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An assessment model for the musical material produced during the course of music therapy

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Abstract

Assessment is described as the collection and analysis of information with an objective of planning and implementing an effective treatment program. Past research suggests that the professional recognition, level of communication in interdisciplinary teams and the results of research directly depend on the successful implementation of an assessment system. However, to date no tools that assess musical material produced during the course of music therapy are formalised or widely implemented into clinical practice.

After exploration of both the clinicians' and researchers' needs for an assessment system and thorough analysis of the existing assessment tools used in music therapy settings, an assessment model for musical material was created. We propose that every music therapy client has his / her own manner of improvising that can be identified by Musical Profile. Musical Profile provides information about the individual manner of playing as well as the temporal evolution of musical processes. This model combines both sensitivity to individual characteristics and objectivity in collecting and measuring the data.

In order to test the validity of Musical Profile it was applied to the analysis of musical content. The audio and MIDI materials analysed were collected in 2008-2009 by a group of researchers from the University of Jyväskylä. Clinical improvisations produced by six depressed clients were imported into the Matlab environment and subsequently analysed with different functions provided by MIRToolbox (version 1.5) and MIDI Toolbox (version 1.0.1). As a last step, statistical analyses were performed using SPSS software. The results show that Musical Profile can be successfully implemented into practice and that this model is capable of revealing significant differences between participants in an objective way.

Keywords

Music therapy, assessment, clinical improvisation, Musical Profile.

1. Introduction

Music therapy emerged as a modern profession during the 1950s in the United States, Austria and Great Britain (Wigram et al., 1995). Over the intervening years it has become a significant part of many health care systems worldwide but receives criticism over insufficient scientific research

into the effectiveness of music therapy interventions (Bunt, 1994). To understand why this situation has occurred, one might consider several circumstances. First, the profession has been established by individual practitioners, so-called music therapy pioneers, who developed music therapy methods based on their personal experience, as opposed to scientific research (Wosch & Wigram, 2007). Second, those music therapists addressed various disorders depending on their working environment, therefore the methods vary depending on the specific client group. Third, music therapy education programs focus on teaching a particular clinical method and generally have little training in research methods. Fourth, music therapy interventions are long, expensive and heavily restricted by ethical issues and client confidentiality agreements, which makes large sample studies challenging to conduct. Considering these circumstances and the fact that music therapy is a relatively young profession, it is not surprising that scientific research into the effectiveness of musical interventions encounters various challenges (Wheeler, 1995).

In order to assist the field to develop and gain recognition, the first challenge to overcome is that many studies conducted thus far are methodologically flawed – they do not address data collection, measurement, evaluation, interpretation and reporting in a consistent manner (Sabbatella, 2004). A case study is a very common research method because it allows an in-depth examination of the therapeutic process, however, the results obtained from a single participant cannot be generalized. Free verbal descriptions might result in claims and propositions, but if they are not tested afterwards, no scientific truth can be established. As a consequence, there is a lot of literature about the effect of music therapy available, but scientific understanding of the mechanisms involved in music therapy is still very limited.

Another challenge for scientific research into the effectiveness of music therapy interventions is the cautious approach to technologies exhibited by the music therapists (Magee, 2006). Hahna's et al. (2012) investigation of the implementation of technology in music therapy clinical work revealed major issues such as lack of professional experience or interest, financial and facility restrictions. One of the highlighted problems was that many clinicians reported having no formal training in technology. Since technology has become an essential part of modern scientific investigation, providing objective measurement methods and fast processing of the data, wider adaptation of computational tools might increase new developments in research.

Music Information Retrieval is an area of research in which computational algorithms are developed for the purposes of extracting musically relevant features from digital audio signals. The computational analysis of improvisations produced within music therapy interventions allows for research on music therapy to expand to more quantitative investigations. For instance, Luck et al. (2008) found that perceived activity, pleasantness and strength of clinical improvisations can be inferred from computationally extracted musical features. Another study of theirs went even further:

showing that prediction of the type of mental disorder the client experiences is possible solely from the musical content of clinical improvisations (Luck et al., 2009). These studies have not only established the links between musical analysis, emotional responses, and medical conditions, but have also demonstrated that it is possible to conduct research that meets scientific standards without losing relevance or reference to music therapy clinical practise.

2. Background

In this section, we provide the definition and goals of clinical assessment; discuss the range of approaches to musical assessment and the present tools available for the assessment of musical content produced during the course of music therapy.

