impacts the motivation to use music analysis and the interpretation of its results. Action strategies (holism vs. reductionism and primary vs. secondary parameters) indicate the different music analysis methods that were chosen by music therapists. Consequences signify the impact of the chosen approach to music analysis, and these differ depending on the preference for implicit knowledge (fragmentation of knowledge and sensitivity to clients' abilities and needs) or explicit knowledge (increased professional recognition, frustration about disagreement, excitement of discovery and increased work load).

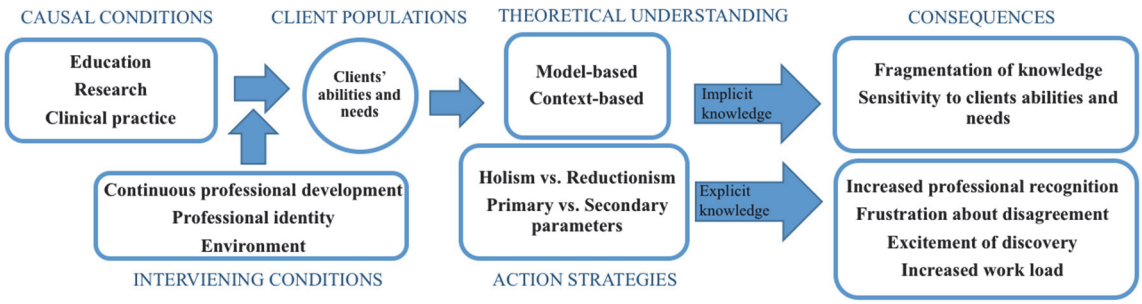

FIGURE 2 Coding paradigm illustrating the relationships between causal conditions, intervening conditions, client populations, theoretical understanding, action strategies and consequences.

Professional freedom emerged as the **Core Category** (Figure 3) from the selective coding stage of analysis. The core category is the best explanation for the observed phenomenon, and in this case, it is described as a tension between professional responsibility and creative impulses. When therapists experience a strong sense of professional responsibility, they tend to favour explicit knowledge (preference for well-documented music analysis methods). Creative impulses, on the other hand, tend to increase therapists' reliance on implicit knowledge (preference for therapist's own feelings and insights). Professional freedom could be seen as a spectrum between these two forces, resulting in therapists' differing preferences for either explicit or implicit knowledge, or an integrative approach that combines features of both.

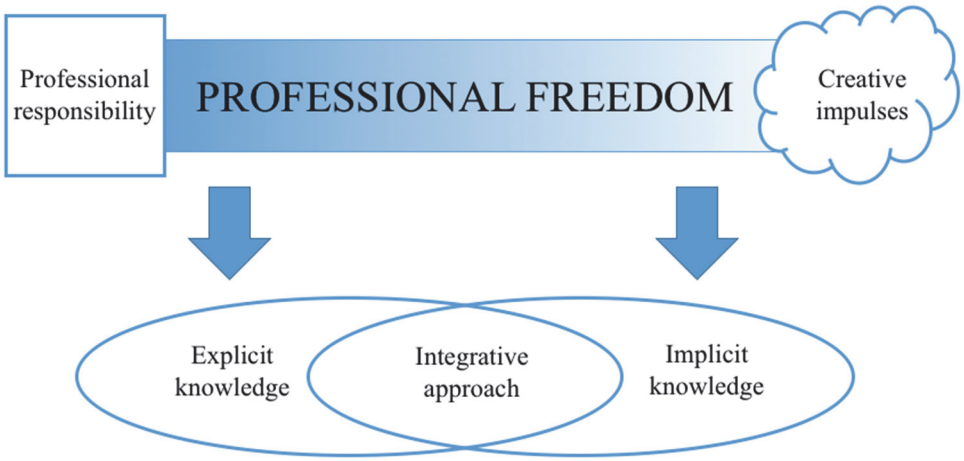

FIGURE 3 Core category illustrating the tension between professional responsibility and creative impulses.

4.3 Article III: Computational music analysis in depression

4.3.1 Background and aims

Study 3 of the present dissertation was designed to determine whether musical parameters could be used as a marker for depression. The main aim of the third article was to compare non-referential and referential improvisations of healthy and depressed participants using computational music analysis. Based on music therapy literature and taxonomic and diagnostic tools, hypotheses were formed that depression would lead to 1) low Event Density, 2) slower Tempo, 3) increased Pulse Clarity, 4) decreased Pitch Average, and 5) narrower Pitch Standard Deviation. No hypotheses were formed regarding the differences between referential and non-referential improvisations, as no relevant literature could be found on this topic.

Depression was chosen as the disorder to be explored in this study because it is the most prevalent mood disorder worldwide, so research into it has wide clinical implications, and because previous studies have shown that it affects music perception (Punkanen, 2011; Sakka & Juslin, 2017), leading to the possibility that it would have an impact on music expression. Depression affects more that 300 million people around the globe and leads to around 800,000 deaths yearly due to suicide (World Health Organisation, 2018). It causes low mood state and reduced energy levels, and often coincides with anxiety, insomnia, and changes in appetite (American Psychiatric Association, 2013). Music therapy has been shown to be an efficacious treatment for depression (Aalbers et al., 2017; Maratos, Gold, Wang, & Crawford, 2008), which makes this topic clinically relevant.

4.3.2 Methods

Participants: The experimental group consisted of 20 patients of Vilnius City Psychiatric Centre in Lithuania, that were receiving treatment at the time for F32 Depressive Episode or F33 Recurrent Depressive Disorder (ICD-10) and had no concurrent diagnosis. They were pairwise matched with 20 healthy participants, the control group, using sex (both groups included four males and 16 females), age (19-71 years old), and musical background (no formal music education). If Vilnius City Psychiatric Centre patients did not achieve a sufficiently high score on Beck's Depression Inventory (BDI) (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), their data was excluded from the experiment (Figure 4). Likewise, if healthy participants scored high on BDI, their data was excluded from the experiment.

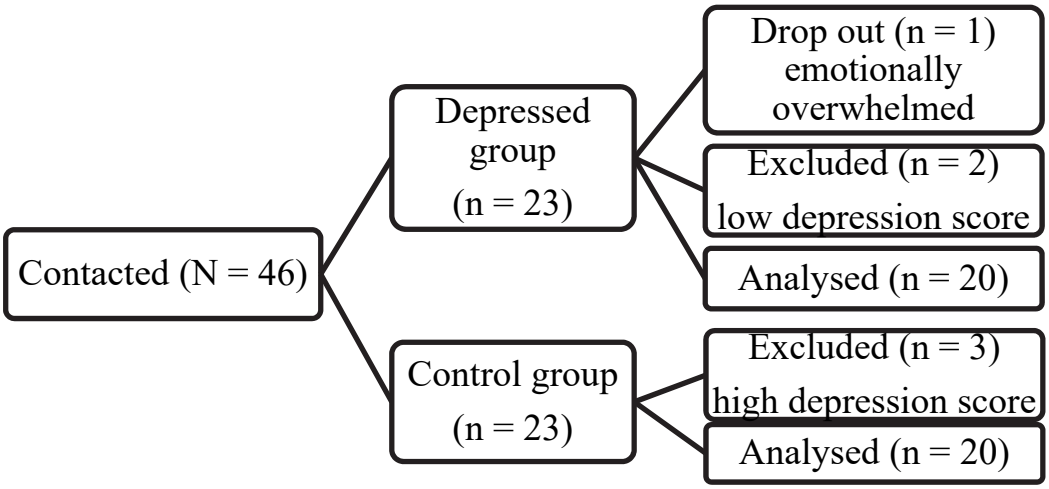

FIGURE 4 Flowchart showing the participant recruitment process.

Procedure: Both the experimental and control groups were asked to follow the same procedure during individual meetings with a single researcher. An initial discussion (before the experiment started) and a concluding discussion (after data collection) were held to provide time and space for participants to address any thoughts and feelings they had about their participation in the study and to allow some grounding if necessary. Both groups were asked to make music spontaneously in two one-minute improvisations – a one-minute referential improvisation and a one minute non-referential improvisation. They were then asked to fill in the Geneva Emotional Music Scale, and Beck's Depression Inventory. The protocol and all materials were approved by Vilnius Regional Ethics Committee for Biomedical Research (research permit number 158200-16-866-378).

Improvisations: None of the participants had any formal musical training, therefore they all started with no prior education in playing piano or improvising. First, they were shown that the amount of force one uses affects the loudness, and that on the left side of the instrument the sounds were lower and darker and

on the right side of the piano sounds were higher and brighter. They were encouraged to explore the instrument and make as diverse a range of sounds as they could for one minute (non-referential improvisation). Afterwards, the participants were presented with the idea of telling a story with sounds, and were shown a few musical examples ("a happy summer's day", "a long autumn evening", "a furious winter storm"). Finally, they were asked to tell, with sounds, how they were feeling today. All instructions were videoed beforehand, and played back on a computer, ensuring that all participants were given identical guidance.

Depression measurement: BDI was chosen as a measurement of depression for this study because it is a highly reliable (21 items, Cronbach's $\alpha = .948$), widely established, self-administered test that has been translated into Lithuanian (Lapkauskieknė, 2003). By answering 21 items, one receives a depression rating on a range from 0 to 63. 0-9 signifies no depression, 10-18 represents mild depression, 19-29 shows moderate depression and 30-63 indicates severe depression. The experimental group's mean BDI score was 29.3 (SD = 10.79), whilst the control group scored 7.05 (SD = 3.46).

Music analysis: All improvisations were captured as MIDI files using a bespoke application, created using the MAX 7 programming environment. Five musical parameters were selected for analysis – one for each of the five hypotheses:

- Event Density – the mean frequentness of note onsets (notes per second);
- Tempo – the speed of the underlying pulsation;
- Pulse Clarity – the regularity of underlying pulsation (from 0 – not clear at all, to 1 – clear pulsation);
- Pitch Average – the mean pitch height;
- Pitch Standard Deviation – the width of pitch range.

Event Density, Pitch Average and Pitch Standard Deviation analyses were performed on the MIDI data using MIDI Toolbox 1.1 (Eerola & Toiviainen, 2004). Tempo and Pulse Clarity analyses were performed on audio conversions of the MIDI data using MIR Toolbox 1.7 (Lartillot & Toiviainen, 2007). The MIDI files were converted to audio in Cubase 5 digital audio workstation, using a 22050 Hz sample rate, and the MiniGrand virtual instrument from Air Music Technology as the timbre.

Statistical analysis: The data was imported into IBM SPSS Statistics 24, where Shapiro-Wilk Tests were used to test for normal distribution, then, depending on the outcome, Mann-Whitney tests or independent samples t-tests were used to compare experimental and control groups, and Wilcoxon Signed-ranks tests or dependent samples t-tests were used to compare referential and non-referential improvisations within groups. An alpha level was set of 0.05 for all tests.

4.3.3 Results

Of the five hypotheses, only two were supported: these were hypotheses three and four, whilst hypotheses one, two and five were rejected. Pulse clarity in the referential improvisations of the experimental group was significantly higher than in the referential improvisations of the control group (experimental group Mdn = 0.13; control group Mdn = 0.06; U = 83, p = .026), indicating that depressed participants tended to play in a more stable rhythm than healthy participants when they were describing their current feelings. Pitch Average was also significantly lower in the referential improvisations of the experimental group compared to the referential improvisations of the control group (experimental group M = 59.47, SD = 8.52; control group M = 63.67; SD = 8.52; t(19) = -2.11, p < .05), meaning that depressed participants tended to play in a lower register than healthy participants when describing their current feelings. There were no significant differences between the groups in non-referential improvisation, showing that all participants explored the instrument in the same way, and the effects of depression were only discernible when trying to communicate feelings via musical expression.

When comparing referential and non-referential improvisations within groups, all participants had a lower Pitch Standard Deviation in the referential improvisation than the non-referential improvisation. This was in accordance with instructions to participants to explore the instrument in non-referential improvisations. However, in the control group the difference between non-referential (M = 10.29, SD = 2.7) and referential (M = 8.34, SD = 2.78) improvisations was larger (t(19) = 3.58, p < .01) than it was in the experimental group (non-referential M = 9.72, SD = 2.83; referential M = 7.79, SD = 4.42); t(19) = 2.17, p < .05). All participants used a narrower range of pitches when expressing their current mood than when exploring the instrument, but this effect was more pronounced in healthy participants. Furthermore, heathy participants played in a significantly higher pitch register when describing their current mood (Mdn = 12.31) than when exploring the instrument (Mdn = 7.14) (Z = 2.05, p = .04).

4.4 Article IV: Computational music analysis and emotion in depression

4.4.1 Background and aims

Article IV combined the findings of Article III (see 4.3.1. for the background and aims of Study 3) with the scores of emotional rating scale GEMS-45 (Zentner et al., 2008). The goals of the final article were to establish differences between depressed and healthy participants in emotional responses to their improvisations and to investigate the links between computationally retrievable musical parameters and felt emotions in depressed and healthy groups.

Study 4 was aimed at music therapy researchers, who explore analysis of clinical improvisation, as well as music therapists, who work with depressed clients. Insights from this work are relevant to people who seek to develop objective music analysis methods or are interested in the effect of depression on musical expression and emotions.

4.4.2 Methods

Study 3 resulted in two articles, so the data collection methodology was the identical for both Article III and Article IV. Information on Participants, Procedure, Measurement of Depression and Music Analysis was described in the previous section (see 5.3.2. Article III. Methods). It should be noted, however, that in the fourth article only three musical parameters out of the initial five were analysed (i.e., Pulse Clarity, Pitch Average, and Pitch Standard Deviation), since the other parameters dealt with in the third article did not yield significant results.

Measurement of Emotions: The Geneva Emotional Music Scale measures felt emotions evoked by music. The original 45 item scale was translated into Lithuanian (GEMS-45-LT) by two independent translators, with a Cohen's kappa of 0.8. Each emotion on the list is measured on a scale from 1 (not at all) to 5 (very much). Emotions form nine categories (Wonder, Transcendence, Power, Tenderness, Nostalgia, Peacefulness, Joyful Activation, Sadness, and Tension). The number of items (individual emotions) per category varied between four and six, and categories had alpha between .61 (Tension) and .88 (Joyful Activation).

Statistical Analyses: Data was analysed using IBM SPSS Statistics 24 in order to correlate felt emotions with musical parameters and to compare experimental and control groups. Shapiro-Wilk Tests were used to test for normal distribution, and subsequently either independent-samples t-tests or Mann-Whitney tests were used to compare experimental and control groups. Data was also analysed using Pearson Correlation to establish relations between felt emotions and musical parameters for each group separately. An alpha level of 0.05 was set for all tests.

4.4.3 Results

For both negatively valanced categories (i.e., Sadness and Tension) the experimental group (depressed participants) scored higher than the control group (healthy participants), whilst the control group scored higher on all positively valanced categories (Figure 5).

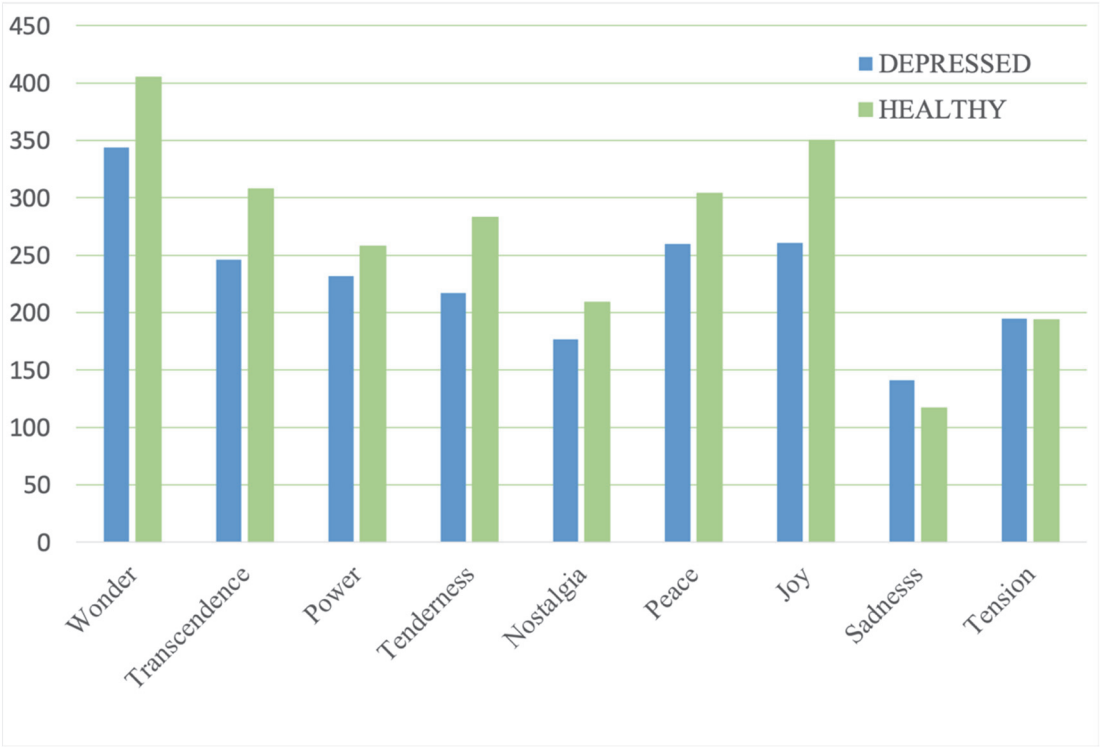

FIGURE 5 Total sum of emotional ratings for depressed and healthy groups.

