

CHAPTER 15

The Music Therapy Toolbox

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Setting and motivation—a short history of the MTTB

The Music Therapy Toolbox (MTTB) is based on the MIDI toolbox (Eerola and Toiviainen 2004a, 2004b), which was created for extracting several musical features from composed music. In a research project, Intelligent Music Systems in Music Therapy (2003–2006, Academy of Finland), a group of researchers started to develop the MIDI toolbox for music therapy usage, for extracting musical features from clinical improvisations. The project aimed to create a new toolbox (MTTB) (Erkkilä 2007; Erkkilä, Ala-Ruona, and Lartillot 2014; Erkkilä *et al.* 2004, 2005) and empirically test it for its ability to analyze clinical improvisations created by individuals with mental retardation and their music therapists. The group found that certain musical features (or musical behavior) predict the severity of mental retardation (Luck *et al.* 2006). Another interesting finding was that clinical improvisations do not often sound like “real music” and may give a random, or chaotic, impression. At least some of the meanings of clinical improvisation can be explained by using a combination of concepts taken from traditional music analysis, psychoacoustics, and mainstream psychology (Luck *et al.* 2008). In brief, the series of empirical investigations showed that, in clinical improvisations, certain anthropological and psychological mechanisms and meanings still exist even when the client is severely retarded.

Theoretical background and development of assessment tool

Daniel Stern's concept of microanalysis played an important role in understanding musical interaction in music therapy. Moreover, early mother-child interactions, communication, and relationship were a main subject of Stern's research (Stern 1971, 2004). Stern described his microanalysis research method and its objectives in 1971:

Using a method frame-by-frame film analysis, we have studied in detail an example of "controlling" and "overstimulating" maternal behavior. We have attempted to identify some of the specific infant behaviors which are significantly influenced by, and in turn influence, such an interaction. We have conceptualized and analyzed this interaction in terms of the behaviors of mother and infant which maintain, terminate, avoid, and initiate social contact and stimulation. (Stern 1971, p. 502)

The context of these observations was non-verbal relationship and interaction. Kenneth Bruscia (1987) developed the Improvisation Assessment Profiles (IAPs) beginning in the early 1980s to assess clinical improvisations as one dimension of the non-verbal context and interaction. Regarding the use of the IAPs, Bruscia wrote: "They are intended to provide a model of client assessment based upon clinical observation, musical analysis, and psychological interpretation of the client's improvisation" (Bruscia 1987, p. 403).

The IAPs contain six profiles. These are Integration, Variability, Tension, Congruence, Salience, and Autonomy. Almost all the profiles assess the music made by clients in clinical improvisation. For the clinical assessment of children with communication disorders, Tony Wigram focused on the profiles Autonomy and Variability (Wigram 1999, 2007). Wosch (2007) focused on the profile Autonomy for a micro-assessment of adults with mental disorders and developed a second-by-second assessment of the "intermusical or interpersonal relationship" (Bruscia 1987). The musical analysis in the profile Autonomy contains the following musical scales.

Rhythmic ground

1. Rhythmic figure
2. Tonal/melodic
3. Harmonic
4. Textural
5. Phrasing
6. Volume
7. Timbre
8. Program/lyrics. (Bruscia 1987)

In each scale, with the exception of the last scale of program/lyrics, the “role relationship” (Bruscia 1987) of the client is assessed musically. The Autonomy-scale rhythmic ground includes tempo, meter, and subdivision (Bruscia 1987). The Autonomy-scale timbre is used to “determine the medium, instrument, production technique, and sound vocabulary” (Bruscia 1987, p. 403) of the client’s improvisation. The Autonomy-scale tonal/melodic contains tonality and melody.

Finally, there are the following levels of intermusical relationship in the profile Autonomy.

Dependent

1. Follower
2. Partner
3. Leader
4. Resister. (Bruscia 1987)

Julia Scholtz and colleagues expanded the level of *resister* to include the level of *independent* in the assessment of children with developmental

disorders (Scholtz, Voigt, and Wosch 2007). All these levels are assessed in each musical scale of the profile Autonomy (Wosch 2007). One example is that the therapist changes the tempo (musical scale, rhythmic ground) and the client follows this change by also changing the tempo. Here the therapist is the *leader* in rhythmic ground and the client is the *follower* in this moment of the clinical improvisation.