2.1. Definition and goals

Assessment involves the collection and analysis of information with an objective of planning and implementing an effective treatment program (Wigram, 1999). This process is often confused with evaluation, which indicates the progress that has been made during the course of treatment (Bruscia, 1987). In other words, assessment is aimed at obtaining data and formulating a hypotheses about the nature and causes of a client's personality, condition, and resources rather than determining the effectiveness of the treatment that has been employed.

Traditionally, assessment in music therapy is performed by using standardised tools that are adopted from general physical, psychological, psychiatric, and cognitive examination (Ruud, 2010). Therefore, the majority of the measurements used in music therapy assessment do not address musical aspects at all (Gregory, 2000; Wilson and Smith 2000). Reasons for the absence a single standardised music therapy assessment tool include intrinsic factors such as the numerous theoretical orientations of the therapists and extrinsic factors like the various needs of the patient population (Isenberg-Grzeda, 1988). The main reasons for the absence of multiple standardized tools are insufficient human resources and technological capacities. Since "musical expression and experience are the actual domains the therapist seeks to act on rather than just act through" (Aigen, 2005, p. 48), this lack of formalised tools designed for the music therapy setting is a serious issue.

There are two main theoretical positions regarding the role of musical analysis in music therapy assessment. Loewy (2000) states that even though clinicians understand therapeutic processes through musical experience, the interpretations and evaluations are based on verbal description. Others, like Smeijsters (2005) believe that "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" (p. 80). These positions might be considered as the opposite ends of

the continuum that represents the range of interpretations of the importance of musical material in the music therapy context. Traditionally, assumptions about the role of music in therapy are determined by the clinical method that the therapist is trained in, although eclectic approaches are common as well.

2.2. Approaches to musical assessment

There are several tools created for the purpose of assessing musical material produced in the music therapy setting. Unfortunately, they all are based on manual – as opposed to computational - analysis of the data. These analyses are time consuming and heavily dependent on the competence as well as the subjective opinion of the therapist. Three assessment methods proposed by Nordoff and Robbins, the Improvisation Assessment Profiles (IAPs) by Bruscia, and Individualised Music Therapy Assessment Profile (IMTAP) by Baxter et al. will be discussed briefly.

The Nordoff-Robbins' Indexing method involves noting audio or video recordings with analysis of clients' tonal vocalizations, tempo, organisation of rhythmical responses, and melodic and rhythmic facility (Mahoney, 2010). A Tempo-Dynamic Schema is designed to analyse musical expressivity in terms of 'normal' if it corresponds to common musical practice, or 'pathological' if it is inflexible or considered musically meaningless. Thirteen Categories of Response are used to assess client's drum beating as a reaction to therapist's piano playing. IAPs are constructed out of six profiles (integration, variability, tension, congruence, salience and autonomy) that are evaluated on various elements (Bruscia, 1987). Musical elements that the profiles can be applied to are rhythm, melody, tonality, texture, volume, and timbre. It is suggested to analyse all elements within one profile (e.g. rhythmic integration, melodic integration etc.) or all the profiles within one element (e.g. rhythmic integration, rhythmic variability etc.). IMTAP is organised into ten domains that evaluate a total of 375 skills (Baxter et al., 2007). Musicality, one of the domains, is assessed based on fundamentals, tempo, rhythm, dynamics, vocal, perfect and relative pitch, creativity and development of musical ideas, music reading and accompaniment.

2.3. Computational Tools

There are several computational tools designed specifically for music therapy practice. None of these tools are formalised, widely implemented into practice or methodically tested for validity and reliability. On the other hand, the attempts to develop a computational tool demonstrate the necessity for computerized aid in music therapy practice and highlight the complexity in processing clinical material. The functionality of these tools varies greatly: from merely storing and retrieving data to sophisticated analysis of the musical interaction between client and therapist. Four of those tools – The Computer Aided Music Therapy Analysis System (CAMTAS), Music Therapy Toolbox

(MTTB), The Music Therapy Analysing Partitura (MAP), and Music Therapy Logbook – will be discussed briefly.

CAMTAS is the first computational tool for the organization and analysis of material produced during music therapy (Hunt et al., 2000). The tool performs simultaneous playback of audio and video material, piano roll for the piano data representation and velocity analysis. CAMTAS functions as a database and an audio player rather than analysis tool. According to Hunt, "computers weren't running quickly enough for what we wanted to explore" (Streeter, 2007).