When comparing the emotion categories between depressed and healthy groups, there were significant differences in Peacefulness, Transcendence and Joyful Activation between the experimental and control groups. Peacefulness (Serene, Calm, Soothed, Meditative, Relaxed) was felt more by healthy participants ($M = 15.2$, $SD = 4.25$) than depressed participants ($M = 13$, $SD = 3.37$), $t(38) = -1.81$, $p = .005$. Joyful Activation (Animated, Bouncy, Joyful, Feel like dancing, Amused, and Stimulated) was also felt more by healthy participants ($M = 17.5$, $SD = 5.77$) than depressed ones ($M = 13.05$, $SD = 5.52$), $t(38) = -2.49$, $p = .017$. Transcendence (Fascinated, Overwhelmed, Feeling of Transcendence, Inspired, Chills [shivers and goose bumps], Feeling of Spirituality), again, was felt more by healthy participants ($Mdn = 15.5$) than depressed ones ($Mdn = 12$), $Z = -2.61$, $p = .009$.

There were two correlations between felt emotions and musical parameters in the depressed group and one in the healthy group. In the depressed group Pitch Average was negatively correlated to Sadness (Sad, Tearful, Sorrowful, Blue), $r(38) = -.65$, $p < .01$; whilst Pitch Standard Deviation was positively correlated to Tension (Tense, Agitated, Irritated, Nervous, Impatient), $r(38) = .54$, $p < .05$. These correlations meant that the more sadness a depressed participant felt the lower the general pitch they tended to play in, and the more tension they felt the higher the wider the range of the pitch.

In the healthy group Pitch Average was positively correlated with Tenderness (Tender, Affectionate, Mellowed [softened-up], In love, Sensual), $r(38) = .48$, $p < .05$, meaning that the more tenderness a healthy participant felt the higher the general pitch they tended to use.

5 DISCUSSION

This research has made a number of contributions of relevance to the music therapy field. First, a novel approach to the classification of music analysis methods was proposed which aids the selection of the most appropriate method for a particular purpose. Second, a grounded theory was developed regarding the use of music analysis in music therapy clinical work and research. Third, a set of links was established between music, emotion, and depression, as evidence of successful method triangulation using computational music analysis. Furthermore, a set of recommendations for clinicians and researchers has been developed, including a table that compares different analysis methods in terms of availability, accessibility, efficiency, and relevance.

5.1 Main findings

5.1.1 Classification of music analysis methods

Previous research (Bonde, 2016; Fachner, 2016) has promoted a grouping of music analysis methods into qualitative/interpretivist and quantitative/objectivist approaches, which, as already discussed, relates to the research paradigm but is not specific to the phenomenon of music. De Backer and Foubert (2016) proposed the distinction between manual and computational methods, and later listed different manual approaches, such as those based on verbal description, standard music notation, and new notation systems (e.g., graphic notations, musical graphics, aural scores, action notation). In the present research, music analysis methods were classified into aural, notation-based (staff and graphical), and computational from the outset. Whilst the distinction of qualitative/interpretivist and quantitative/objectivist refers to the analytical styles employed, and from a wider perspective to the epistemological stance of the analyst, the classifications proposed in this dissertation – aural, notation-based (staff and graphical), and computational – refer specifically to the data sources to be analysed.

Music is an acoustic phenomenon, and is perceived via the auditory system, but it can also be represented visually or measured according to physical properties, such as frequency and amplitude. There is such a variety of musical analysis methods because each of the available approaches has benefits and drawbacks, and no single approach is universally appropriate. Aural methods have the benefit of embodied cognition, where the analysis and interpretation of auditory information can be aided and enhanced by visual, tactile, and emotional information, the importance of which cannot be overestimated in a therapeutic setting. Yet, when analysing aurally, one has a huge amount of information about a single moment, making the comparison of specific details or times within many hours of improvisation far more challenging than if using more restrictive notation-based or computational analysis. Notation cannot convey the secondary musical parameters or extra-musical information contained in an improvisation but can utilize interpretation and collective wisdom gleaned from centuries of musicological research. Computational analysis can perform many complicated calculations in milliseconds, but currently lacks ecological validity in music therapy. The rationale for introducing this classification was to aid the process of choosing the most appropriate method for any given situation.

In integrating the approach specified in this research with those that already exist, it is perhaps best to consider it an extension of the earlier proposals. Subsequently, the two analytical paradigms (qualitative/interpretivist and quantitative/objectivist) can be extended with the three data sources (aural, notation-based, computational) into six possible combinations. Quantitative methods can be aural, such as Wigram's event counting (Wigram & Jacobsen, 2019), based on notation, for example the content analysis of staff notation employed in Study I of this dissertation, and computational (e.g., Foubert, Collins, & De Backer, 2017; Luck et al., 2009). Qualitative methods can be aural (Stine, 2019) as well as notation-based (Bergstrøm-Nielsen, 2010) and, theoretically, one could employ interpretative assessment techniques to the outcome of computational analysis, such as the self-similarity matrix used in Article I, in a qualitative research design.

5.1.2 Factors that influenced the choice of music analysis methods

The most surprising finding of Study 2 was the variety of approaches to music analysis used by the participants, particularly considering the small sample size and that all the informants practice the psychodynamic approach to music therapy. The variety of analytical methodologies, and the varying view of the importance of musical analysis in clinical work and research, seemed to relate to the therapists' self-perceived professional identity, which ranged across a spectrum from the primary identity as a 'musician', where music was of paramount importance, to the primary identity as a 'therapist', where verbal communication was considered key. This diversity is likely to be caused by the origins of the field, as it was developed based on clinical work of various music therapy pioneers as opposed to a single theoretical framework that unites all approaches to music in therapy. At this point in time, it seems that there are almost as many approaches

to music therapy as there are therapists, which might benefit individual clients, but makes the field, as a whole, much harder to quantify.

Therapists' approaches to music analysis varied between model-based, in which individuals tended to search for patterns and regularities in a positivistic way, or context-based, in which empathic awareness and interpretivism were more important. Both extremes were evident amongst the informants, as well various positions in between. Action strategies were either holistic, such as when Ms. C. said, "harmony, melody, form… in the session it is always everything together", or reductionist, where specific parameters are chosen to be analysed. Context-based understanding could be compared to Kurth's holistic paradigm, where "sub-components and single perceptions should be understood within the 'flowing' totality of 'music as experienced'…of 'power, energy, tension, volume and mass' in music" (Wigram, Nygaard Pedersen and Bonde, 2002, p. 48), which is important in clinical work. Model-based understanding, on the other hand, is necessary for professional recognition and development, as a positivistic approach to music analysis leads to greater credibility and ease of communication when working in interdisciplinary teams, obtaining funding for large scale research projects, and publishing articles in higher rated scientific journals.

The most unique finding of Study 2 was the overarching concept of professional freedom. It identified the tension therapists experience between professional responsibilities and creative impulses. It is important to note, that it is not implied here that creative freedom is irresponsible and professional responsibility is inherently uncompromising, but rather indicates that those two forces can pull an individual music therapist in different directions and lend themselves better to different musical analysis methods. Stern (1985) wrote about implicit knowledge being unconscious and based on action, and explicit knowledge being expressed in symbolic or verbal form. He considered it as layers of maturation that can coexist simultaneously, as opposed to Freudian theories, which imply that explicit knowledge has to replace implicit. If we draw parallels between a child's development and the process of becoming a music therapist, Stern's ideas would suggest that music therapists have both implicit and explicit knowledge at their disposal, and their training and professional life experiences will determine which approach they tend to rely upon.

It is interesting to note that clients' abilities and needs mostly affected the selection of musical parameters, but not the analysis methods applied to those parameters. For instance, if a client was only able to play rhythmic instruments then tonality analysis of their improvisation would be meaningless, but one could use aural, notation-based, or computational methods to analyse the rhythm. Clinical goals could also guide the choice of musical parameters, but again, did not affect the analytical approach. For example, if a therapist was working on grounding a client by creating improvisations with a stable pulsation then there would be no clinical need to assess other musical parameters, but pulsation can be successfully analysed using any analytical approach.

Of all the factors that compelled music therapists to analyse music, three emerged as being of particular importance: research, clinical practice, and education. Whilst not all music therapists are engaged in research, and therapists are not typically in positions to directly influence regulation and policy in the schools and hospitals in which they are employed, it is in music therapy training programs where the necessary changes could be made. If greater emphasis were placed on educating future music therapists on the use of technology and different approaches to music analysis, practitioners would have greater expertise in employing various music analysis methods in their clinical work, whilst researchers would have better tools to investigate the musical processes occurring during therapy. The need for additional courses in music therapy training programs has been highlighted multiple times in previous literature and remains a critical issue (Crowe & Rio, 2004; Magee, 2013; Stensæth & Magee, 2016; Streeter, 2007).

5.1.3 Links between musical parameters, emotional experiences and symptoms of depression

The results of Study 3 showed that depressed participants played in a lower pitch register with more stable rhythm than healthy participants when they were describing their current feelings. This indicated that depression had an effect on Pulse Clarity and Pitch Average in referential improvisation. The fact that these differences were only observed in referential improvisation could be interpreted in two ways: Firstly, it might indicate that the participant groups were well matched on musical ability as there were no significant differences in free improvisation, but, secondly, this might also be evidence that depression does not affect the general ability to improvise, but only emotional expression via music. This would be in contrast to the Diagnostic and Statistical Manual of Mental Disorders fifth edition (American Psychiatric Association, 2013), which suggests that depression reduces physical movement and energy levels in a more general way.

These results also seem to support psychodynamic music therapy theory by highlighting the importance of the emotional, i.e., extramusical, meaning of clinical improvisation, and demonstrate that computational music analysis can be used to observe clinically relevant issues. In the context of existing music therapy literature, this study added to the understanding of intrinsic connections, which link emotional experiences with different music parameters (Bunt & Pavlicevic, 2001).

Another interesting finding was that, in addition to using a narrower pitch range in the referential improvisation, healthy participants also played in a higher register, as indicated by increased Pitch Mean. In other words, the difference between emotional expression and free improvisation was more musically varied in the healthy group than in the depressed group. This effect of depression on musical expression is supported by clinical literature (Darnley-Smith & Patey, 2003; Jackson, 2013; Sekeles, 2007).

Depressed participants felt significantly less Peacefulness, Joyful Activation, and Transcendence whilst improvising. Although depressed participants felt more sadness and tension than healthy participants, the difference was not

significant. This was not in accordance with Punkanen's (2011) research, but was similar to Sakka & Juslin's (2017) findings. There were two links between emotions and musical parameters in the depressed group: Pitch Average was negatively correlated to Sadness and Pitch Standard Deviation was positively correlated to Tension. In the healthy group Pitch Average was positively correlated with Tenderness. Although this was, to our knowledge, the first such study relating musical parameters and emotional ratings, and further research is needed to confirm the links, it seems that a higher Pitch Average is linked to emotion with positive valence (in this case Tenderness), whilst decreased Pitch Average is linked to emotion with negative valence (in this case Sadness).

Contrary to expectations, this study did not find significant differences between the healthy and depressed groups in Event Density, Tempo and Pitch Standard Deviation parameters, finding support for only two of the original five hypotheses. Again, this might be due to various factors. The sample size of Study 3 was small. Were it to be repeated with a larger sample, support might be found for all the hypotheses. However, there is also the possibility that these were weak premises for hypotheses. As described in Study 3, these were formulated based on inferences and observations from diagnostic tools and clinical reports. Whilst the behaviours and symptoms described in those might be true for some who suffers from depression, they may not be generalizable to the population as a whole. Indeed, recent research has highlighted the possibility that depression might affect sufferers in multiple ways. Drysdale et al. (2017) found that there were four neurophysiological subtypes of depression that could be identified based on patterns of dysfunctional connectivity in limbic and frontostriatal networks. It is plausible, then, that each subtype of depression could have a distinct pattern of related musical behaviour, which could be revealed only in a research project with a large sample size and a study design that enabled the clustering of musical behaviours into similar subtypes.

5.2 Observations

5.2.1 Challenges in triangulating music analysis methods

As was concluded in Article I, there are two main challenges to triangulating different analysis methods. First, a researcher must choose an appropriate method. It should measure what is intended and be reliable, but it should also be compatible with other methods, thus avoiding situations where different methods reveal the same – as opposed to complementary – information. Unless the goal is definitive confirmation, each analysis method should bring something unique to the picture. Second, a researcher must assess how the results fit together and whether there is sufficient information to answer the research question. For example, although IMTAP was very reliable, it did not find much difference between improvisations, as it is intended to measure global changes, and was therefore not sensitive enough for the kind of analysis undertaken in these studies. It did reveal

the increase in creativity and the development of musical ideas, but so did all the other measures employed, in this way, IMTAP did not contribute anything unique. Verbal transcript analysis, on the other hand, revealed a lot of information about clients' ways of thinking and feeling, yet that wealth of information could not be properly utilized in this research, as there was no replicable way of linking and directly comparing it to the other analysis methods used in this research. It is possible that verbal analysis could be fully integrated into musical findings if aural music analysis were less structured than it is in IMTAP, and, instead, a hermeneutic or phenomenological approach applied to data analysis.

5.2.2 Availability, accessibility, efficiency and relevance

This research shows that every analysis method has a use in certain circumstances, and, at the same time, no single method is useful in every situation. Selecting an appropriate method for a specific clinical case or a research project is a complex process, which depends on factors such as workplace or institutional guidelines, priorities and concerns for individual clients, and methodological knowledge. When different approaches to music analysis were reviewed in Studies 1 and 2, it appeared that methods tended to vary based on their availability, accessibility, efficiency, and relevance (Figure 6). The following statements are insights gained during this research process and should be viewed as a preliminary guide for music therapists to be built upon and further clarified.

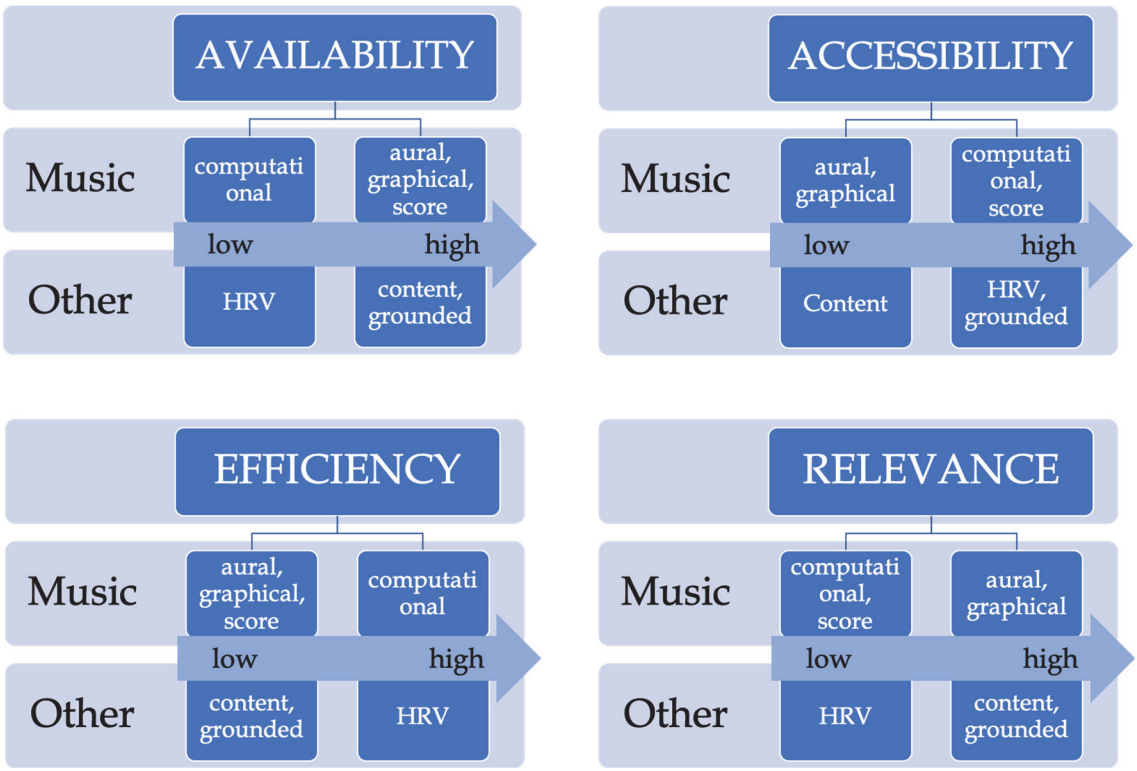

FIGURE 6 Four characteristics of analysis methods related to both musical and non-musical data: availability, accessibility, efficiency and relevance.