In Stern's comprehensive video analysis, the early non-verbal interaction patterns "which maintain, terminate, avoid and initiate social contact" (Stern 1971, p. 502) included gestures, mimic, voice, and so on, and can be compared with the musical role relationships of *follower*, *resister*, and *leader* described by Bruscia. This microanalysis of interaction (Bruscia 1987; Wosch 2007) is limited to musical behavior and is missing all motor activities, mimic, and more dimensions of behavior. However, in a survey of British music therapists, Elaine Streeter (2010) found that 91 percent of the clinicians were interested first of all in the "identification and quantification of interaction episodes," including musical interaction for future software assessment. The microanalysis version of IAP Autonomy (Wosch 2007) is very time consuming and has been applied so far solely in music therapy research. An automatized version is needed for clinical practice. The MTTB is very close in its automatized measurement of music features to the basic paradigm of musical role relationships of IAP Autonomy.

Procedure, data collection, data analysis, and interpretation

The first version of the MTTB only reads and handles MIDI (Musical Instruments Digital Interface) data. It is a protocol, where the key elements of musical information are presented as numbers and not as real music (Erkkilä *et al.* 2014). This means that in order to analyze musical data it must be first played by MIDI instruments or turn to MIDI from digital audio. The second version of the MTTB enables analyzing digital audio as well. Though challenging for musical feature extraction, digital audio brings certain important possibilities such as timbre-related features (not possible with MIDI data). The MTTB allows for the creation of a graphical

notation of music consisting of user-selected musical features and interaction between client and therapist.

The musical features of the complete MTTB MIDI version are:

- density
- mean duration
- mean pitch
- standard deviation of pitch
- mean velocity
- pulse clarity
- tonality
- articulation
- tempo
- dissonance
- synchronicity. (Erkkilä 2007)

All these features are calculations from musical data. Two examples are given here for these calculations. Density is the “number of notes in the window divided by the length of the window” (Erkkilä 2007, p. 37). In the first version of the MTTB, the time-window was six seconds. In the second version of the MTTB, used in microanalysis, it is one second. Articulation is “the proportion of short silence in the window. Values close to zero indicate *legato* playing, while values close to one indicate *staccato* playing” (Erkkilä 2007, p. 37). For access to the MTTB, contact the Music Therapy Department, University of Jyväskylä. We are working on providing access to an MTTB download via a webpage.

Application of the MTTB

In MTTB analysis there are a few starting points that must be taken into account when producing clinical improvisations. With MIDI data, it is important that each improviser’s music is sent on separate MIDI channels.

If they are on the same channel, the MTTB understands the improvisation as a product of one improviser, which is not appropriate. With digital audio, it is also important to be able to separate the channels for the same reason. The current version of the MTTB reads a stereo file where the improvisers are panned on the left and right channels. When working with audio, recorded by microphones, it is important to prevent leaking between the microphones in order to have the sound as “clean” as possible on each of the channels. There are different kinds of microphones available, which largely only detect the source signal and not too many surrounding sounds. Recording improvisations in MIDI and/or audio formats can nowadays be done with relatively cheap, small-sized, and even transportable equipment. One needs a computer (a laptop, for instance), recording software installed (for recording MIDI and digital audio), MIDI and audio interface (separately or combined in the same gear), two microphones for recording the audio signal (from two djembe drums, one for the client and one for the therapist, for instance), and MIDI outputs on the instruments sending MIDI data (MIDI inputs and outputs are standard for most of the digital music instruments today). If one already has a computer, two djembe drums, and two digital keyboards, the investment starts from 1000 euros (even less) for the additional gear. In [Table 15.1](#), some basic consequences for MTTB analysis are described depending on the setup and starting point.