MAP is a graphical notation system that represents musical and non-musical events that occur during a music therapy session (Gilboa, 2012). Auditory material (music, talking, silence, crying, laughing, etc.) has to be manually transcribed into specific graphical codes. Although it portrays the dynamics of the therapeutic process in a very concise form as intended by the developers (Gilboa & Bensimon, 2007), the process proves to be highly time consuming and subjective in the interpretation of what the graphical code actually means.

The Music Therapy Logbook performs both qualitative and quantitative analysis of audio and MIDI material (Streeter et al., 2012). The available functions include time-decomposed analysis of duration, instrumentation, tempo, and interaction between client and therapist (Streeter, 2010). The creators emphasise the necessity of using a multichannel wireless digital audio recording system that would not limit movements or the instrumentation choice. This also enables music - silence segmentation that visualises the dynamics of music therapy session without the necessity of manual input as seen in MAP.

MTTB is designed for the investigation of MIDI material (Erkkilä, 2007). Time decomposed analyses are performed on the temporal surface, register, dynamic, tonality, dissonance and pulse related features. The most innovative feature is a quantification of the client-therapist interaction, which is measured by the synchronicity of client and therapist's improvisations and is presented as an imitation diagram. The main limitation is that analysis is performed on a single improvisation that must be recorded in MIDI format.

3. Proposed model

In this section, we present the Musical Profile model for musical assessment of material produced during the course of music therapy. First, the main goals and methodology are discussed. Second, the construction of the individual parts of the model – Typical Performance, Temporal Evolution and Individual Tendencies – are explored. Each of the parts is illustrated by using examples from the musical data of the Participant 1 (see section 4 Experiment).

3.1. Musical Profile

The proposed Musical Profile model is designed for feature extraction, analysis and presentation of the musical processes occurring during the course of music therapy. The extracted data is analysed in a variety of ways, which reveal different aspects of the performance. Collectively the Musical Profile covers three parts: Typical Performance, Temporal Evolution and Individual Tendencies. Each of the parts contain a table or a graph with numeric results and a verbal description that explains the information presented.

At this stage, the Musical Profile is a systematic method of measuring therapeutically relevant musical content of clinical improvisations. A software package that will function as a database with options for automatic analysis is considered to be the next developmental stage. FIGURE 1 illustrates how the information could be presented to the user of the hypothetical Musical Profile software.

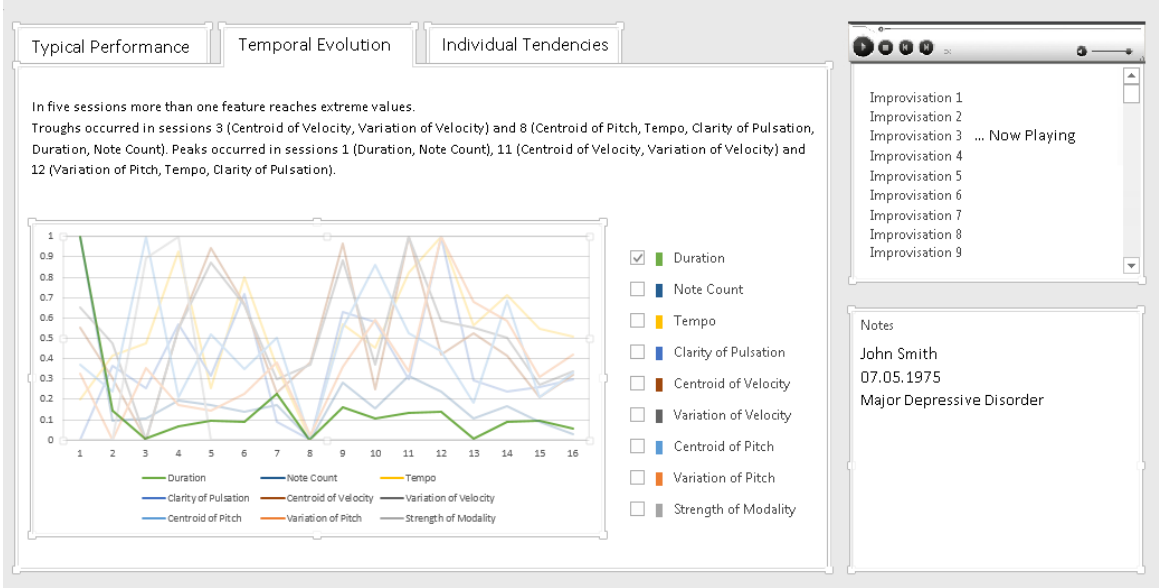

FIGURE 1. Illustration of hypothetical Musical Profile software (adapted from Letule, 2014).