Availability refers to financial costs and additional resources required in order to obtain and use a particular method. For example, the MIDI Toolbox software is free, but it can only be run in the Matlab environment, for which a standard license costs 800 euros annually (The Individual License, n.d.), plus one needs a secure server to store the data and a relatively powerful computer to run the data analysis. Aural music analysis, on the other hand, is readily available for anyone to use. *Accessibility* indicates how much training is required to successfully implement a particular analysis method. For example, traditional score-based notation requires competence in music theory, whilst graphical notation can be utilized without any prior knowledge of traditional staff notation. *Efficiency* of a music analysis method refers to the time required to retrieve findings. As an illustration, score-based analysis takes hours to transcribe and to analyse, whilst computational music analysis of the same material might take a few seconds. *Relevance* describes how ecologically valid a particular method is in a music therapy setting. For instance, computational music analysis is commonly used for automated music identification and classification, but its potential uses in the music therapy field have yet to be fully explored. Aural music analysis, on the other hand, has been implemented in music therapy literature for many years.

These four characteristics – availability, accessibility, efficiency and relevance – can also be used to describe analysis methods for non-musical data (Figure 6, section *Other*). This dissertation includes content analysis of client-therapists discourse data (Study 1) and grounded theory based on interview data (Study 2), which are verbal data analysis methods. Of the available physiological methods, only HRV is used (Study 1). The use of content analysis could be considered comparable with Visual Analogue Scales, and standardised questionnaires, such as GEMS-45 or BDI (Study 3). The grounded theory approach, on the other hand, might be considered comparable to narrative, phenomenological or action research. As for HRV, it might be comparable to other physiological measures such as respiration rate, galvanic skin response, or oxygenation levels.

5.2.3 Reflexivity

Malterud (2001) remarked that "a researcher's background and position will affect what they choose to investigate, the angle of investigation, the methods judged most adequate for this purpose, the findings considered most appropriate, and the framing and communication of conclusions" (p. 483-484). Since the role of personal experience and preference have an inevitable effect on the research process, especially in qualitative and mixed methods designs, recognizing these preconceptions is necessary to avoid bias.

This author has received a Bachelor's degree in musicology, and is familiar with music theory. This immediately makes her more likely to utilize these skills in music therapy research. She has also completed a Master's degree in Music, Mind and Technology, receiving training and instruction in computational music analysis techniques using the Matlab environment. She has studied under Olivier Lartillot – a co-creator of MIR Toolbox – and had a chance to make personal inquiries about certain algorithms that he developed, how they work, and how the

output they generate can be interpreted. She has participated in courses at the Music Therapy Clinic for Training and Research and has been exposed to "psychodynamic theory [which] had a strong influence on Finnish music therapy" (Erkkilä, 2016, p. 25). During her doctoral studies, she has participated in an Academy of Finland project "No Pain, No Gain: Internal Mechanisms of Improvisational Integrative Music Therapy in the Treatment of Depression", which has informed the selection of the client population for Study 3. She has also taught courses in music technology and research design, which necessitated the creation of a list of recommendations as a part of ongoing discussion with students on research design. In other words, this research project could have been carried out using very different methods, but the author's professional path has taken her down a very specific route from music theory to computational music analysis and psychodynamic music therapy as a treatment for depression, resulting in the present dissertation.

5.3 Recommendations for clinicians and researchers

When carrying out a large-scale research project, not all the valuable insights and experiences gained can be included in the resulting articles, as these are constrained by both word limits and research scope. The following are some recommendations based on insights from the studies:

1. Researchers should not underestimate the importance of a well-defined research question (Beckhet & Zauszniewski, 2012). Narrowing the scope of the research and determining the type of data that would be the most useful in answering the research question is the best way to arrive at an appropriate choice of music analysis method. For example, in Study 1 the comparison of the two improvisations was very general, and a more detailed comparison might have been possible if only two musical parameters had been selected for analysis.
2. A very important part of any assessment is validity and reliability (Lachin, 2004). Validity identifies whether the method successfully assesses the target concept, thus traditional or manual music analysis methods have an advantage in the music therapy field. Reliability, on the other hand, identifies the consistency of the results of the method, where different situations and assessors would result in the same findings (Haynes, Richard, & Kubany, 1995), and, in this regard, computational music analysis methods have the advantage.
3. If multiple music analysis methods are used in a single study, it is important to make sure that each method provides unique findings that contribute to the richness of music description, as opposed to only resulting in the same – thus redundant – information.
4. When combining different measurements, keep in mind the scale of the findings. Usually, one cannot directly compare macro findings, for example a pitch mean for a whole improvisation, to micro findings such as a

time-decomposed improvisation, where "*e c e d c d e c a*" was the melody sequence.

5. Even if a research question is defined clearly and music analysis methods are well chosen, one should always explore the data before committing to a specific methodology, as some data might lack richness, or have too many missing values to reach conclusive findings.
6. Data management software (e.g., ATLAS.ti, HyperRESEARCH, NVivo) helps to easily organize multiple data types and although it initially takes time to learn how to use these programmes effectively, it will save time over the length of a project.
7. Some measurements have abbreviated versions, and, although the full version provides greater detail, it should be considered whether an abbreviated version might be more appropriate when researchers have limited access to each participant. In Study 3 it took participants 10-20 minutes to fill in GEMS-45 so there was insufficient time to collect other types of information. With hindsight, it would have been better to use GEMS-9, that uses a reduced scale of emotions, and to have included a measure of musical sophistication as well.
8. Triangulation between methods is highly time consuming and is therefore more suited to research than clinical practice. In everyday clinical work one music analysis method should suffice, as Study 1 indicated that different music analysis methods provided relatively similar results. In research projects multiple measures might be used, thus it is important to arrive at the methods that are most appropriate to address the research questions and are the best fit for the individual circumstances of an experiment.
9. One cannot become an expert in all subjects. Music therapists might be advised to focus on exploring musical processes, as opposed to specializing in MIR processes, such as feature extraction. By the time we have developed a manual method to successfully interpret rhythmic pattern recognition and accurate timbre estimation in clinical settings, MIR will likely be advanced enough to successfully retrieve it for us.

5.4 Limitations

The topic of this dissertation is one that has, so far, been little explored in scientific literature. This lack of similar research leads to the results being presented in isolation, since comparison to previous studies is not possible. Furthermore, the exploratory nature of this dissertation limits the generalizability of the findings. The methodology in this dissertation was chosen not to establish predictive models or develop specific tools that could be used for the purposes of assessment, rather to establish a starting point for further research towards those ends. For example, Study 3 was designed solely to seek significant links between music, depression, and emotion. The findings of this research can now form the

premise of further research towards the development of an assessment tool, and warrant the further resources needed to recruit a larger sample size.

The use of various research designs (qualitative, quantitative, mixed) to study a range of methods (aural, notation-based, computational) was motivated by an aim to provide a comprehensive representation of the approaches to music analysis methods in music therapy research and practice. Although combining qualitative and quantitative analytical approaches provides rich and comprehensive data, it also makes the research scope rather divergent and leads to the acquisition of an excess of information of decreasing relevance to the project, which must then be heavily filtered.

Regarding the improvisations themselves, this research focused on recordings captured from MIDI piano and mallet instruments. Audio rendering of this data was performed using only artificial timbres. Consequently, the subtleties of working with audio recordings of acoustic instruments have not been explored, nor were improvisations captured on other musical instruments.

The studies did not provide data on participants' backgrounds, such as their musical aptitude, skills, preferences, and other information that might have been useful to therapists in deciding on a music analysis method (Study 2), or affected clients' improvisations (Study 3). Study 2 was carried out in Europe, so the factors influencing therapists' choice of analysis methods might vary in different areas of the world. Similarly, Study 3 used solely Lithuanian participants, and improvisations and emotional responses might be affected by depression in different ways in other cultures.

Finally, this research focused on individual performance, which is different from music therapy clinical work where interaction is a key component. It was necessary to take this route in order to establish the effects of a condition on individual performance, but these findings lack ecological validity in a normal therapeutic setting. The effect of therapists' music making on clients improvisation, as well as the therapeutic process in its entirety and how emotions and musical expression change over time, is a topic for further research, but was outside the scope of the current dissertation.

5.5 Relevance and implications

This dissertation contributes towards greater understanding of the uses of different music analysis methods in music therapy. A new way of classifying music analysis methods and grounded theory on their use will enable music therapists to more easily familiarize themselves with available methods and their characteristics. This research discusses relevant concepts (e.g., professional responsibilities, creative impulses, model-based or context-based understanding) that could encourage music therapists towards greater self-awareness of their personal professional identity, and to share their professional experience with colleagues around the world. This increased self-awareness might also positively impact therapists' continuous professional development regarding the analysis of music,

in terms of the identification of areas where training or upskilling is needed. For those who rely on implicit knowledge, this research encourages them to look into more objective analysis methods. For those who rely on explicit knowledge, it suggests that different clinical situations might benefit from the use of different analysis methods. This author hopes that this research will also encourage changes in curriculum design for music therapy courses, with greater emphasis placed on teaching the importance and methods of music analysis, particularly computational. As Stensæth and Magee (2016) observed, "technology needs to be included as a mandatory subject in many music therapy programs and curricula to secure that music therapists get sufficient training in the use of it" (p. 150).

Kim (2006) notes that "psychodynamic theories and concepts that therapists apply to the phenomena encountered in their clinical work are largely based on psychological inferences, and are hard to prove scientifically" ("Conclusion", para. 1), thus objective results that support psychodynamic music therapy theory are needed. The findings of Study 3 support the assumption that improvisation is a means of self-projection and nonverbal communication (Hadley, 2003; Metzner, 2016), as the effects of depression were only seen in referential improvisations. These results, then, support psychodynamic music therapy literature hypothesising that musical and psychological processes are linked (Hadley, 2003; Kim, 2016).

This dissertation also contributes towards understanding of the effects of depression on both musical expression and emotional experiences. Previous research has shown that depression can affect the perception of music, but this research is the first attempt at establishing its effect on music -making, providing distinct links between musical parameters, emotional responses and clinical diagnosis. This forms the basis, in the mid to long-term, for the development of an assessment tool for depression based on musical expression. Such a tool could be used to advance diagnosis of depression in people who are non-verbal or, for other reasons, cannot be diagnosed using traditional tools for other reasons. Such a tool would also aid therapists in their clinical work and provide a convenient and reliable means of data collection for future research.

This dissertation has the potential to aid the professional recognition of music therapy (Letulė, 2016) in several ways. In the words of a participant from Study 2 (Letulė, Ala-Ruona, Erkkilä, 2018, p. 459):

> I think in order to say out loud, and to be well graded in social and health care systems we need to standardise assessment tools, because if we can argue that we have unique information, we can argue that we have unique treatment, if we can measure something unique, we can work with something unique.

Working towards a stronger and more unified position on musical analysis and using that to acquire knowledge regarding depressed individuals and music making, musical parameters and emotional experiences can be all used to advocate for the importance and efficacy of music therapy in health care systems. This research has implications also for practitioners and researchers outside the music

therapy field, as it explores the links between creative expression and clinical diagnoses and could serve as an example of combining art research methods and applying them in a health care environment.

6 CONCLUSION

This dissertation explored music analysis methods in music therapy research and clinical work. As a result of that exploration, this research introduced a novel way of classifying music analysis methods based on music representation (aural, notation-based and computational). It has also shown that music therapists' sense of professional responsibility and their creative impulses have an effect on when and how they analyse music and the importance they place on it. Choice of music analysis methods also depends on the background, the career stage, and the specific working environment of the music therapist, thus the approach to using music analysis in their clinical work and research should be seen as a developmental process, rather than a fixed choice.

The present work also highlighted that not all approaches to music analysis will be equally useful for a specific case. Music analysis methods that could be meaningfully applied in music therapy research and clinical work require expertise in music analysis (education on music theory in case of notation-based analysis and use of technology in case of computational music analysis), time (some methods are very time consuming), availability (money for recording equipment and software fees), and applicability (guidelines for interpreting the results). Well-chosen analysis methods can have an impact on clinical practice, as well as wider implications for music therapy as a profession and a discipline.

Ockelford (2013) wrote that "although research in music psychology, education, and therapy has expanded exponentially in the 21st century, there is something of a black hole around which much of the discourse circles: music itself" (back cover). This work contributed towards the greater understanding of methods that could be used to shed the light onto the music in music therapy. Computational music analysis has great potential in the music therapy field but lacks quantifiable links between music and clinically relevant issues. This research utilized computational music analysis methods for the assessment of depression and demonstrated that there are quantifiable differences between depressed and non-depressed participants in making music and emotional experiences around it.

YHTEENVETO (SUMMARY IN FINNISH)

Tämä tutkimusprojekti sai alkunsa havainnosta, että lukuisissa tutkimuksissa ehdotettiin musiikkianalyysimenetelmiä musiikkiterapiatyöhön, mutta kirjallisuudessa oli selkeä pula tutkimuksista, joissa tarkasteltaisiin näiden menetelmien käyttöä musiikkiterapiatyössä ja -tutkimuksessa. Oli myös epäselvää miksi musiikkiterapiassa ei juurikaan tehdä ohjelmistoavusteista musiikkianalyysiä, vaikka musiikkiterapia on näyttöön perustuva praktiikka, ja MIR (Music Information Retrieval [suom. musiikillisen information haku]) tarjoaa tehokkaimman ja puolueettoman menetelmän musiikillisen aineiston keräämiseen.

Tässä väitöskirjassa pyritään vastaamaan seuraaviin kysymyksiin: Kuinka erilaisten musiikkianalyysimenetelmien tulokset vertautuvat toisiinsa? Mitä musiikkianalyysimenetelmiä musiikkiterapeutit käyttävät kliinisessä työssään ja tutkimuksessaan? Mitkä tekijät ohjaavat heidän valintojaan musiikkianalyysimenetelmien suhteen? Voidaanko löytää yhteyksiä ohjelmiston avulla eroteltujen kliinisen improvisaation musiikillisten parametrien ja tunnekokemusten välillä? Selvittäessäni vastauksia näihin kysymyksiin pyrin rakentamaan siltoja musiikkitieteen, MIR:n (ohjelmistoavusteisen musiikkianalyysimenetelmän) ja musiikkiterapian välillä. Niin ikään pyrin rakentamaan siltoja musiikkianalyysimenetelmiä kehittävien tutkijoiden, näitä menetelmiä soveltavien kliinikoiden, ja erilaisten musiikkianalyysimenetelmien (kuulonvarainen, nuotinnosperusteinen ja ohjelmistoavusteinen) välillä.

Tämä väitöstutkimus koostuu neljästä tutkimusartikkelista. Artikkelit pohjaavat kolmeen osatutkimukseen, joissa hyödynnettiin erilaisia aineistoja: monimenetelmätutkimus (1. osatutkimus), laadullinen tutkimus (2. osatutkimus) ja määrällinen tutkimus (3. osatutkimus). Erilaisia aineistoja hyödyntämällä pyrittiin tarjoamaan monipuolinen yleiskuva musiikkianalyysimenetelmien käytöstä musiikkiterapiassa.

Perinteisesti musiikkianalyysimenetelmät luokitellaan laadullisiin/tulkinnallisiin tai määrällisiin/objektiivisiin menetelmiin. Jaottelulla viitataan käytettyihin analyysitapoihin, mutta laajemmasta perspektiivistä tarkasteltuna myös analysoijan tietoteoreettiseen asennoitumiseen. Tämän väitöskirjan ensimmäisessä osatutkimuksessa musiikkianalyysimenetelmät luokitellaan analysoitavan aineiston lähteen mukaan kuulonvaraiseen, nuotinnosperusteiseen, tai ohjelmistoavusteiseen analyysiin. Tämä johtaa kahden analyyttisen paradigman (laadullinen/tulkinnallinen ja kvantitatiivinen/objektiivinen) laajentamiseen koskemaan kolmea aineiston lähdettä (kuulonvarainen, nuotinnos, analyysiohjelmisto), jotka voivat täten muodostaa kuusi mahdollista yhdistelmää.

Toisessa osatutkimuksessa ankkuroidun teorian muodostuksen aikana syntyi näkemys, että musiikkiterapiaan on lähes yhtä monta lähestymistapaa kuin on musiikkiterapeuttejakin. Tämä tilanne saattaa olla asiakkaiden kannalta hyödyllinen, mutta tekee musiikkiterapian kentän määrällisen tarkastelun vaikeaksi. Käytettyjen analyysimenetelmien kirjo ja musiikkiterapeuttien vaihtelevat näkemykset musiikkianalyysin merkityksestä kliinisessä työssä ja tutkimuksessa vai-

kuttivat olevan yhteydessä terapeuttien ammatilliseen identiteettiin. Musiikkiterapeuttien identiteetit vaihtelivat asteikolla, jonka toisessa päässä terapeutit kokivat ensisijaisesti olevansa 'muusikkoja'. Tällöin musiikki oli terapiatyössä erittäin tärkeää. Asteikon toisessa päässä identiteetiksi koettiin 'terapeutti', jolloin verbaalinen kommunikaatio koettiin puolestaan keskeiseksi välineeksi. Tämä muonimuotoisuus alalla johtunee sen alkuperästä, sillä musiikkiterapia on kehittynyt useiden yksittäisten musiikkiterapeuttien pioneerityöstä yhteisen teoreettisen viitekehyksen sijaan.