TABLE 15.1: CURRENT PRECONDITION FOR APPLICATION OF THE MTTB

	YES	NO
Identical instruments for both improvisers	The data is fully comparable between the improvisers in terms of the expressive possibilities	The data is not fully comparable between the improvisers, and the different expressive possibilities must be taken into account in the analysis
Identical sounds (e.g. piano) for both improvisers	The data is fully comparable between the improvisers when the sound does not affect the way of playing	The data is not fully comparable between the improvisers because different sounds affect the way of playing
Identical instruments and sounds in sequential sessions	Improvisations can be compared longitudinally for possible expressive or interactive changes, for instance	Comparing improvisations longitudinally is challenging or impossible, and affected by different setups

Identical instruments and sounds for all the clients	Opens possibilities for group-based analysis for finding patterns typical of a certain subgroup, for instance	Comparison between subjects is not very relevant or appropriate
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A current challenge with the MTTB is that it only runs on *MatLab* engineering software. This means that hospitals, private practice, or university hospitals have to have *MatLab* software or need to buy access. Individual access currently starts at 2000 euros. However, we plan to work on a stand-alone version of the MTTB without *MatLab*.

Data collection and selection

There are various strategies to choose the improvisations to be used for MTTB analysis. Because MTTB analysis as such is a quick process, after the improvisations have been properly saved, the number of improvisations to be analyzed at a time is not the most critical question from the MTTB point of view. However, data reduction may be relevant for other reasons, such as the clinical relevance of an improvisation. When an improvisation is meaningful in a specific way, it may trigger strong emotions, images, associations, and so on, and this may be a reason to analyze just this improvisation and not others. In particular, in everyday clinical practice, it is a good idea to keep a diary where the therapist keeps track of the improvisations and evaluates their clinical meaning. To specifically focus on improvisation comparison in the course of time, one may want to develop a particular improvisational task with a more or less pre-planned procedure for increasing comparability between the improvisations created in different sessions. An example of such a task is to create an improvisation based on a fixed amount of time where the therapist always follows the same basic starting point—such as creating a simple accompaniment on a stable tempo based on rhythmic and tonal ideas—which remains the same between the sessions. When that task is repeated every now and then, there is a strong basis for comparison when the client's play can change. The basic rule is that the more differences between the contexts and starting points of the improvisations, the harder it is to make

relevant comparison between them. Examples will be described in three cases in the following section about analysis data.

Data analysis and interpretation

Before using the MTTB for analysis and assessment of clinical improvisations, one has to carefully consider the added value of it and whether the clinical approach is suitable for its use. In principle, the MTTB does the analysis regardless of instruments and how they are played. Basically, the MTTB only offers an objective way to look at the clinical improvisation based on certain musical features extracted through mathematical algorithms. When it is possible to look separately at the client's and therapist's music in terms of each of the musical features, various aspects of interaction between the improvisers can be considered as well. With the MTTB, many fundamental elements of music (such as rhythm, register, timbre, tonality, etc.) can be considered. After that, it is up to the clinician or researcher to try to interpret what it means when the client, for example, first mostly improvises on a lower register, then in the course of the therapeutic process gradually expands the use of register.

One may want to look at music psychology literature and research to know how low and high musical registers are understood from a music psychology perspective (for example, are they sad or happy?). In music therapy literature and research, we have different models for interpreting certain musical phenomena as well. Analyzing improvisations as such, without rationale or a clear idea for improvisational work, is perhaps not too rewarding. But if there is any aspect of interaction or expression, based on musical behavior between the client and therapist, the MTTB may be worth applying. Furthermore, if there is anything that remains the same between improvisations within a music therapy process in terms of improvisational task, instruments employed, and so on, there is room for comparison. Three applications and dimensions of the MTTB in the assessment of musical interaction in clinical improvisations will be described in the following sections.

ASSESSMENT OF SYNCHRONICITY

De Backer (2008), who has specialized in clinical improvisation with psychotic patients, defines musical synchrony (in clinical improvisation) as shared sensations of common pulse and rhythm between the client and therapist with some moments of timbre-related interweaving as well. He also mentions single musical initiatives, dynamic features and endings of musical events, which give an impression of sharing.

In terms of the MTTB, synchrony can only be investigated by looking at what objectively happens in music concerning different musical features. In practice, the MTTB synchrony means simultaneity or interconnectivity of reciprocal musical behavior regarding certain musical features or feature combinations. Thus, synchrony may appear on a rhythmic level, which can be seen in a single musical feature, pulse clarity, or it can be a more complex phenomenon, for instance activity or strength (see the following regarding the client-therapist relationship), which is a combination of several musical features. Whether the question really is about experienced synchrony in a psychotherapeutic sense, such as empathy or rapport, is outside the MTTB's capacity. Therefore, to gain a richer picture on the synchrony, it is important to combine different data sources such as MTTB results and the real experiences of the improvisers. This fits the reasoning of Bruscia regarding the IAPs, which states that client assessment is based not only on music analysis but also on clinical observation and on psychological interpretation (Bruscia 1987).