3.2. Method

In order to construct the Musical Profiling model, it was necessary to employ methods that would measure musical processes precisely. A literature review on music therapy assessment revealed relevant features, which were extracted and analysed in the MATLAB environment using MIR Toolbox (version 1.5) and MIDI Toolbox (version 1.0.1). For MIR Toolbox analyses MIDI data was converted to .wav files using Cubase 5 software. The same timbre (Jazz Grand Piano A from the HALionOne Virtual Instrument) and sample rate (22050 Hz) were used for the conversion of all improvisations. Lastly, the data obtained during musical processing was imported into SPSS for statistical analysis.

The main criteria for feature selection were a pertinent connection between the extracted musical features and the perceptual qualities of the improvisations. Several relevant features were not included into the analysis, because of the limitations of the recording technique. For example, since timbre was not encoded into the MIDI data, the analysis of overtones was dismissed. The same applies to articulation (the duration of notes was fixed at 0.4 s long) or texture (the mallet instrument is played with two sticks, therefore no more than two notes can be presented at any given time). Selected features were organised into five classes (TABLE 1): Activity (Duration and Note Count), Pulsation (Tempo and Clarity), Dynamics (Centroid and Variation), Pitch (Centroid and Variation), and Modality (Strength and Mode). For more information about the feature extraction calculations performed see Lartillot (2013).

TABLE 1. Tools and methods used in order to perform feature extraction for the construction of the Musical Profile.

Class	Parameter	Tool	Function	Comment
Activity	Duration	Mir Toolbox	*mirlength*	The temporal length of an audio file in seconds
	Note Count	Midi Toolbo	*nnotes*	The count of the number of note onsets
Pulsation	Tempo	Mir Toolbox	*mirtempo*	The value of estimated tempo in beats per minute (bpm)
	Clarity	Mir Toolbox	*mirpulseclarity*	The strength of the beat, ranging from 0 to 1, where is the clearest pulsation
Dynamics	Centroid	N/A	N/A	The mean of MIDI velocity values
	Variation	N/A	N/A	The SD of MIDI velocity values
Pitch	Centroid	N/A	N/A	The mean of MIDI pitch values, rounded to integer
	Variation	N/A	N/A	The SD of MIDI pitch values, rounded to integer
Modality	Strength	Mir Toolbox	*mirmode*	The strength of the mode, ranging from 0 to 1, wher 1 is the strongest mode
	Mode	Mir Toolbox	*mirmode*	Major or Minor

3.3. Typical Performance

Typical Performance serves as an overall description of the client's performing manner. This would indicate e.g. how long the session tends to last or how fast the tempo usually is. Typical Performance should not be treated as a goal to achieve, but as an indication of the client's typical behaviour. From a therapeutic point of view the indicator of events that might benefit from further exploration are deviations from the Typical Performance since changes in the musical expression might reflect important psychological processes taking place. This part of the Profile is constructed of the averages of nine features (Duration, Note Count, Tempo, Pulse Clarity, Dynamic Centroid, Dynamic Variation, Pitch Centroid, Pitch Variation, and Modality) and the mode (the most frequent response) of Mode (major or minor).

EXAMPLE: The average duration of improvisations (TABLE 2) is 6 min 15s, producing approximately 381 notes. Tempo is fast (124 bpm), pulse clarity is not expressed strongly (0.13). Dynamics are extremely soft (29.96) and the pitch centroid is around D4. The variation of dynamics (6.44) and pitch (5.39) are similar. Modality is not expressed strongly (0.02).

TABLE 2. Typical Performance of Participant 1 (adapted from Letule, 2014).