Kolmannen osatutkimuksen tulosten mukaan masentuneet tutkimushenkilöt soittivat terveisiin henkilöihin verrattuna rekisterillisesti alempaa ja tasaisemmassa rytmissä, kun he kuvasivat musiikilla sen hetkisiä tunteitaan. Tulos osoittaa, että tunteisiin viittaavassa improvisoinnissa masennus saattaa vaikuttaa keskimääräiseen sävelkorkeuteen ja musiikillisen sykkeen selkeyteen. Vapaan improvisoinnin osalta tilastollisesti merkittäviä eroja ryhmien välillä ei löydetty. Se, että ero tutkimusryhmien välillä havaittiin ainoastaan tunteisiin viittaavan improvisoinnin tilanteessa, voidaan tulkita kahdella tavalla. Tulos voi johtua siitä, että masentunen ja terveiden tutkimushenkilöiden ryhmät ovat vastanneet musiikillisten taitojen osalta toisiaan. Toisaalta tulos saattaa tarkoittaa, ettei masennus vaikuta yleisesti kykyyn improvisoida, vaan tunteiden ilmaisemiseen musiikin kautta.

Työssä korostuu havainto, etteivät kaikki musiikkianalyysimenetelmät toimi yhtä hyvin jokaisessa tilanteessa. Musiikkianalyysimenetelmien tarkoituksenmukainen käyttö kliinisessä työssä ja tutkimuksessa vaatii musiikkianalyysimenetelmien osaamista (musiikinteorian ja analyysiohjelmistojen koulutusta), aikaa (jotkut analyysimenetelmät ovat hitaita toteuttaa), saatavuutta (taloudellisia resursseja mm. äänityslaitteita ja ohjelmistoja varten), sekä sovellettavuutta (ohjeita tulosten tulkintaan). Hyvin valitut analyysimenetelmät voivat vaikuttaa kliinisiin käytänteisiin, ja niillä voi olla myös laajempaa vaikutusta musiikkiterapiaan ammatti- ja tieteenalana.

Erilaisten tutkimusasetelmien (laadullinen, määrällinen, monimenetelmäisyys) käyttö eri musiikkianalyysimenetelmien tarkasteluun (kuulonvarainen, nuotinnosperusteinen ja ohjelmistoavusteinen) johtui halusta tarjota ymmärrettävä ja edustava kuvaus tavoista käyttää näitä analyysimenetelmiä musiikkiterapiatyössä ja tutkimuksessa. Vaikkakin laadullisten ja määrällisten tutkimusmenetelmien yhdistäminen tarjoaa rikkaan ja kattavan aineiston, voivat aineistot myös viedä eri suuntiin ja synnyttää projektin kannalta ylimääräistä tietoa, jota täytyy vahvasti suodattaa.

Tutkimus osoittaa, että jokaista musiikkiananalyysimenetelmää voidaan potentiaalisesti hyödyntää tietyissä tilanteissa, ja ettei yksikään menetelmä ei toimi jokaisessa tilanteessa. Tarkoituksenmukaisen menetelmän valitseminen kulloiselleenkin kliiniseen tapaukseen tai tutkimusprojektiin on monimutkainen prosessi, joka riippuu esimerkiksi työn toteutuspaikasta ja institution ohjeista, asiakkaiden yksilöllisistä tarpeista, sekä musiikkiterapeutin metodologisesta tietotaidosta.

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ORIGINAL PAPERS

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TRIANGULATION OF METHODS IN ASSESSING CLINICAL IMPROVISATIONS

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ARTICLE

TRIANGULATION OF METHODS IN ASSESSING CLINICAL IMPROVISATIONS

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Introduction

Music is an essential, though complex, component of a music therapy process. According to Austin (1996) multiple aspects of music exist in psychodynamic music therapy 'as pure experience in the here and now, as a mediator between unconscious and conscious awareness, and as a form of symbolic communication' (p. 41). Musical, psychological, and physiological experiences in music therapy are interlinked. The challenge is to integrate these different aspects in order to give a complete picture. Priestley (1995) noted, that 'the cathartic release of tension through the music, without knowledge of what the feelings are about, gives temporary relief, but without understanding in words, the tension will mount again leading to the need for further relief without knowledge and so on' (p. 28).

Musical material produced during music therapy has been investigated in a number of ways. Lee (2000) and Sutton (2001) transcribed free improvisations into traditional notation and analysed these scores to achieve insight into the improvisations. Abbotson and North, with a group of engineers (Streeter, 2010; Streeter et al., 2012), and the team from the University of Jyväskylä (Erkkilä, 2007; Erkkilä, Ala-Ruona, & Lartillot, 2014) developed computational analysis methods specifically for clinical improvisations, and there are also volumes of literature concerned with the aural analysis of music. However, the picture can be incomplete if only focusing on one aspect of an improvisation or method of analysis. This study aims to

investigate the applicability of method triangulation, the concurrent analysis of several data sources with several methods, to clinical improvisation assessment. After exploring a theoretical background and introducing a methodology, a case study is presented.

Theoretical background

Triangulation

In social sciences, triangulation describes the use of multiple research approaches in the study of the same phenomenon (Hussein, 2009). These methods can be both qualitative and quantitative, employing multiple observers, theories, methods and materials. The two main goals for the use of triangulation are to validate results and to seek results that complement each other. As Hammersley (2008) presented it, 'using data of different types can help us both to determine what interpretations of phenomena are more and less likely to be valid and to provide complementary information that illuminates different aspects of what we are studying' (p. 31).

McFee (1992) described two types of triangulation: *between methods*, in which 'mutual validation is sought' and *within methods*, in which 'data are built up from various perspectives' (p. 215). Triangulation between methods might include, for example, the use of interviews with therapists in addition to observation and field notes about the same therapy process. Carter, Bryant-Lukosius, DiCenso, Blythe, and Neville (2014) further divide the triangulation *within* method into three types: investigator, theory, and data source triangulation. Investigator triangulation includes more than one researcher collecting and analysing the data. Theory triangulation applies multiple theories in the analysis and interpretation of data. Data source triangulation involves collecting data from various types of people, for example, individuals, families, and communities.

There are certain challenges in employing the triangulation method in research (Farmer, Robinson, Elliott & Eyles, 2006). If multiple methods are applied, one might struggle to find a valid way to integrate the results into a single conclusion. For instance, if combining the data of individual and group interviews, one must decide if the opinion of ten (a group interview) should be equated with the opinion of one (an individual interview). If choosing within method triangulation, one might find it difficult to determine which types of data should be included as relevant to the study and how much of it is sufficient. In the case of using multiple investigators, one must decide how many researchers are sufficient to avoid subjectivity biases and other

threats to the validity of the research.

In a music therapy setting, using triangulation might involve various analysis methods of verbal, numeric, and musical data (Bonde, 2005). Verbal data may include transcripts of therapy sessions, therapists' notes, clients' medical histories, clients' diaries, researchers' observations, and interviews etc. Numeric data is produced using standardised scales (such as Likert-type scales) or physiological measurements (e.g. heart rate measurements, lung volumes). Musical material can be captured in many forms: real-time aural analysis can be performed, or the music can be recorded as audio or MIDI data and transcribed into a score or graphic notation.

Triangulation provides 'investigative strategies that offer evidence to inform judgments, not techniques that provide guaranteed truth or completeness' (Hammersley, 2008, p. 32). Using many points of view might provide useful insights into the processes under investigation. In order to use the triangulation method effectively, Beckhet and Zauszniewski (2012) emphasised the importance of formulating a clear research question and carefully selecting methods.

Technologies in music therapy

Although some therapists advocate the use of acoustic instruments for vivid tactile experiences and aesthetic appreciation of sound quality, the development of technologies has undoubtedly benefited therapy practice, training, and research (Streeter, 2007). Fifty years ago recording a good quality improvisation required expensive equipment and extensive training, whereas now that can be achieved using a single mobile device.

Some client groups benefit from digital technologies more than others. For example, highly sensitive devices converting signals from electronic sensors into sounds enable communication that could not be otherwise achieved with physically disabled clients (Hunt, Kirk & Neighbour, 2004; Magee & Burland, 2008). Even though technologies become increasingly accessible and affordable, there is debate as to what extent it should be incorporated into practice. The prominence of technological education for music therapy students differs greatly. It is noted that in the USA, technologies are included in the curriculum more often than in the UK, therefore ensuring greater technological competencies and skills of students (Streeter, 2007).

The term *technologies* can refer to the recording, storing, retrieving, analysing, and manipulating of auditory, visual, and physiological data. Crowe and Rio (2004) suggest using the following categories regarding the types of technology in music therapy practice and research: adapted musical instruments, recording technology, electric/electronic musical instruments, computer applications, medical technology, assistive technology for the disabled, and technology-based music/sound healing practices. As shown by Crowe and Rio's extensive literature review, technologies can be incorporated into music therapy in many different ways.

Although the management and analysis of data using technological aid has benefits, Magee (2006) reported that 69% of her respondents never used technologies in their clinical music therapy work. Understandably, utilising technologies requires financial, time, and space resources that are not always available. However Magee's survey revealed that the primary reason for not using technologies was a lack of knowledge and required skills. 88.5% respondents answered positively to the question of whether it would be helpful to have information on how technology can be used. Since Magee's study was conducted a decade ago, the situation it highlights may have improved. Nevertheless, in the interests of addressing this issue, here we briefly describe the principles of using technology with regard to music.

There are three kinds of instruments: acoustic, electric, and electronic. Acoustic instruments produce sound based on the qualities of the material they are made of. Electric instruments – such as electric guitar – are designed to be plugged into an amplifier to enhance the sound, but can in some measure be played without it. Electronic instruments – such as synthesizers – need a power source to produce the sound in the first place. Currently the predominant form of such electronic instruments is digital or software-based. Software-based instruments run as applications installed on personal computers or mobile devices. Such devices normally utilise MIDI as a means of controlling musical parameters.

There are many different software programs that can be used to record music. Some of these are free (e.g. Ardour, Audacity, Reaper), although commercial programs have greater functionality for editing and reproduction (e.g. Cubase, Logic, Protools). Both electric and electronic instruments can be directly plugged into the computer for recording purposes. In order to record acoustic instruments, one has to have a separate audio interface and a microphone or pickup. Recording the output from microphones or pickups to the computer results in

an audio file (e.g. .wav .au .aiff .mp3), whilst the data produced using MIDI controllers, which does not contain any audible content, is saved in .mid format. The MIDI data contains information about which note is played (pitch), how loudly it is played (velocity) and for how long it is played (duration). As a consequence, it is possible to easily convert MIDI information into a score, whereas score generation from audio recordings is still at an early stage of research and development.

Recording music can be a therapeutic method used in song writing, or to give recordings to the client to take home and listen to between sessions (Grocke, Bloch, & Castle, 2009). In order to achieve the best results, there are a few things to keep in mind. If using acoustic instruments, it is important that the room in which the recording takes place would be quiet, because the microphone will capture all the sounds present. In the case of capturing MIDI data, the noise in the recording environment does not impact on the recording at all. However audio recordings contain more nuance and subtlety of variation in musical expression, than can be coded into MIDI data, and this additional information may be therapeutically relevant.

Research aims

The goal of the case study presented here was to determine whether there was an observable difference between the first and last improvisations of all ten sessions. In order to do so, musical, physiological, and verbal data were analysed for both clinical improvisations. The musical structure of the improvisations was assessed using these three separate methods, aural, score-based, and computational, as already defined. Heart rate variability measurements taken whilst improvising, and verbal data relating to the improvised music, were also assessed. The statistical significance of the difference between improvisations was not the purpose of this investigation. Instead, the objective in presenting this case study is to demonstrate how the triangulation method can be used to complement musical assessment by introducing the results of physiological and verbal analysis.

Methodology

Musical analysis

Aural

The ability to analyse music aurally is important to all music professionals. As the composer, pianist, and music theorist Edward Cone (1989)

expressed: 'the greatest analysts (like Schenker at his best) are those with the keenest ears' (p. 41). Aural music analysis is the most commonly used approach for music therapy assessment purposes. Compared to score-based and computational music analysis methods, the aural approach requires the least preparation. In assessing clinical improvisations by ear, it is neither needed to set up special equipment nor transcribe data. The limitations of examining the music aurally are the subjectivity of the results and – if not using defined musical terms – the challenges in choosing appropriate language in order to describe the observed musical processes (Priestley, 1995).

Aural examination can be performed without following a specific approach, although methods developed and tested by other clinicians have greater validity and reliability. Perhaps the most thorough method, based on aural examination of musical material produced in therapy, is Improvisation Assessment Profiles (IAPs) by Bruscia (1987). IAPs enable the clinician/researcher to evaluate the profiles (integration, variability, tension, congruence, salience and autonomy) of musical elements (rhythm, melody, tonality, texture, volume, timbre). One might analyse a few elements within one profile (e.g. rhythmic integration, melodic integration) or a few profiles within one element (e.g. rhythmic integration, rhythmic variability).

In this study the Individualized Music Therapy Assessment Profile (IMTAP) by Baxter et al. (2007) was employed for aural analysis of clinical improvisations. This method was selected because in our estimation it assesses the most comprehensive list of musical competencies. Although IMTAP contains ten domains in total (gross motor, fine motor, oral motor, sensory, receptive communication/auditory perception, expressive communication, cognitive, emotional, social and musicality skills), for the purposes of this study we utilised only the musicality domain. It allows for the assessment of fundamental components such as tempo, rhythm, dynamics, vocal, perfect and relative pitch, creativity and development of musical ideas, music reading, and accompaniment. Assessment is based on a scale measuring the consistency with which a client demonstrates these skills: never (0%), rarely (under 50%), inconsistent (50-80%), and consistent (80-100%). 'Dependent on the number of domains scored, and the means for review, the assessor can expect to spend between 15 and 90 minutes' in analysing the data (Baxter et al., 2007, p.15). IMTAP can be used as a baseline for treatment and/or an on-going assessment of selected aspects of client's functioning

Score-based

Score-based music analysis may be non-structured annotation, or the observation of a specific analytic protocol, one of the most common of which is the Schenkerian method. Schenkerian analysis has the benefit of having vast numbers of examples of analysis and interpretations in the literature, but is only applied to tonal music. In the case of atonal musical materials, other methods are available such as semiotics (Nattiez, 1990) or motivic analysis (Epstein 1987). The limitation of score-based music notation is that it 'omits things like the complex overtone structures of musical sounds, representing sounds by their fundamentals alone' (Cook, 1987, p. 16). For that reason, if the timbral qualities of clinical improvisations are of importance, score-based methods might not be the best fit for the data.

Methods have been developed specifically for the purposes of the analysis of clinical improvisations. Jos De Backer, in his work with psychotic patients, analysed clinical improvisations based on a score transcription (De Backer, 2008). He proposed that the music in therapy can be identified as sensorial play ('the patient is perceptually and emotionally detached from his own musical production', p. 93) or as musical form ('musical structure that is created within a symbolising process', p. 93). Repetition can be interpreted as a sign of sensorial play taking place, because musical form structures are developed and explored. A completely different approach to the analysis of clinical improvisation was proposed by Carl Bergstrøm-Nielsen, whereby he suggested creating graphic notation, a thematic drawing or a sketch of a perceived musical structure, instead of a conventional score (Bergstrøm-Nielsen, 1993). The symbols used in graphic notations, and the meanings assigned to them, are determined by each individual separately; there are no hard and fast rules. This method is less time consuming and could be valuable in everyday clinical work, but may be less suitable for comparative purposes in research.

In this study, a motivic score-based analysis method was employed. This method was considered to complement the other proposed analysis approaches in providing information of similar scope, but from a different perspective. Motivic development, which may be observable in the score-based analysis of clinical improvisations, can be directly compared with the computationally analysed spectral development.

Computational

Computational software for musical analysis is a relatively new, but rapidly developing, research area. The

use of computers speeds up the analysis process and ensures objectivity of results. The limitation of this approach is the setting up of the necessary equipment, which can be costly. In addition to financial investment in the software and hardware for music recording and analysis, certain knowledge and skills are needed for the analysis to be beneficial.

Various programs have been designed for audio analysis (e.g. Sonic visualizer, MIR Toolbox) and MIDI (e.g. MIDI Toolbox) files. At the moment, clinical improvisations can be assessed using any music analysis software, but it should be noted that certain programmes have been created specifically for music therapy purposes. One can already familiarise oneself with the research carried out using prototype versions of such software, for example The Music Therapy Logbook (Streeter, 2010; Streeter et al., 2012) or Music Therapy Toolbox (Erkkilä, 2007; Erkkilä, Ala-Ruona & Lartillot, 2014).

In this study, the MIR Toolbox (Lartillot & Toiviainen, 2007) software (v. 1.6.1, available for free download) that runs in the MATLAB environment (commercial software) was chosen. MIR Toolbox performs musical analysis of files saved in audio format. This was chosen because it enables the analysis of a range of musical aspects – temporal surface, register, dynamics, tonality, dissonance, and pulse related features. Of particular interest for this research was the analysis called similarity matrix. The similarity matrix is produced from an algorithm that computes an autocorrelation analysis on the audio file. The autocorrelation identifies the self-similarity within a piece and, in layman's terms, highlights points of repetition within the piece of music.