In principle, there is also a phenomenon called "fake synchrony." It is the therapist's capacity and desire for musical synchrony, which may lead to a one-sided experience of synchrony. An example of this is when a clinician is improvising with an ASD client with limited skills for interaction. The therapist may unconsciously connect to the client's music without real responsiveness on the client's side. In other words, the client is just playing their own, internal music, hardly recognizing the other, but the therapist may have a feeling of synchrony due to the fact that they are very sensitively responding to the client's music. By using the MTTB, it is possible to analyze this phenomenon. The crucial concept here is timing. On the MTTB graph, it is possible to roughly check whether it is the therapist who always imitates the client's musical behavior. In [Figure 15.1](#), one example of the synchronicity of the therapist can be seen in the musical feature of mean velocity (mean vel). In the upper graph, the client's line

begins. The therapist joins in in the third second. The therapist adapts very closely to the client's line. With this, the lighter color increases in the upper part of the mean velocity graph. This upper part identifies the therapist's activity and the lower part the client's activity. Another possibility is to apply the MTTB function called the imitation diagram, which shows who of the improvisers does something first and whether there is a pattern concerning this.

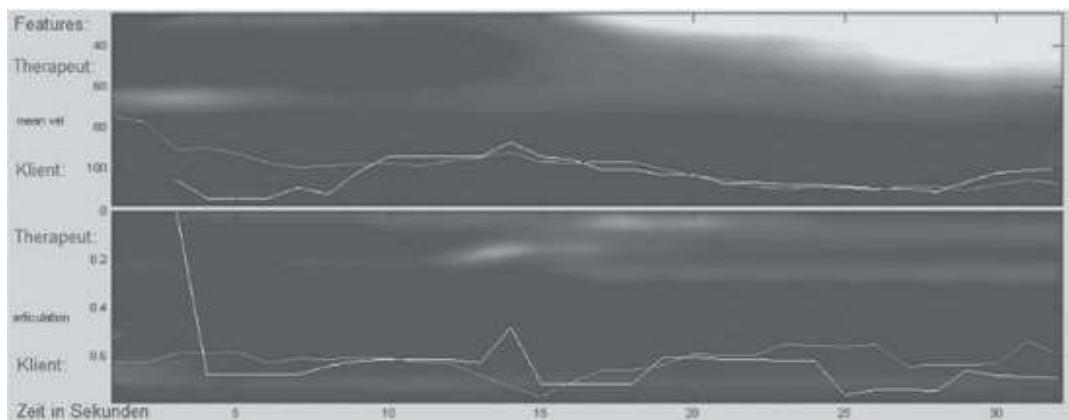


Figure 15.1: Synchronicity feature in MTTB basic musical features of mean velocity (version MTTB-B)
 (white line = client, grey line = therapist)

In summary, the MTTB shows objective and precise similarity and simultaneity in music and provides a tool for tracing possible "fake synchrony." However, it is always a good idea to pay attention to other data sources as well, such as bodily synchrony (body movements, facial expression, etc.) and psychological experiences (experienced togetherness, empathy, rapport), and to look at the overall picture.

ASSESSMENT OF THE INTERMUSICAL RELATIONSHIP USING THE PROFILE AUTONOMY

In 2010 and 2011 a research and development group at the University of Applied Sciences, Würzburg-Schweinfurt, started the development of the MTTB in the assessment of role relationship of Bruscia's IAP Autonomy between client and therapist in clinical improvisations (Jonscher, Gruschka, and Scheder-Springer 2010). In [Figure 15.2](#) an example for *resister* (second

38–40, see time-baseline) can be seen. In this case, the musical features density and pulse clarity for client (top line) and therapist (bottom line) move in opposite directions away from each other.