ACTIVITY	*Duration*	*368.*	*In secon*
	Note Count	*381.*	*Number of not*
PULSATION	*Tempo*	*123.*	*In beats per minu*
	Clarity	*0.*	*From 0 to 1, where 1 is the clearest pulsati*
DYNAMICS	*Centroid*	*29.*	*On scale from 1 to 1*
	Variation	*6.*	*Based on dynamic centro*
PITCH	*Centroid*		*On scale from 1 to 1*
	Variation	*5.*	*Based on pitch centro*
MODALITY	*Strength*	*0.*	*From 0 to 1, where 1 is the strongest modal*
	Mode	*Ma*	*Major or min*

3.4. Temporal Evolution

Temporal Evolution tracks the changes in musical expression over a period of time. A change in the manner of playing should not be valued for its own sake – it will be up to the therapist to decide if the client needs more challenges or stabilisation during the course of therapy. A single graph incorporating all nine features is created using data normalisation, by scaling between 0 and 1.

EXAMPLE: In five sessions more than one feature reaches extreme values (FIGURE 2). Troughs occurred in sessions 3 (Centroid of Velocity, Variation of Velocity) and 8 (Centroid of Pitch, Tempo, Clarity of Pulsation, Duration, Note Count). Peaks occurred in sessions 1 (Duration, Note Count), 11 (Centroid of Velocity, Variation of Velocity) and 12 (Variation of Pitch, Tempo, Clarity of Pulsation).

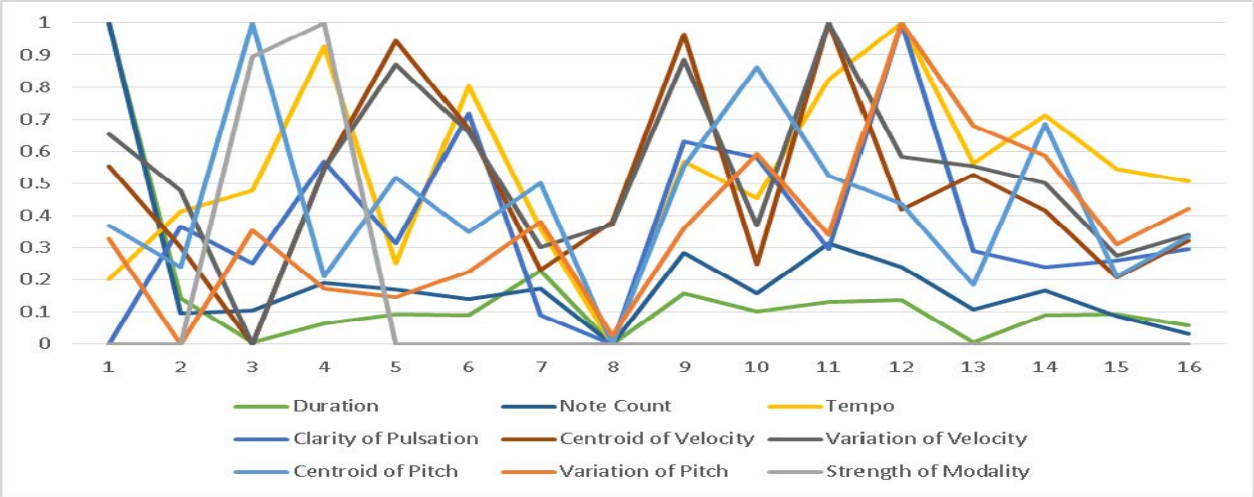

FIGURE 2. Temporal Evolution of musical features for Participant 1 (adapted from Letule, 2014).

3.5. Individual Tendencies

Individual Tendencies highlights specific details in the manner that the client expresses him/herself. These insights are the product of Pearson's Correlations between Centroid of Pitch, Strength of Modality, Tempo, Clarity of Pulsation, Centroid of Velocity and Notes per Second. If Centroid of Velocity is negatively correlated with Centroid of Pitch that means that the participant tends to play more quietly in a higher register. The linear dependence between features is displayed in the correlation matrices and, again, it is up to the therapist to decide if this information should be used in order to match or challenge the client.

EXAMPLE: There are three significant correlations in the manner of performing (TABLE 7). First, the participant plays quieter in higher registers. Second, the beat is clearer when tempo is fast. Third, when the tempo is fast, the improvisation is quieter.

Table 3. *Individual Tendencies* for Participant 1 (adapted from Letule, 2014).

Parameters	1	2	3	4	5	6
1 Centroid of Pitch	-					
2 Strength of Modality	.22	-				
3 Tempo	.13	.25	-			
4 Clarity of Pulsation	.15	.07	.74**	-		
5 Centroid of Velocity	-.52*	-.26	-.58*	-.43	-	
6 Notes per second	-.14	-.26	.18	.20	-.36	-

Note. * p<.05, ** p<.01.