Non-musical analysis

Physiological measurements

As explained by Miller (2011), the use of physiological measurements in the assessment of music therapy is still very limited. Researchers and clinicians usually rely on subjective rating protocols, and very rarely complement them with physiological data. However a wide range of physiological measurements have been used to assess the emotional impact of music listening in the field of music and emotions. In his overview of the physiological effects Hodges (2010) named skin conductance, heart rate, respiration rate, blood pressure, muscular tension, skin temperature, blood-oxygen saturation, hormone concentration, pupillary reflex, and gastric motility. Not all of these approaches can be easily or successfully applied outside music listening. For the specific purpose of assessing music improvisations within music therapy, Miller

(2011) recommended to focus on muscular tension, electrodermal activity, heart rate, heart rate variability (HRV), and electroencephalography (EEG), depending on feasibility and availability.

In the present study, heart rate variability (HRV) was chosen as a physiological measure because it offers an objective window into the current state of a person's autonomic nervous system (ANS) (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). Furthermore, data can be easily collected in a non-intrusive fashion, without interfering with the proceedings of the therapy session. More specifically, we monitored the client's heart rate using a Suunto Memory Belt (Suunto Oy, Kuopio, Finland), which is a chest strap with a 1000 Hz sampling rate (i.e. 1 ms accuracy). Data pre-processing and analysis was performed with version 2.2 of Kubios HRV, a HRV analysis software developed at the University of Eastern Finland (Niskanen, Tarvainen, Ranta-aho, & Karjalainen, 2004).

Conventional HRV analysis methods are typically designed for very controlled environments, with all the study participants performing the exact same task during a specific amount of time. This is not realistic for a music therapy setting, where improvisations can last varying amounts of time, from a couple of minutes to the entire length of the session. Since one can only compare data segments of equal length, our need for flexibility was fulfilled by averaging multiple windows of 2 minutes each with the amount of windows depending on the length of the improvisation.

We performed a power spectral analysis using Welch's periodogram, and calculated low frequency (LF) and high frequency (HF) values. In terms of interpretation, HF power can be used as an indicator of vagal tone and parasympathetic activity, which is the 'rest-and-digest' state of the ANS (Appelhans & Luecken, 2006). We also paid close attention to the relative distribution of LF and HF, because the emotional or psychological impact of a given intervention is not always visible on the level of overall or absolute HRV measures (Wu & Lo, 2008).

Text analysis

Text analysis refers to the systematic analysis of semiotic data, which can be written or spoken. In a music therapy context, language can be analysed using materials such as therapists' notes, patients' diaries, clinical reports, and transcriptions of conversation between client and patient. Since text analysis methods are derived from various theoretical backgrounds, and intended for different methods and method-

ologies, it is advisable to identify the specific text analysis method used in one's research.

For discourse analysis (DA) the context of the data is considered to be critical, although there is no consensus regarding the extent to which researchers are justified in using information from outside the data itself (Wodak & Meyer, 2009). DA methods derived from social psychology (as opposed to cognitive or historical approaches) are critical for discourse analysis (van Dijk, 2008), interpretative phenomenology (Smith, 1996), and conversation analysis (Goodwin & Heritage, 1990). An alternative to DA is Content Analysis (CA) methodology, which investigates a subject's reality without necessarily linking it to social contexts. CA is performed by forming analytical categories and connecting these to the text (Hardy, Harley, & Philips, 2004).

In this study we chose to employ CA, because insufficient information on the client's life circumstances meant DA was inappropriate. Both inductive and deductive approaches were employed in line-by-line analysis of the verbal transcripts. The inductive approach was used to establish the client's thoughts and experiences from her fragmented speech. The deductive approach was used to compare categories at different times (at the beginning and the end) of the therapeutic process. The categories were conceptualised by finding the most salient themes in the client's speech and identifying those according to psychodynamic music therapy theory.

Participant

The client was a 26 year-old female, spending a semester in Finland as an Erasmus exchange student. She did not have any medical diagnosis and was not taking any medication. In her diary (the therapist proposed to write down any thoughts between the sessions), she wrote:

> *After the honeymoon (1), the negative feelings towards the host country (2), the adaptation phase (3), now I am in adaptation phase part 2 (3.5). … I do not want to be active but it is not out of laziness; it is more as if I feel like a participant-observer. I am observing myself as a participant of my life-experiment. I feel like letting things be, and not dashing through my daily journeys.*

She attended ten individual sessions of improvisational psychodynamic music therapy (Erkkilä, Ala-Ruona, Punkanen, & Fachner, 2012). The therapist gave her a choice of instrumentation: a digital MalletKAT instrument or an acoustic djembe drum. In the first and last sessions, and also for the most part of the other sessions, she played only the MalletKAT instrument. During the

therapy process the client used vivid language full of images and metaphors in describing her experiences, but seemed to be disconnected from her feelings. When answering the therapist's question about her emotions in the last session she said 'if you give me a list of emotions maybe I can say "uh, yeah, this!" I just think of the basic ones like angry, happy, calm and sad – that's it. I can't think of more…I can't speak in emotions'. On the other hand, whilst talking about the effect of therapy on her life, she said that music helped her to release the tension and pain in her back and neck and that she is now less scared to make mistakes.

Case presentation

Table 1 comprises descriptive information about the improvisations from sessions one and ten from all three analytical approaches – the musical, physiological, and verbal. The musical data presented in Table 1 were the result of computational analysis of audio data using MIR Toolbox, and descriptive statistics taken from MIDI information. Observably, the client spent more time improvising (380s to 456s) and talking (7.1 min to 17.6 min) in Session 10 compared to Session 1. Both the pitch range and the average velocity (how hard the instrument is struck) of the MalletKAT improvisations decreased. The average pitch (the mean of MIDI values) increased – the client played in a higher register, which, according to self-report, she preferred. Variation in average heart rate was minimal, but there was a stronger parasympathetic activation in the last improvisation, as indicated by increased HF.

Although some controversy remains regarding the physiological underpinnings of LF power, a majority of researchers nowadays agree that it is the combined result of both sympathetic (fight-or-flight) and parasympathetic (rest-and-digest) activity (Heathers, 2014). The source of HF power fluctuations is more straightforward, as it can be attributed exclusively to parasympathetic activity (Shaffer, McCraty, & Zerr, 2014).

Table 1. The outcomes of musical, heart rate and language analysis of the first and last sessions.

Session	Music				Heart rate			Language	
	Duration of playing	Average pitch	Pitch range	Average velocity	Average HR	LF	HF	Duration of speech	Number of words
1	380 s	C 5	C4-C7	44	57.56	538 ms^2	282 ms^2	7.1 min	417
10	456 s	G# 5	G4-A6	39	57.71	406 ms^2	484 ms^2	17.6 min	1128

Musical analysis

Aural

The IMTAP Musical profile was originally assessed by the first author of this paper, and subsequently verified by the second author, in order to avoid subjectivity bias (investigator triangulation). The original charts (Baxter et al., 2007) were filled in whilst watching video recordings of the sessions. The musicality profile consists of nine subdomains, each of which contains a list of skills. The manifestation of these skills in both Session 1 and Session 10 were assessed on a scale: Never (0%), Rarely (under 50%), Inconsistent (50-80%), Consistent (80-100%). Here we summarise the results:

A. Fundamentals (e.g. 'is alerted by music', 'expressed enjoyment of music'): in both sessions, the manifestation of skills relating to Musical Fundamentals were Consistent.
B. Tempo (e.g. 'tolerates changing tempo', 'demonstrates awareness of gross tempo changes'): in both sessions this was Consistent.
C. Rhythm (e.g. 'imitates simple rhythmic pattern', 'imitates intermediate rhythmic pattern'): in the first session Rarely was shown in the rhythmic skills, whilst in the last one, this was Inconsistent.
D. Dynamics (e.g. 'demonstrates awareness of gross dynamic changes', 'tolerates changing dynamic'): in both sessions – Consistent.
E. Vocal (e.g. 'unconscious vocalisations in tonality', 'vocalizes in response to particular musical style/idiom'): not applicable.
F. Perfect and relative pitch (e.g. 'seeks and matches single tones', 'plays melodically in tonality of music'): in both sessions Inconsistent in seeking and matching single tones and Never plays in a key (improvisations are atonal).
G. Creativity and development of musical ideas (e.g. 'creates melody independently', 'improvises melody to given rhythmical pattern'): in the first session, Rarely creates musical ideas, but Never develops those or uses recognisable musical styles, whilst in the last improvisation the client was Inconsistent in creating musical ideas, although still Never developing those or using recognisable musical style.
H. Musical reading (e.g. 'plays simple accompaniment using chord chart', 'reads and plays simple rhythmic notation'): not applicable.
I. Accompaniment (e.g. 'accompanies therapist singing/playing', 'vocalises and plays simultaneously with pulse'): not applicable.

Several domains – vocal, musical reading and accompaniment – were not assessed, because these activities were not included in this particular music therapy style. The client scored lowest in skills related to the ability to produce tonal music, and the complexity of melodic and rhythmic patterns. To summarise the comparison between the first and last sessions, there was a slight improvement in two subdomains: Rhythm, and Creativity and development of musical ideas (in both cases from Rarely to Inconsistent).

Score-based

MIDI files were converted into traditional notation using Sibelius software (v. 8.0.1.). The transcription of the two improvisations under investigation resulted in 12 pages of score. Figures 1 and 2 show two excerpts representative of the improvisations from sessions 1 and 10. Motivic analysis was performed by the first author and verified by the second author. Motifs were annotated using symbols: a (motif: ascending), b (motif: descending), c (motif: undulating), A (phrase: ascending), B (phrase: descending), C (phrase: undulating), o (ostinato), a1, b1, o1, etc. (variation of the musical material).

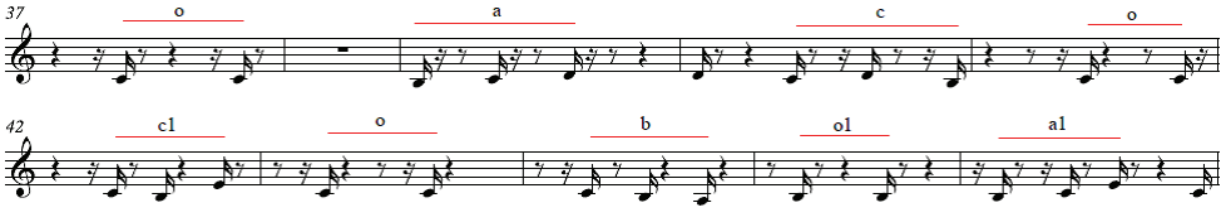

Figure 1. An excerpt from the score analysis of the first MalletKAT improvisation (session 1).

The first improvisation was performed using two mallets, resulting in an alternation between a single melodic line and a succession of intervals. For the purposes of comparison with the last improvisation, where only one mallet was available for the client, we chose an excerpt from the first improvisation where the client played with one mallet only. Therefore the excerpts are: two lines from the beginning of the first improvisation (Figure 1) and two lines from the beginning of the last improvisation (Figure 2).

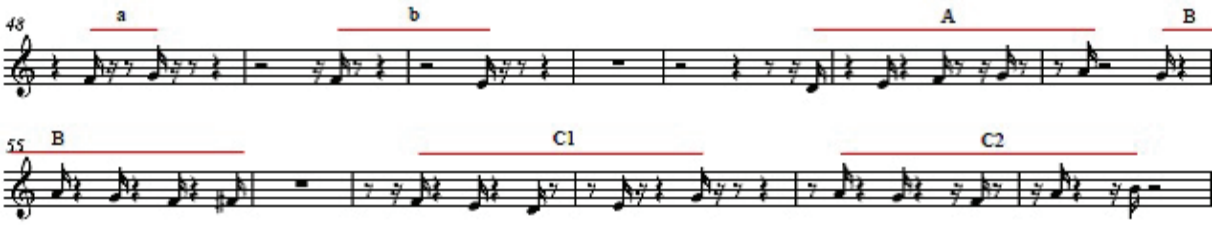

Figure 2. An excerpt from the score analysis of the last MalletKAT improvisation (session 10).

Score-based motivic analysis revealed a difference in the complexity of musical organisation in the improvisations. In the last improvisation the client developed short motifs (a, b) into phrases (A, B) and ceased to use repetitive patterns (ostinato). In addition to this, the intervals between the successive notes expanded (disjunctive melodic motion) and the client played black keys as well as white ones.

Computational Analysis

Results revealed that the client played in a less variable manner in the first improvisation, whilst the last improvisation showed greater variability.

Figure 3 shows an annotated similarity matrix for Session 1. Both the x and y axes represent the timeline of the recording. The beginning of the improvisation is marked with a star in the bottom left corner of the score and continues diagonally up and right. The improvisation starts with a dark patch because the client was not playing. The square circled in white represents the moment the client starts hitting the keys. She plays a few notes in a simple pattern therefore this part is highlighted as highly similar to itself. One can choose to study the graph globally (e.g. there are four main parts to the improvisation) or locally, second by second (e.g. the first part consists of four smaller sections).

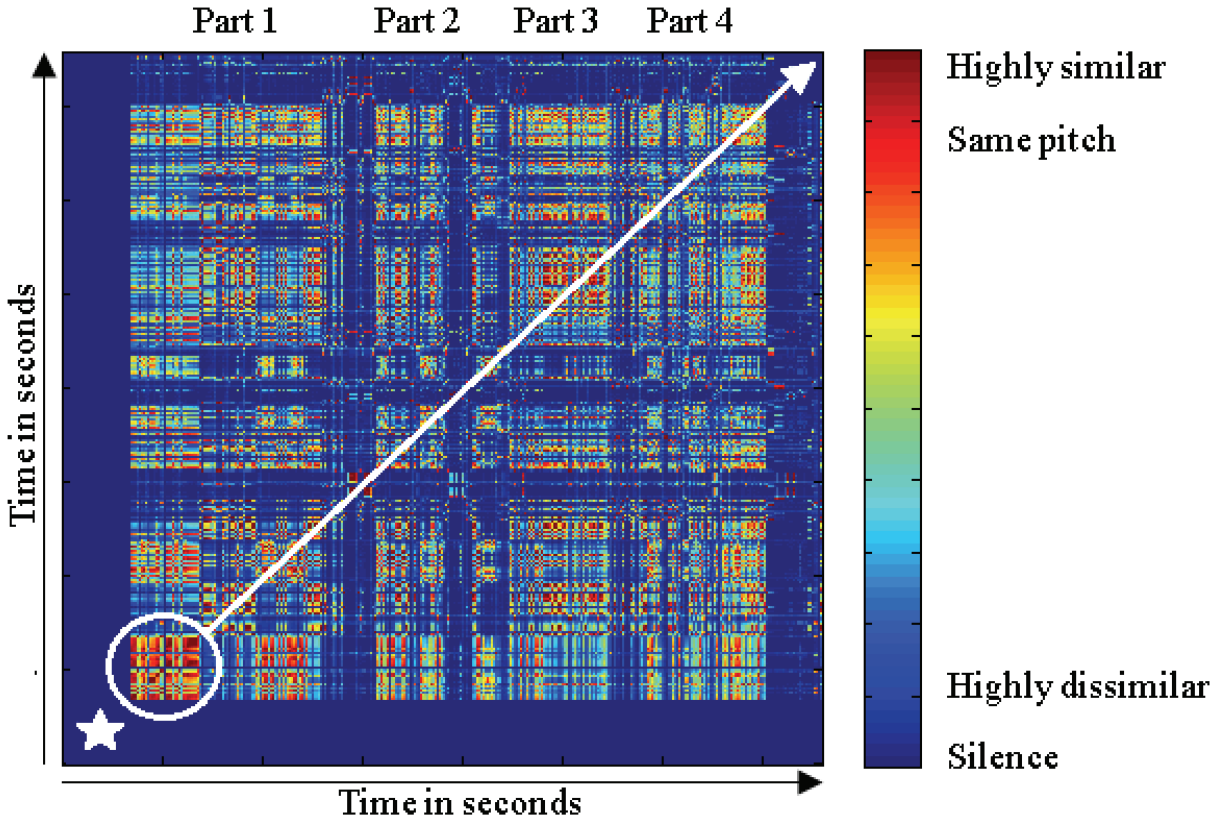

Figure 3. Annotated similarity matrix of the first MalletKAT improvisation.

The first improvisation (Figure 4) started with a long pause – the client was reluctant to begin. To start with, the client played highly similar musical material. An excerpt of the exact same repetitive material was transcribed into the score and analysed above (Figure 1). Whilst the first improvisation can be segmented into four main parts, the last one consists of at least 11 parts.

Interestingly, whilst the client started her first improvisation with complete silence (dark area in the bottom left corner of the graph), she finished the last improvisation by repetitively hitting B5 (white square in the top right corner of the graph), which makes a complete contrast from the similarity analysis perspective.

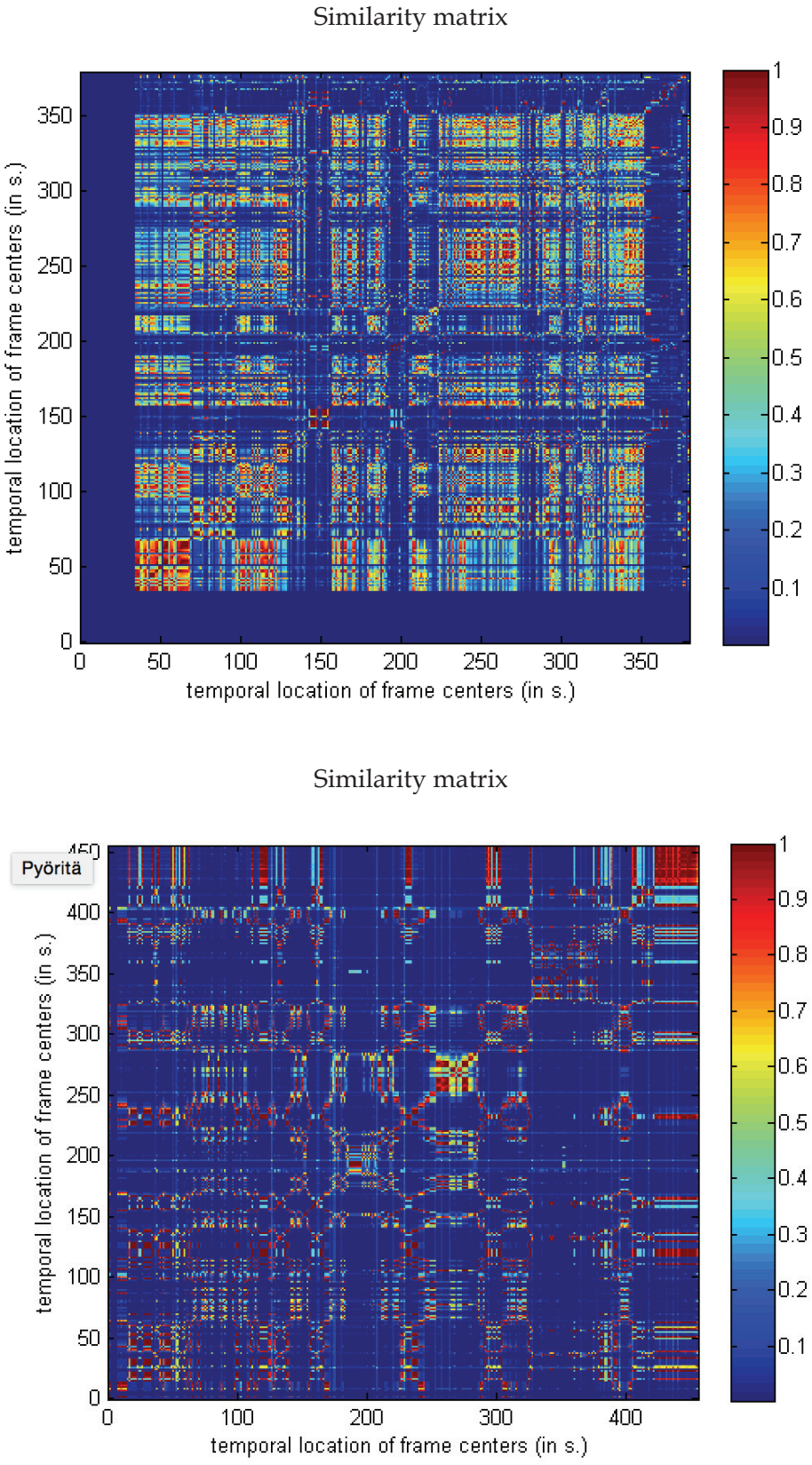

Figure 4. Similarity matrices of Session 1 (upper) and Session 10 (lower) MalletKAT improvisations.

Non-musical analysis

Heart rate

The heart rate data in the form of a spectrogram represents the evolution of the power spectrum across time. The spectrograms were calculated using the Lomb-Scargle method, with a moving window of 20 seconds and a 50% overlap. The colours indicate the power spectral density (s2/Hz) for each frequency – the brighter the colour, the higher the spectral density. More power in the LF range (0.05 Hz to .15 Hz) compared to the HF range (0.15 Hz to 0.4 Hz) indicates a lesser influence of the parasympathetic system while the opposite would refer to increased parasympathetic activity.

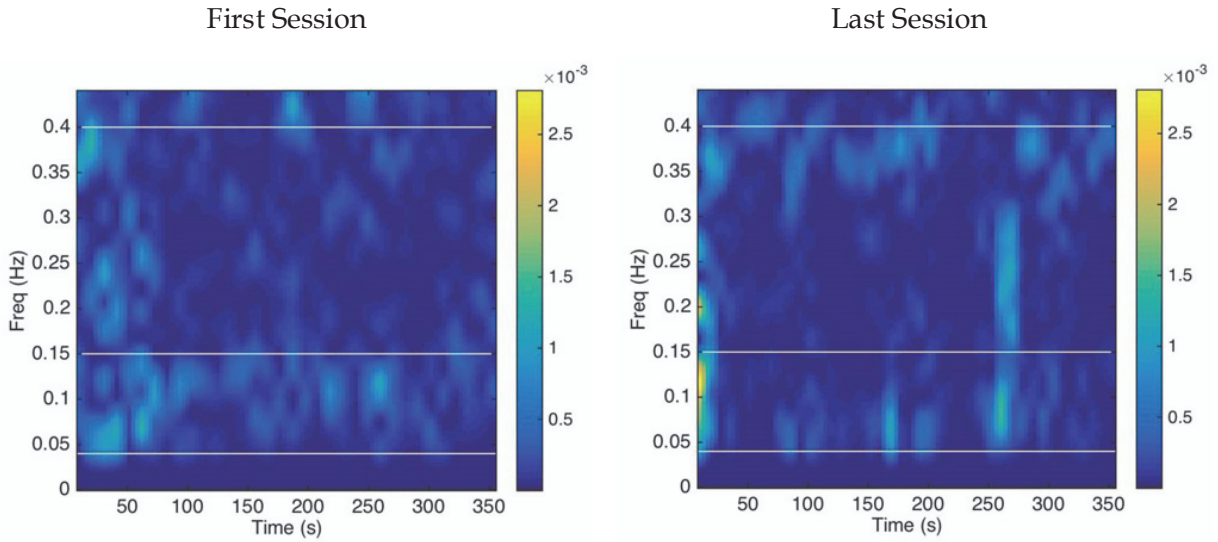

Figure 5. Heart rate spectograms from Session 1 (left) and Session 10 (right) MalletKAT improvisations.

Text analysis

The content analysis of the client's transcribed speech was performed manually by the first author and subsequently checked by the second author. The transcripts were first analysed line by line with initial coding, and then focused coding (Saldana, 2009). Four main categories were established: feelings, thoughts, interaction with the therapist, and motivation. The thoughts, emotions, and images came from the client's reported experiences whilst improvising. Table 2 contains excerpts from the client's speech in order to illustrate the change between sessions.

Table 2. Excerpts from client's speech from the first and last sessions.

Categories	Session 1	Session 10
Feelings	The sounds don't go together. And actually it's just like; it doesn't feel good when you do it. It makes me feel a bit uncomfortable.	I don't want to be driven by my emotions. I can accept my emotions but I don't want my emotions to overcome my own reason, myself. […] To make them like circulate, and not destroy, or overcome me.
Thoughts	I don't know... I was just playing whatever. It sounds stupid to do something that doesn't sound right.	Out of this corridor in this big house, if I go out, it's summer and I would like to explore through the garden, and then I came to this river. I took the boat, the rowing boat to go to the other side. And from there, that's the end, the new start.
Interaction	I feel a bit... like a bit uncomfortable that you have to try to follow what I'm doing. Because I'm doing kind of nonsense...	[after ending the improvisation by hitting a key on a therapists Mallet-Kat] Yeah why not, it's the last time!
Motivation	You hear that it's wrong. And it doesn't really encourage you to continue. Because you don't really want to do it again.	I learned a lot of things in the past weeks, so I just need to put that in practice and I hope this time I'm getting closer to the person I want to be.

There were quantitative and qualitative differences in the client's speech between sessions one and ten. The client spoke twice as much (both in duration and word count) in the last session (Table 1) and was better able to reflect on her inner experiences. From the first author's analytic memo about categories: 'There are four categories in total: emotional (feelings) – hidden, uncontrollable; cognitive (thoughts) – true-self, precious; relationships (interaction with therapist) – dangerous, longing; motivation – disappearing, energy'. The importance of the motivation arose while reading transcription of session five, when the client said '*when I'm not really motivated I don't really cook or eat too much. But now at the end I was like, actually, I'm gonna stop by the shop to buy something so that I can cook something to eat*'.

Discussion and conclusions

After ten sessions of psychodynamic therapy the client was musically and verbally more engaged with the therapist and was better able to reflect

on her experiences in Session 10 compared to Session 1. At the end of the therapeutic process she reported that improvising music helped her to release tension and that she was less afraid of trying something new and making mistakes.

This case study demonstrated a way to combine different data and analysis methods in the assessment of the improvisations produced during music therapy. We employed separate methods, and separate analyses, but the results were brought together afterwards and interpreted as a whole. By incorporating findings from physiological and verbal data, two improvisations were meaningfully compared to each other. Based on this case study, the most promising approach comprises analysing musical and physiological measurements for the detection of salient points, both within individual sessions and in therapeutic progress, and comparing the results to text analysis in order to interpret their meaning and importance.

The first musical finding was that the client spent more time improvising in the last session, compared to the first one. HRV measurements indicated that the client was more relaxed in the last session. This was supported by textual analysis: she spent more time talking to the therapist and said that she felt more comfortable sharing her thoughts with the therapist. As creating a safe therapeutic space between therapist and client is crucial in music therapy (Austin, 1996), the client's greater engagement is not an unexpected finding.

The second finding was that the client's way of expressing herself musically became more complex over time. It is common that clients start by exploring the instrument, and later focus on developing specific musical ideas (Bruscia, 1987). This is supported by both the descriptive statistics taken from the improvisations, where the pitch range decreased, and thematic analysis, where the initial motifs developed into themes. These findings are in accordance with De Backer (2008), describing musical processes in a therapeutic setting as a transition from sensorial play to musical form. The increased complexity of musical material was reflected in the client's speech afterwards, where she would share the insights that she was having whilst improvising.

For the assessment of the first and last music therapy sessions, we found the IMTAP to be the least applicable method. The IMTAP findings were in accordance with the results of other musical analyses; it highlighted the increase in creativity and the development of musical ideas, but it seemed that IMTAP was more suitable for the global assessment of musical progress when analysing many sessions, rather than local analysis of an individual improvisation. Since, in psychodynamic music therapy, a client is encouraged to be expressive rather than to demonstrate any conventional musical skill, the IMTAP's focus on the development of recognisable musical styles seemed misplaced. By comparison, the motivic and computational analysis methods

used yielded comparable and much more applicable results. The method triangulation in this case study analysis presented two main challenges; first choosing the methods, and second combining the results. The first recommendation (1) for future research is to perform an initial exploration of the data in order to select the most appropriate methods, the second recommendation (2), as stated by Beckhet and Zauszniewski (2012), is to formulate a clear research question, and the third and final recommendation (3) is to use data management software, which enables video, audio, verbal transcripts, and researchers' comments to be collectively contained in a single application window (e.g. ELAN, Brugman & Russel, 2004).

The main limitation of this study was the narrow scope of investigation. We compared only the first and last sessions of a single client. One might argue, that higher stress levels as indicated by HRV measurements and limited verbal interaction might be explained as a reaction to a stranger (therapist) and a completely unknown task (playing MalletKAT). Larger scale research investigating the whole therapeutic process with many clients is needed to support the results of this research. In addition to this, the triangulation method proved to be highly time consuming. For everyday clinical work it might be more suitable to limit the choice of methods to no more than two or three. In this study three different musical analysis methods were explored, producing very similar results. In clinical practice one musical method might be sufficient. Triangulation of methods provides a vast amount of data; therefore a well-targeted selection of the measurements will yield the best results for the least energy spent in the analysis and interpretation of the data.

It would be potentially fruitful to pursue further research on the triangulation of methods in order to establish the links between musical and psychological processes. This study does not offer a conclusive finding as to the efficacy of the music therapy intervention. In order to confirm that certain musical behaviours have the same meaning for a group of clients, one would have to study a substantially larger and more diverse population. What this case study does offer is an example of using multiple analysis methods to create a multifaceted picture of a client's musical behaviour. By means of triangulating methods and data, researchers and therapists can be aided in making informed decisions about the evolution of a therapeutic process. When several methods produce similar results, it is likely that the findings are of consequence. Multidimensional investigation may result in better understanding of how musical processes, physiological reactions, and psychological phenomena interact during the course of music therapy, and may provide the key to linking specific features of all three.

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PII

PROFESSIONAL FREEDOM: A GROUNDED THEORY ON THE USE OF MUSIC ANALYSIS IN PSYCHODYNAMIC MUSIC THERAPY

by

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Professional freedom: A grounded theory on the use of music analysis in psychodynamic music therapy

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ABSTRACT

Although music is the fundamental element of music therapy, music analysis methods are a particularly under-researched area. This study investigates how and when psychodynamically orientated music therapists employ the analysis of musical material in both clinical work and research. Constructivist grounded theory was employed in the collection and analysis of the data. Eight participants, all highly experienced in psychodynamic music therapy, were recruited using referral sampling. In-depth interviews focused on therapists' experiences of working with different client groups, and the applicability of different assessment methods. Strauss and Corbin's coding paradigm was used to determine causal and intervening conditions, action strategies and the consequences of music analysis. Professional freedom (a tension between creative forces and professional responsibilities) emerged as the most important factor influencing the method, application and frequency of music analysis. Therapists used either explicit knowledge (model-based theoretical understanding and reductionist action strategy), or implicit knowledge (context-based theoretical understanding and holistic action strategy) or used a combination of both approaches. Implicit knowledge was found to lessen the ability to give an account of analytical processes, but increased sensitivity to clients' abilities and needs, while explicit knowledge led to frustration about interdisciplinary disagreement, greater excitement about discovery and increased workloads.

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KEYWORDS Music analysis; grounded theory; psychodynamic music therapy

Introduction

Music is the essential mode in music therapy. It enables both communication and interaction with the client. Yet, despite its key importance to the therapeutic process, Bonde (2016b) notes that "music therapy literature includes surprisingly and disappointingly few studies with a focus on music itself" (p. 105). The author continues by comparing the music in music therapy to a black box – a complex system whose internal workings are not readily understood. To date, while some research has been carried out (Bonde, 2016a), there remains very little scientific understanding of the music in music therapy.

Musicologists, by contrast, have been analysing music for centuries, and research from this field is also relevant to the music therapy setting (Ansdell, 1997; Rolsvjord, 2006).

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Meyer (1989) introduced the distinction between the primary and secondary parameters of music. Primary parameters, such as meter and harmony, have discrete, proportional relationships (up-beat and down-beat, or tonic and dominant). Secondary parameters, such as dynamics and timbre, do not have the capacity to form musical syntax, because the changes in these parameters are relative (softer and louder, darker and brighter, etc.). Primary parameters, because of organizational complexity, take time to perceive, while secondary parameters are perceived instantaneously. But, as Eitan and Granot (2009) point out, "while the perception and cognition of secondary parameters, even in a musical context, may be chiefly based upon general auditory experience (or perhaps even on innate tendencies), processing primary parameters relies chiefly on music-specific exposure" (p. 144). In music therapy, this music-specific exposure is not a commonality amongst the client population; therefore, musicological analyses that focus on primary parameters are not sufficient to account for the musical processes taking place in therapy.

In the music therapy literature, three music analysis methods have been documented: aural (Abrams, 2007; Baxter et al., 2007; Forinash & Gonzalez, 1989; Keith, 2007; Mahoney, 2010), notation-based (Bergstrøm-Nielsen, 1993; Gilboa & Bensimon, 2007; Lee, 2000) and computational (Erkkilä, Lartillot, Luck, Riikkilä, & Toiviainen, 2004; Hunt, Kirk, Abbotson, & Abbotson, 2000; Streeter et al., 2012). Aural music analysis is the most subjective method of the three, and arguably the most prevalent in music therapy practice. Nordoff–Robbins scales (Nordoff & Robbins, 1977) and later contributions (Aigen, 2014; Guerrero & Turry, 2012), Bruscia's Improvisation Assessment Profiles (Bruscia, 1987; Gardstrom, 2004), Bruscia's method of analysing GIM music (Bruscia, 1996) and Wigram's quantitative use of IAP (1999, 2000) are amongst the most influential aural analysis methods. Notation-based analysis is performed after transcribing music into either a traditional or a graphical score. Because of the skill and attention to detail required in the transcription of clinical improvisations, this method is the most time consuming of the three (Gilboa, 2012), but could enable a very detailed examination of musical processes. Computational methods promise great benefits in terms of efficiency, but currently lack links between computationally retrieved results and clinically relevant issues (De Backer, 2008). At the present developmental stage, algorithms cannot achieve pattern-recognition results comparable to those of notation-based analyses and cannot identify secondary parameter changes as successfully as aural analysis (Letulė, Brabant, Thompson, & Erkkilä, 2015). Furthermore, very few of these methods have been subjected to rigorous testing for validity and reliability (Sabbatella, 2004). With the exception of the Streeter surveys (2010), which included questions about music therapy evaluation methods, to date there has been no research on how music therapists use these diverse music analysis methods in their practice.