4. Experiment

This section describes an experiment that was conducted in order to explore the Musical Profile model using real clinical data. Data used, software tools employed, musical features selected, methods applied and results obtained will be discussed in detail.

4.1. Data

In 2008-2009 a group of researchers from the University of Jyväskylä (Erkkilä et al., 2011) conducted a randomised controlled trial. The aim of this study was to determine the efficacy of music therapy in addition to standard care, compared with standard care only in the treatment of depression in working-age people. Participants that were randomly assigned to the music therapy group were provided with twenty bi-weekly sessions of 60 minutes each. Sessions involved a combination of verbal interaction and free improvisation on a mallet instrument, a percussion instrument or an acoustic djembe drum, depending on the participant's choice. All the improvisations produced in the sessions were recorded using Pro Tools on the hard disk of a PC. The overall results revealed that participants who received music therapy showed greater reduction in levels of depression than those who did not.

For the purposes of the current experiment, only improvisations performed on the digital mallet midi controller were selected. The mallet instrument is a chromatic pitched instrument that provides the possibility for analysis of both pitch and rhythmical content. In order to facilitate subsequent statistical analysis a threshold of no less than 15 improvisations was determined. Six participants fit the criteria, providing more than 10 hours of improvisations for analysis.

4.2. Statistical tests

The Musical Profile model was tested by performing statistical analysis using SPSS software. The previous section explains the data extraction method that was applied to clinical improvisations. The statistical tests performed on the extracted data include one-way ANOVA for Typical performance and Temporal Evolution and Pearson's Correlations for Individual Tendencies. We hypothesized that the Musical Profile method would highlight individual differences between participants in the manner of playing a musical instrument. Therefore, if the method selected for the Musical Profile was suitable, the results of the individual participants were expected to differ significantly.

4.3. Results

A one-way ANOVA was performed on Typical Performance data in order to determine how representative selected measures were. The test revealed that there were significant differences between participants on eight (Duration, Note Count, Tempo, Clarity of Pulsation, Centroid of

Velocity, Variation of Velocity, Centroid of Pitch, and Strength of Modality) out of nine features (TABLE 4). Variance of Pitch was the only feature that did not vary significantly.

TABLE 4. Significant results of the ANOVA test between six participants on eight features (adapted from Letule, 2014).

	Duration	**Note Cou**	**Tempo**	**Clarity of Pulsation**	**Centroid of Velocity**	**Variation of Velocity**	**Centroid of Pitch**	**Strength of Modality**
Welch *F*	8.612**	7.394**	5.938**	5.039**	43.090**	34.264**	7.872**	3.106*
df1	5	5	5	5	5	5	5	5
df2	43.296	45.495	44.586	45.920	44.427	44.890	42.648	46.184

Note. * p<.05, ** p<.01.

Post hoc analysis using Games-Howell testing revealed specific details about significant (p<.05) differences. The feature that varied the most amongst all participants was Variance of Velocity. Another interesting finding was that Participant 2's improvisations were always different from the other participants. This Profile differed significantly from at least one other participant in all features, whilst in Variance of Velocity and Strength of Modality this Profile was significantly different to all other participants.

Although there are observable differences between Temporal Evolution sections of the Musical Profile, revealed changes in the musical material over a period of time were not statistically significant. The R-squared values, that indicate goodness of fit of the trendline to the data, were very low for all participants.

The Individual Tendencies section is presented as a set of Pearson's correlations between musical features. The most interesting finding is that none of the participants shared the same set of correlations between the selected features. Participant 4 had no significant correlations between features whilst Participants 1, 2 and 5 had three correlations each (TABLE 5). The negative correlation between Centroid of Pitch and Centroid of Velocity was the most common between participants, which is the tendency to play quieter in the high register.

Table 5. Significant Pearson's Correlations for six participants.

Part.	**Centroid of Pitch / Strength of Modality**	**Centroid of Pitch / Centroid of Velocity**	**Centroid of Pitch / Notes per Second**	**Tempo / Clarity of Pulsation**	**Tempo / Centroid of Velocity**	**Clarity of Pulsation / Centroid of Velocity**
1		-.52		.74	-.58	
2	.46	-.53	.76			
3						.53
4						

5	.56	-.75	.58
6		-.77	.51

5. Discussion and Conclusions

In order to evaluate the effects of treatment, it is essential to use tools that provide adequate measurements of the changes and processes involved. Several tools for musical assessment have been suggested but none have been systematically tested for validity or reliability, or widely implemented into practice (Baxter et al., 2007). Some tools, like IAPs or IMTAPs, are relevant to music therapy, but are rather time consuming to perform and dependent on the experience and subjective opinion of the therapist. Others, like Camtas or MTTB, provide options for computational feature extraction and analysis, but are criticized for limited functionality and questionable relevance to clinical practices.

The current study proposes a method of data analysis that combines both an individual approach to every client and an objective method of data gather and analysis. The proposed method is a form of ongoing assessment (Hanser, 1999) with options for analysis both on individual sessions and over the whole course of therapy. This model is based on the Nordoff-Robbins approach, where every client is considered to be unique in his musical expression. The Typical Performance and Individual Tendencies sections of the Musical Profile model establish the typical musical behaviour of every participant. The proposed model is based on the assumption that musical processes are correlated with psychological ones (Smeijsters, 2005) and changes in one process reflect changes in another. The Temporal Evolution section of the Musical Profile model highlights those changes over a period of time.

This tool does not test the clinical method employed or, in its current stage, provide direct links between musical processes and therapeutic issues. The Musical Profile is created to aid – not to replace – the therapist in performing musical assessment. For example, if the Temporal Evolution graph indicates that the client's tempo was generally slowing down along with decreasing dynamics in the improvisations, a therapist might decide that a client is regressing. It is up to the clinician if he will challenge the performing manner by introducing faster and louder music (in order to see how the client manages being outside of his comfort zone) or not. Researchers, on the other hand, might investigate the variation and commonalities of musical expression by clients who are diagnosed with specific disorders. Instead of starting a new trial, researchers could collect numerous Musical Profiles from therapists that already work with the target client population. This would decrease the time spent and costs of a project, which would enable sample size large enough to establish generalisations about the effect of a disorder on the manner of improvising.

Although the experiment conducted in order to test the Musical Profile model was small, the results were favourable. There were significant differences between at least two participants on every parameter except Pitch Variation. This might be caused by the choice of instrument, because mallet had only 4 octaves available and all the participants used most of it. Variance of Velocity was the parameter that revealed the most significant differences in the improvising manner. The most common tendency – to play quieter in the higher register – was not expressed by all participants, which again, allows differentiation between individuals. Tests confirmed that measures chosen for the Music Profile model are sensitive to the differences in improvising manner and could serve as a basis for a computational tool that implements an individualised approach to music analysis. The goodness of fit to the trendline had no significant results, indicating that generally the participants performed in a rather chaotic manner. This might be explained by the nondirective psychodynamic approach of the therapeutic intervention chosen for the current study. Only future research with larger sample sizes and different therapeutic approaches would determine if this is symptomatic of music therapy in general.

The main limitations of the study were factors related to the material used for testing. Since MIDI improvisations do not necessarily have timbral information embedded and mallet instruments do not facilitate variations in articulation or texture, these features were not included into the construction of this version of the Musical Profile. Technical issues have occurred as well, for example, in some cases Velocity values were constant throughout the whole improvisation. This has occurred because of errors in setting up the instrument during data gather, since it is highly unlikely that a human participant could maintain such a level of consistency. The next version of the Musical Profile will expand the list of available musical features (e.g. timbre, texture, articulation). Musical analysis will also be complemented by computational video analysis, considering that video material is often collected, but not explored to its full extent. The future development of the Musical Profile will focus on a software package, which will function as a database with options for analysis of audio, MIDI and video material captured during the course of music therapy.

Even if the adoption of the Musical Profile model would positively affect interdisciplinary communication, develop both clinical and research methods and reduce costs of treatment, the background investigation suggests that the implementation of any computational aid might be challenging. The distance between music therapy and music information retrieval practices is quite substantial, since the majority of music therapy clinicians have no training in technology and fail to see the benefits of integrating it into their work (Hahna et al., 2012). For this reason the proposed model is designed for use by therapists without any technical skills, and the Musical Profiles are presented in a user-friendly manner that avoids complicated terms and excessive information. Changing this conservative attitude towards technology in the therapeutic environment might be

equally as important as developing the functionality of the existing models. Music therapy has developed rapidly as a discipline over the last 60 years and hopefully soon we will reach a point where there are substantial human resources and technology available to shed light on the processes involved in musical interventions.

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