The objective of the present study is to explore how and when psychodynamically oriented music therapists use music analysis in practice. The term psychodynamic music therapy refers herein to the "existence of, and dynamic processes in, an unconscious mind, which has an influence on intrapsychic and interpersonal processes within and outside of the musical activity between the therapist and patient" (Metzner, 2016, p. 448). A psychodynamic music therapist seeks to enable a client to communicate his/her inner state through musical expression. A researcher, then, needs to reject absolutism in favour of referentialism (i.e., a belief that music is capable of communicating extramusical meanings) (Meyer, 1956). Readers should bear in mind that this investigation does not seek to recommend a single best approach to music analysis, but rather to explore multiple perspectives and to reveal

the causalities and consequences of different action strategies in music therapy practice. The current study aims to determine factors influencing music therapists' approaches to music analysis and explore how available music analysis methods are being utilised in practice, and, as a result, to create the grounds for future studies by identifying key categories for qualitative as well as quantitative research and to guide the development of subsequent music analysis methods.

Method

We chose a constructivist grounded theory approach for the present study in order to capture the complexities of the phenomenon (Charmaz, 2006, 2014; Mills, Bonner, & Francis, 2006). Since grounded theory building is entirely inductive, it was not affected by the lack of previous literature on the topic (Daveson, 2016; O'Callaghan, 2016).

Although, according to grounded theory principles, a literature review was performed as the last step of the research process, we were already aware of eminent authors in this field, and used this knowledge to select informants for the present study. We made a list of psychodynamically oriented music therapists that had developed music analysis methods or published research that employed music analysis methods. All key informants were, or had been, involved in clinical, educational and research work and had no less than 10 years of professional experience. In order to form a comprehensive theory, we chose therapists that used various music analysis methods and worked with diverse client populations. Though we attempted to recruit informants from a wider geographical area, not all invitations to participate were answered, and the eight who participated were all based in Europe.

In qualitative research, findings are generated rather than discovered, therefore it was very important to be reflexive on the entire research context (Gentles, Jack, Nicholas, & McKibbon, 2014; Mruck & Mey, 2007). We removed terminology from the interview questions that might have led participants, and attempted to prevent our professional interests from affecting the way we viewed or worked with data. Although we are involved in the activities of the Finnish Centre for Interdisciplinary Music Research, apply an Integrative Improvisational Music Therapy approach (Erkkilä et al., 2011), and use computational music analysis tools such as MIR Toolbox (Eerola & Toiviainen, 2004; Lartillot & Toiviainen, 2007) and Music Therapy Toolbox (Erkkilä, 2007), the current research is equally interested in all possible approaches to and outcomes of analysing music in psychodynamic music therapy.

According to the National Advisory Board on Research Ethics in the country where the current study was carried out, this type of research did not require ethical review. The present study was based on interviews with a small sample of experts, and the data was analysed by one researcher only. Consequently, it lacked triangulation within and between methods (Carter, Bryant-Lukosius, DiCenso, Blythe, & Neville, 2014; Flick, 2004). More generally, this qualitative study had a relatively broad research question with little previous research having been undertaken on the topic, so it was challenging for informants to answer, and – because of the diversity of opinions and experiences – difficult for researchers to conceptualize without being too simplistic (Wheeler & Bruscia, 2016). It should also be noted that interviews were conducted in English, and none of the informants were native English speakers. The most challenging aspect of the current study was the process of raising the analytical

level from description to abstraction. Participants voiced very different, sometimes opposing, opinions on approaches to music analysis and it was difficult to account for all variation within a single core concept.

The subjects, material, design, and analysis methods varied depending on the phase of the study. Phase 1 – Exploration – identified the most salient themes (initial coding), and facilitated the design of the questionnaire for Phase 2. In Phase 2 – Theoretical Sampling – new interview data were collected and coded (initial, axial, selective coding) until the point of saturation was reached. In Phase 3 – Refinement – the theory was presented in order to clarify and validate it. We employed two styles of interaction with participants: in Phases 1 and 3 interviews were interactive and discussion-like, while in Phase 2 the approach was based on open, non-directive listening to informants. Although Phase 3 discussion did not result in any new categories, it was an important part of validation. As Strauss and Corbin (1990) said, "opening up one's analysis to the scrutiny of others helps guard against bias. Discussions with other researchers often lead to new insights and increased theoretical sensitivity" (p.11).

Phase 1 – exploration

Participant

Key informant 1, coded as Mr A, was a Finnish music therapist with 29 years of experience (at the time of interviewing, February 2015). Mr A was selected because his research interests (as seen from research publications) were the most similar to the research question of the current study.

Procedure

Interview data were collected in person over two meetings, which lasted a total of 3.5 h.

Materials

Mr A answered 49 questions about music recording techniques, music analysis, analysis interpretation, communication with clients and colleagues, the use of different assessment tools, and issues in relating assessment results to clinical issues. Because interviews were lengthy and rich in data, we decided that these were sufficient for the first stage of the current study.

Data analysis

Transcripts of the interviews with Mr A were analysed with initial coding. We used the *in-vivo* technique (labelling the data only with participant's own words) to stay as close to the participant's point of view as possible. This phase was used to identify different practices in music analysis and highlight areas of inconsistency and debate.

Phase 2 – theoretical sampling

Participants

Six participants were interviewed during Phase 2 from March to May 2015 (see Table 1). In addition to being music therapists, some had training in music performance, music education, composition, dance therapy, psychotherapy, and psychoanalysis.

Table 1. Information about participants in Phase 2.

Participant	Experience (years)	Country
Ms B	25	Finland
Ms C	25	Switzerland
Mr D	32	Denmark
Mr E	30	Belgium
Ms F	10	Denmark
Mr G	19	Finland

Procedure

Interviews were conducted in person where possible or via Skype, and lasted on average for 62 min.

Materials

The main questions addressed to each participant related to music making (four questions), music analysis (three questions), interpretation of analysis results (three questions), and a final open question that inquired whether there was anything else the participant considered to be important regarding music analysis in music therapy that had not been discussed in the interview. As seen in Appendix 1, the questions were very open: no music parameters (e.g., rhythm, melody) or music analysis methods (e.g., aural, computational) were identified in the questions in order to avoid leading. If participants found a question confusing and asked for clarification, then suggestions (marked as a. b. c. in Appendix 1) were presented to them. Clarifying and probing questions were asked with the aim of explicating or expanding upon opinions and experiences, which necessarily varied for each participant.

Data analysis

Coding was completed in three stages. In the first stage, open coding was used to identify concepts, define their properties, and start grouping them into categories. Two techniques were used in open coding – first line-by-line *in-vivo* coding, followed by process coding. During process coding (Saldana, 2009), all the gerunds (verbs ending "–ing") and transitional indicators ("if", "when", "because", etc.) were highlighted and subsequently used to generate new codes or establish code properties. While many categories discussed in the results correspond with individual interview questions (e.g., therapists' background, client populations), some emerged directly from data (e.g., creativity, bodily experiences). Axial coding was the second stage of data analysis, which focused on the connections between categories by clustering the data. Following Strauss and Corbin's coding paradigm (Strauss & Corbin, 1990), causal conditions, intervening conditions, action strategies and consequences were identified. Selective coding was the final stage, which was used to integrate all the findings into a coherent picture. Conditions, strategies, and consequences were interrelated, and a core category emerged as the best explanation for the observed phenomenon.

Phase 3 – refinement

Once it was judged that saturation point had been reached in Phase 2 and the theory was formulated, an oral presentation was given at the 10th European Music Therapy Conference in Vienna (Letulė, Thompson, & Erkkilä, 2016). To begin with, the first author gave a 30-min presentation explaining the methodology and results of this study. Compared to the final version of the theory presented in this paper, some

categories had different names (e.g., "positivistic" instead of "model-based" theoretical understanding) and "client's abilities and needs" was paired with other intervening conditions, as opposed to having its own space in the flowchart of the coding paradigm. After the presentation, the audience was informed that their input, voiced during the next 10 min, would be used as part of the study and encouraged to express any thoughts or opinions regarding the theory. Several audience members affirmed that they could relate to the theory from their own professional experience. In addition to this feedback, a suggestion was made to replace the term "intuition" with "implicit knowledge", which was adopted.

One member of the audience was approached for thorough feedback on the proposed theory. Like all the other key informants, Mr H was involved in clinical work, research, and education, but he had also had specific experience in using the grounded theory method. He was a Finnish music therapist with 26 years of experience. The meeting occurred in August 2016 and lasted 75 min. Mr H was presented with coded transcripts, figures, and tables, as well as a draft of the Abstract, Method and Results of this paper. His feedback resulted in the revision of the names of some categories and inclusion of more tables in the manuscript, as this helped to present findings more clearly.

Results

Results will be reported in three sections that reflect different levels of data analysis: Summary (description), Coding Paradigm (analysis) and Core Category (interpretation).

Summary

Informants reported the use of a variety of therapeutic methods, both active (improvisation, singing, song writing) and receptive (listening to client's preferred music), in their clinical work. They practiced in both public and private sectors in a variety of venues (hospitals, schools, nursing homes, etc.). In response to questions they referred to examples from their work with neurological (e.g., autism, epilepsy, cerebral palsy, deafness, blindness, brain injury, intellectual disabilities) and psychopathological (e.g., depression, anxiety, bipolar disorder, schizophrenia, personality disorders, addictions) disorders and non-clinical populations (Table 2).

Participants had varying degrees of familiarity with different approaches to music analysis. Some informants (Mr D, Mr E, and Ms F), had extensive knowledge of different assessment tools and had clearly defined opinions regarding the phenomenon. They

Table 2. Client populations discussed in Phase 2.

Participant	Neurological clients	Psychiatric clients	Non-clinical population
B	×	(×)	
C	(×)	×	
D	×	×	(×)
E	×	×	
F	×	×	
G	(×)	×	

Note. (x) – has some experience, but not the main client group.

referred to K. Bruscia's IAPs (Bruscia, 1987), VOIAS by S. Storm (Storm, 2013), MATADOC by W. L. Magee and colleagues (Magee, Siegert, Daveson, Lenton-Smith, & Taylor, 2014), S. Malloch's Vocal Timbre (Malloch, 1999), and E. Streeter's work with Music Therapy Logbook (Streeter et al., 2012) as examples of music analysis that they did not implement in practice, but regarded highly. Others (Ms B and Ms C) tended towards implicit knowledge rather than formalised analysis methods, did not refer to other published works, and sometimes had difficulty in verbalising their implicit knowledge.

Participants also had different attitudes towards music assessment in their clinical work. Ms B and Ms C liked to have more freedom – their decisions relied primarily on implicit knowledge, while the other informants employed specific methods as part of the structure of their sessions. Ms B, for example, avoided systematic work and thought that using a tool or specific method would detract from her sensitivity to an individual client. In their clinical approaches, some (Ms B & Mr D) focused on individually differing circumstances – client personalities, cultural backgrounds, and the stage of the therapeutic process – while others (Mr E & Ms F) aimed for generalizable, verifiable knowledge. Ms F said:

> I wanted it to be objective, the results of this type of assessment can be quite severe – if it is not good enough the child might be taken away. So my opinion should not be based on whether I like the family or not, or can relate to them – it needs to be based on objective issues.

When asked about tools or specific methods of music analysis, informants' answers were grouped into one of three categories: aural, notation-based, and computational (Table 3). While all therapists – consciously or not – analysed music in an unstructured way, Ms F also used a well-documented aural music analysis method. Mr D and Mr E used traditional notation on staves. Mr D also employed graphical notation, which was based on various visual symbols. Mr E, the only user of computational software, found that notation-based analysis enabled detailed examination of music, but was time consuming, and that using computational methods was objective, fast (1 week for notation – 5 min for computation), and performed complex operations, but at the current stage of development software was sometimes unreliable. Without regard to which analytical approach informants chose to use in their work, all agreed that having a variety of options was beneficial and emphasized the complementary nature of different methodologies.

When answering the question "Which musical parameters do you consider the most important when analysing music?", participants identified both primary and secondary parameters (Table 4). The most frequently discussed primary parameter was rhythmical organisation. When talking about primary parameters, informants used terms such as "cells" or "patterns" and spoke of "finding" them. Of the secondary parameters dynamics was identified most frequently during the interviews.

Table 3. Phase 2 participants' use of music analysis methods.

	Aural	Notation-based	Computational
B			
C			
D		×	
E		×	×
F	×		
G			

Table 4. Phase 2 participants' perceived importance of music parameters.

	Primary			Secondary			
	Melody	Rhythm	Harmony	Dynamics	Tempo	Timbre	Structure
B		×		×	×		×
C	×	×	×				×
D		(×)		×	×	×	
E	×	×	×	(×)	×	×	×
F	×	×	×	×		×	×
G	×	(×)	×	×	(×)	×	×

Note. (x) – referred to a parameter indirectly and only once.

In discussing secondary parameters, informants used terms like "atmosphere" and "mood" and spoke of "sensing" them. In Mr E's opinion, secondary parameters were connected to the unconsciousness.

All informants, except Ms C, referred to creativity when talking about assessment in music therapy. Ms F talked about evaluating the level of creativity and methods to assess it, while Mr D emphasised the importance of experiencing the joy of creativity in making music with a client. Although Mr E did not specifically mention the word creativity, the way he described the phenomena indicated the importance of creativity in his work: "music therapy – I'm very sure you cannot be taught it, you can only develop it. And music training I feel like it is only developing the potential of music in yourself".

Therapists also talked about the significance of bodily experiences. Mr E considered the music therapist a resonant object: "Therapist can feel sometimes very physically, but mostly mentally, what is happening in the relationship. That, like a projective identification, that you can experience what is in the psyche of the patient". Countertransference was a common theme in other informants' narratives regarding the interpretation of musical expression, for example, Ms F said:

> Relationship and your own countertransference, emotions and things how you experience the client in your own body – and I think you really need to develop that tool in your clinical work, so that you can trust more on your own emotions and feelings about the client… for that you need, for example, very regular supervision for yourself and maybe sometimes your own therapy, if you have some personal issues going on.

Some informants investigated in their clinical work and research what constituted a healthy style of playing and what could be identified as pathological playing. Mr E argued that musical expression could indicate the severity of a client's condition:

> Autism… they are looking for sensorial material, like ocean drum. When you give it to him, autistic child is calm for an hour, looking at the fish and so on. Borderline patients, when you see the preference of an instrument, how heavier the pathology, how more rhythmically. Psychotic patients have no interest in melodic, borderline patients they like more the melodic instruments… Harmony is … for the neurotic people, and the melody is more for borderline, and rhythm for psychosis. Of course, this is not being proved, but I see in daily practice.

Ms F notes that "norms are very interesting in terms of specific clinical goal …is it good enough or not…looking to non-clinical population we will learn a lot about different combinations of parameters, or combinations about analysis, what they will mean". Conversely, Ms C believes, that a client's opinion is the only one that matters. "I say…my associations…also what I feel if it is very strong…But I do not interpret,

normally they know it and they say it. . .And that what they say is the most important, more than what I think".

In understanding and accounting for musical expression, informants had a range of perspectives. Ms B did not want to generalise. Ms C thought it was about the quality of the relationship with the therapist. Mr D considered a client's behaviour holistically, without discrimination. Mr E considered the client's pathology. Ms F thought that the client's level of confidence was the most important factor determining their musical expression, and for Mr G it was the client's regulation of arousal (e.g., in the case of traumatised children "very difficult for you to keep the steady beat. . . it might very easily start to go faster or slower because you don't really feel a beat inside of you. And I think that's also related to this regulation problem").

Coding paradigm

The Coding Paradigm identified from the data had 6 constituent parts: (1) *Causal conditions*, (2) *Intervening conditions*, (3) *Client populations*, (4) *Theoretical understanding*, (5) *Action strategies*, and (6) *Consequences* (Figure 1). Causal conditions were the situations in which therapists were compelled to perform music analysis. Intervening conditions were the circumstances that influenced the choice of approach to the analysis, affecting it indirectly. Client populations affected the choice of the analysis method like a filter – the more severe the client's disability, the more limited the options for music analysis. Theoretical understanding explained both the underlying motivations towards different actions and the interpretations assigned to the results of music analysis. Action strategies were the different music analysis methods chosen by the participants. Consequences described the interdisciplinary and intradisciplinary impact of different approaches to the phenomena.

(1) Causal conditions

Three categories of causal condition emerged: *education*, *research*, and *clinical practice*. In the *education* condition, participants analysed music because they were either a student, and it was a part of their training, or an educator, who was asked to teach music analysis. The influence of individual role models was highlighted when Ms F described the reasons why she started to analyse music: "My first encounter with assessment being taught by Tony Wigram. That just hit a core in me". In the *research* condition, participants analysed music because they wished to add to the

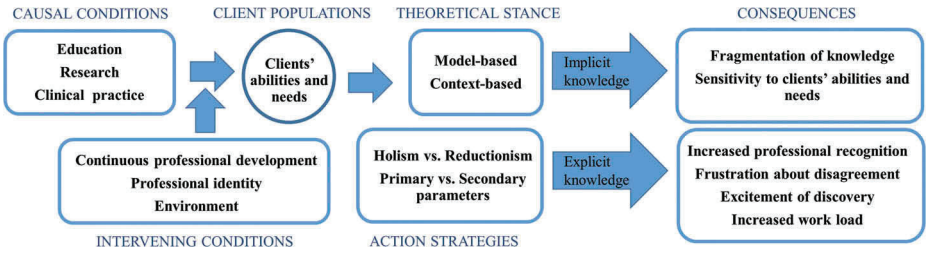

Figure 1. Coding paradigm illustrating the relationships between causal conditions, intervening conditions, client populations, theoretical understanding, action strategies, and consequences.

existing body of knowledge and/or were seeking validity. As Mr E. said, "at the university here they said it is very subjective, you cannot validate it. Now with the computational analysis we have a lot more quantitative data and we use the quantitative data to prove the qualitative data".

In the *clinical practice* condition, participants analysed music because of external factors, such as communication with clients and their relatives, requirements for clinical reports and requests for consultation. Ms F said, "different ways of interacting, I saw it while they were having a [musical] contact, so it made sense to me to dig deeper, because my co-workers asked me all the time – what do you think? . . .could you help me?" Internal factors fell into five subcategories: sense of professional responsibility, professional development, inexperience, workload and belief that the therapeutic process happens outside the session. Sense of professional responsibility played a role when it was judged that the results of a therapist's assessment would have a severe impact, for example in determining whether a child would be taken into custody or would remain with biological parents. Professional development was related to a sense of obligation to acquire the newest methodological and theoretical knowledge about one's practice. Inexperience influenced early career therapists, who sought to have their implicit knowledge or assessments validated by the results of music analysis. Heavy workload limited therapists' available time between sessions and having a clear method of analysis saved time and brought clarity to the process. The belief that the therapeutic process continued outside the session was also a reason to explore the music. As Mr E said, "When I am very triggered or I am suffering by some patient, I ask colleague 'Can we improvise together?' and then the music digests it and makes new forms. And this I bring into the next session."

(2) Intervening conditions

Three intervening conditions emerged: *continuous professional development*, *professional identity*, and *environment*. *Continuous professional development* affected the tendency to analyse music when a therapist was a member of an organisation (e.g., association, hospital or university), when they attended scientific events (e.g., conference, congress or symposium) or when they received new knowledge from students. For example, at the university where Mr D was teaching, "everyone recorded improvisations", so he started doing it as well. He also talked about workplace policies at different hospitals, which impacted the way he had to assess clients.

Professional identity affected the tendency to analyse music depending on where participants fell on a spectrum: musician versus therapist. Mr E, who was at the musician end of the spectrum, said that "music says it all", while Ms C, who was at the therapist end, believed that what a client expressed verbally during a session was most important. Participants having extensive musical training were more likely to analyse music. Professional Identity could be further differentiated by a participant's training, for example, some of the informants had degrees in musicology, composition, or performance, while others had been fully trained in psychoanalysis, or had influences from existentialism. It is important to note that all participants had both clinical and musical training. Therefore, while training could explain certain therapeutic or musical choices (the use of composition or performance in therapy, influences of psychoanalysis or existentialism), it did not explain whether a

participant would lean towards the therapist's or musician's end of the professional identity spectrum.

The *environment* condition could be divided into three categories: personal background, music preference, and role models. A participant's informal learning environment in early life affected the tendency to analyse music, as Mr E noted: "Family, where you have been born, education, and what kind of environment we are developed, and the choice of your first instrument is very interesting. Is the same instrument of the father?" Participants also mentioned certain musical styles (e.g. avant-garde, electronic music, serialism, minimalism, South American, and jazz) that influenced their way of playing or thinking. Mr E. explained that by listening to contemporary music he learned "when it is even chaotic playing . . . I can find some structure in it. And I talk about that: "it's like Stockhausen", or "it is like Philip Glass", [then] patients say "this is music, so therapist finds it meaningful".

(3) Client population

Client population affected the choice of music analysis method, depending on how reduced a client's abilities were overall, how varied a client's functionality was day-to-day, what the therapeutic goals were, and how many different populations a therapist worked with concurrently. Primarily, the client population affected the activities that could be undertaken in music therapy. Mr D said "some people are wordless – really down there with intellectual disabilities, so you cannot talk and you cannot expect to have turn-taking music phenomenon". Consequently, the search for harmonic or melodic patterns is likely to be fruitless. Furthermore, the importance of bodily expression increased as musical and verbal expression decreased. All these factors shaped the therapist's actions and ways of thinking. Mr E said, "The most I learnt from my patients in the practice room and later in my clinical work. . .how I have to listen, how I have to play".

(4) Theoretical understanding

Theoretical understanding could be summarised as two stances that were adopted by participants: *model-based* (a mindset that leaned more towards positivism and searched for patterns and regularities) and *context-based* (a mindset that inclined more towards interpretivism and empathetic understanding of a singular case). Mr E said, "It's all in the music: the interactions, the improvisational effects, the communication, interpretation – everything is in the music". The intent to decode music arose from a wish to objectively explain and validate the working mechanisms of intervention. Also, participants who had greater involvement in academia were more likely to exhibit a model-based mindset. Ms B presented another perspective: "I am really afraid of analysing too mechanically, because a situation can be very different. Clients are so different, so the meanings can be really different". She perceived the meaning as something negotiated, which depended on individual experience, the stage of the therapeutic process, the state of a client's wellbeing that day, and the client's cultural background. These categories were not forced onto the data but emerged from it and helped to navigate it. For example, Ms C was unique in her approach: she was not interested in patterns, but neither did she make any interpretations.

(5) Action strategies

A participant's action strategy tended to fit onto two spectra: Perspective, representing the tendency towards a holistic or reductionist perspective, and Parameters, indicating a tendency to focus on primary or secondary musical parameters. *Holistic perspective* could be applied to both musical expression and to a client's physical expression during musical interaction. Ms C understood musical expression holistically: "It is all music, harmony, melody, form. . .in the session it is always everything together, it is not only one, music is all elements together". Mr D asked "how I am. . . to distinguish the musical expression from everything else? There are many cases in which the behaviour, the eye contact, the breath and other things, are the things that really contribute to some overall communication". A *reductionist perspective* could be applied to music analysis using three different approaches: (1) Aural analysis (Ms F), (2) Notation-based analysis (Mr D and Mr E) and (3) Computational analysis (Mr E).

Primary and *secondary musical parameters* could be analysed from both holistic and reductionist perspectives. Primary parameters are musical features that can be transcribed into a traditional score and analysed aurally or computationally. Secondary parameters can be analysed aurally and computationally, but cannot be fully represented in a traditional score, only in a graphical notation. A participant's choice of analysis method determined which set of features they were more inclined to pay attention to. Primary parameters were analysed in order to find patterns that formed over time (e.g. development of rhythmical patterns), while secondary parameters were instantaneously sensed (e.g. loud as opposed to quiet) and did not constitute hierarchical organisation.

(6) Consequences

The Consequences of a participant's actions could be interdisciplinary or intradisciplinary and depended on the strategies chosen. When relying on implicit knowledge (context-based understanding and a holistic strategy), the consequences were different compared to when relying on explicit knowledge (model-based understanding and a reductionist strategy). *Interdisciplinary* consequences related to one category only – professional recognition. Approaches based on explicit knowledge seemed to increase professional recognition. As Ms F said:

> In terms of the whole field. . . I think in order to say out loud, and to be well graded in social and health care systems we need to standardise assessment tools, because if we can argue that we have unique information, we can argue that we have unique treatment, if we can measure something unique, we can work with something unique.

Intradisciplinary consequences varied for each approach adopted. Where implicit knowledge dominated participants were less able to give an account of analytical processes they employed, but had a great sensitivity to clients' abilities and needs. Where explicit knowledge dominated, there was frustration about disagreement, excitement regarding discoveries, and, depending on the therapist's choice of analysis method, a potentially increased workload.

Core category

Selective coding resulted in the emergence of the core category – professional freedom. Professional freedom could be described as a spectrum representing the tension between a

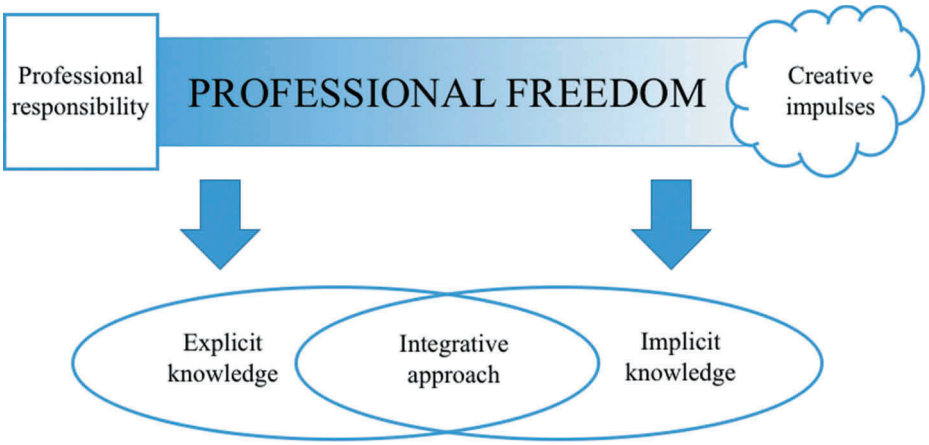

Figure 2. Core category illustrating the tension between professional responsibilities and creative impulses.

therapist's professional responsibility and creative freedom (Figure 2). On one end of the spectrum was reliance on explicit knowledge and use of well-documented methods. On the other end of the spectrum was reliance on implicit knowledge and intuition, and the importance of sensitivity to the client "here and now". The first approach tended to be employed by those who used, or even developed upon, pre-existing methods of analysis that were documented and tested. The second approach relied more heavily on the use of the therapist's feelings and insights as the main tool to assess the therapeutic process. The integrative approach combined both explicit and implicit knowledge. Of the participants in this study, Ms F used explicit knowledge, Ms B, Ms C and Mr G. favoured implicit knowledge, while Mr A, Mr D, and Mr E tended to integrate both.

Discussion

The purpose of the current study was to determine how and when music therapists analysed musical material. It was found that, when analysing music, therapists tended to favour explicit or implicit knowledge. These approaches were not separate, but rather formed a spectrum with many degrees in between. In general, when relying on explicit knowledge, therapists tended to search for patterns and regularities (model-based *theoretical understanding* and using a reductionist *action strategy*), while when relying on implicit knowledge, therapists focused on being sensitive to an individual client's case (context-based *theoretical understanding* and using a holistic *action strategy*).

The results of this investigation present a complex picture, where the possible reasons for analysing music (education, research, clinical practice – *causal conditions*) are influenced by various factors (continuous professional development, professional identity, environment – *intervening conditions*) and specific *client populations* (client's abilities and needs). Attitudes towards music analysis differed on two levels: *theoretical understanding* (model- or context- based) and *action strategies* (primary and secondary parameters analysed in a holistic or reductionist manner). As for *consequences*, when employing implicit knowledge, the ability to give an account of analytical processes lessens, but sensitivity to clients' abilities and needs increases,

while explicit knowledge can lead to frustration about interdisciplinary disagreement, greater excitement about discovery and potentially increased workloads.

The explanation that this study offers for the variety of attitudes to analysing music is that each therapist needs to find a balance – professional freedom – between their inner creative impulses and professional responsibilities. On one hand, in psychodynamic music therapy clients are often encouraged to "go-with-the-flow" in a free improvisation – an activity which is believed to reflect unconscious processes taking place (De Backer & Sutton, 2014; Erkkilä, Ala-Ruona, Punkanen, & Fachner, 2012; Metzner, 2016). In order to facilitate such a flow, therapists are trained to bear uncertainty, to be spontaneous and sensitive to possible occurrence of transference or counter-transference (Hadley, 2003; Wigram, 2012). On the other hand, music therapists are expected to fill out formalised assessment tools, follow pre-existing working plans and make decisions that will affect a client's life. As Smetana (2017) describes it, "even when structuring and directive interventions were indicated, the music therapeutic work required a high degree of flexibility and willingness for spontaneous action. Furthermore, it was always necessary to find a certain balance between presence and restraint" (p. 117).

The findings of this study have implications for all disciplines that combine creative expression and health care intervention. For music therapists, it provides a means of understanding the choice of method and use of music analysis and encourages further discussion and research into it. Firstly, it appears that each music therapist – consciously or not – seeks a balance between professional responsibility and their creative impulses. It seems that this personal decision can have a wider impact on the discipline, for example, on professional recognition and the fragmentation of knowledge. Secondly, education plays an important role in therapists' attitude to music analysis (as shown by causal conditions in the coding paradigm). Based on the results of this study, we would recommend a greater emphasis on courses teaching music analysis methodology as a part of music therapists' training programmes.

In addition to formulating a grounded theory, as presented in the results, we would like to share some observations – hypotheses, if you will, to be tested in future studies. It seems that therapists who had diverse client populations and heavy workloads tended to favour context-based approaches, and that those more heavily involved in academia had a more model-based understanding. Also, it appears that participants having more musical training were more likely to analyse music. But is it that one starts to analyse music after having extensive musical training, or is it that because of having a more analytical approach to it, one seeks further training in it? Also, why did no participants mention any interpretative methods of music analysis (Trondalen & Wosch, 2016)? Did they believe these methods to be self-evident, were interview questions not inclusive enough, or maybe these methods are not commonly practised? Furthermore, no participant discussed technical limitations such as how to make a good recording or where to store data (Hadley, Hahna, Miller, & Bonaventura, 2014). Is it that having a good smartphone eliminates most of these issues today, or was this because the experienced professional participants had access to specialized facilities that are not widely available?

Regardless of its exploratory nature, this study offers valuable insight into the way music therapists analyse music for assessment purposes, and also provides deeper insight into the mindset and practical approaches that expert therapists, and, by implication, music therapists as a wider community, employ. Approaches to music analysis seem to vary depending on the background, the stage of career, and the specific working environment of each individual, and this should be considered a developmental

process, rather than a fixed choice. Despite all these interesting results, the question remains: how can we understand so differently something that is at the very core of music therapy? Maybe, after all, as Ruud (1998) wrote: "Our profession will be forever populated with people and paradigms with competing claims of knowledge. The only answer is to learn from each other and communicate what we learn" (p. 114).

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Appendix 1. The questionnaire used in Phase 2.

(1) What are possible factors that contribute to a client's musical expression?
   (a) Client's personal qualities: musical skills, musical preferences
   (b) Diagnosis-related qualities
(2) In your experience, how do specific disorders affect a client's musical expression?
   (a) Depression – restricted expressivity
   (b) Developmental disorders – lack of changes
(3) What are the possible ways a therapist contributes to music created together with a client?
   (a) Therapist's personal qualities: personality, current mood, thoughts about the client and perhaps chemistries, unconscious factors (can be positive and negative)
   (b) Professional qualities: planned interventions, training, clinical experience, a specific improvisational technique/model, client's diagnosis, knowledge of a client's diagnosis
(4) Which musical abilities do you consider meaningful in musical assessment?
   (a) Ability to improvise
   (b) Musical interaction
   (c) Emotional expression
(5) Which musical parameters do you consider the most important when analysing music?
   (a) Music theory related features (e.g., melody, harmony, rhythm)
   (b) Basic features (e.g., pulse, dynamics, timbre)
(6) Do you relate musical expression to emotional or psychological aspects? If yes, could you identify those relations?
   (a) High pitch might indicate joy or anxiety
   (b) Basic rhythm might indicate need for support
(7) Do you use any tools or specific methods when analysing music?
   (a) What is your opinion on IAPs?
   (b) What is your opinion on graphical or staff notation systems?
   (c) What is your opinion on computational tools?
(8) What are the main issues in making an assessment based on musical material?
   (a) It is not important in clinical work

(b) Lack of time
(c) Lack of appropriate tools
(d) Lack of guidelines on how to relate results to clinical issues

(9) Why are there no standardised protocols for musical assessment?
(a) Clinical methods related issues
(b) Clinical population related issues
(c) Requirements of institutions

(10) What are possible strategies that would improve the implementation of musical analysis into clinical practice?
(a) Education-related (teaching methods in clinical training)
(b) Research-related (develop better tools)

(11) Is there something important about the assessment of musical material that we have not discussed yet?

PIII

THE EFFECT OF DEPRESSION ON MUSICAL EXPRESSION: COMPUTATIONAL ANALYSIS OF REFERENTIAL AND NON-REFERENTIAL CLINICAL IMPROVISATIONS

by

Nerdinga Letulė, Ieva Paliulaitytė, Marc Thompson, Alvydas Navickas, Stephen Croucher, & Jaakko Erkkilä

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PIV

THE EFFECTS OF DEPRESSION ON EMOTIONAL EXPERIENCES DURING MUSICAL IMPROVISATION

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