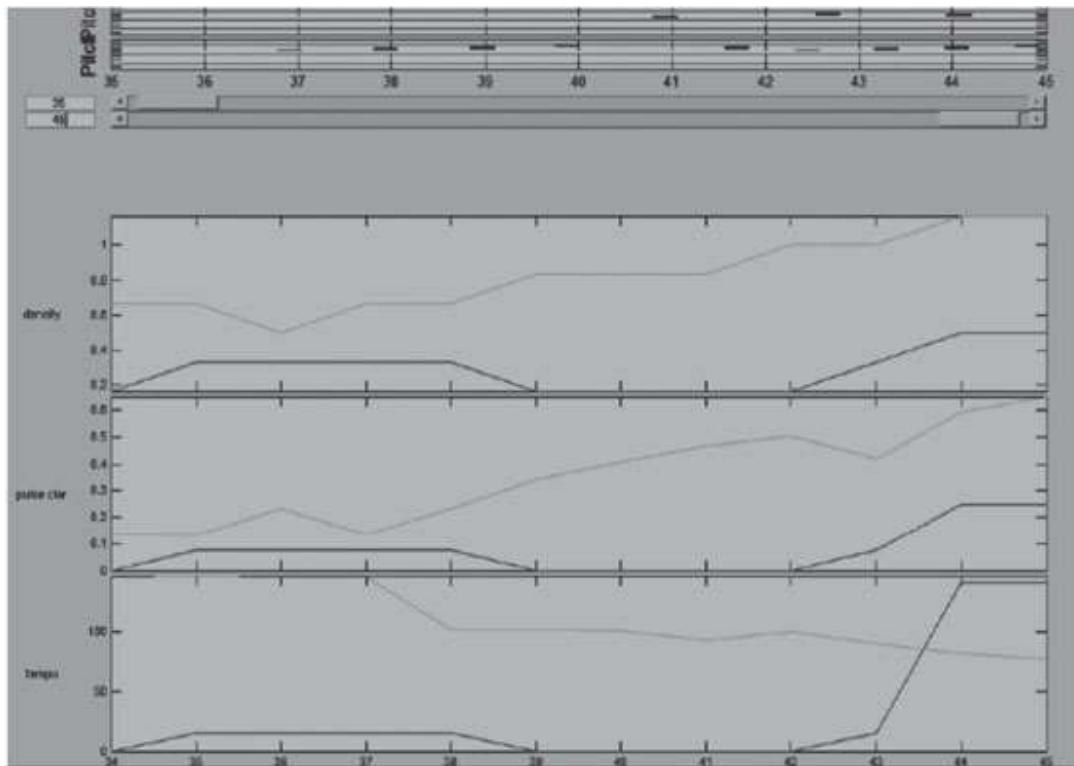


Figure 15.2: Example of resister in MTTB features (top line = client; bottom line = therapist; second 38–40 shows the resisting behavior of the client)

[Figure 15.3](#) shows an example of *independent* (middle box) using the musical feature tempo. Here, the client (light grey) plays similarly to the therapist (dark grey) but sometimes a little faster (above the therapist) and sometimes a little slower (below the therapist).

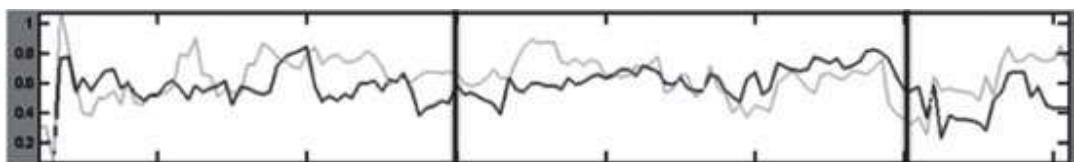


Figure 15.3: Example of independent in MTTB feature tempo (dark grey line = client; light grey line = therapist; the dark grey box shows the

independent behavior of the client)

However, these levels of intermusical relationship or role relationship are not calculated yet in algorithms. Using the definitions of the six levels, the music therapist can detect these levels in the MTTB graphs. The next step of development can be the detection of the levels of *leader* and of *follower*. The calculation of these roles includes higher numbers for the *leader* and lower numbers for the *follower*. At the same time, with this distance between the *leader's* and *follower's* curves in the MTTB graph, synchronicity takes place. The *follower* follows the *leader*. In [Figure 15.4](#) one can see that in the musical feature density the therapist (dark grey line) follows the client (light grey line) in second 80 (see time-baseline). In second 90, this changes. The therapist leads and the client follows during the next 10 seconds.

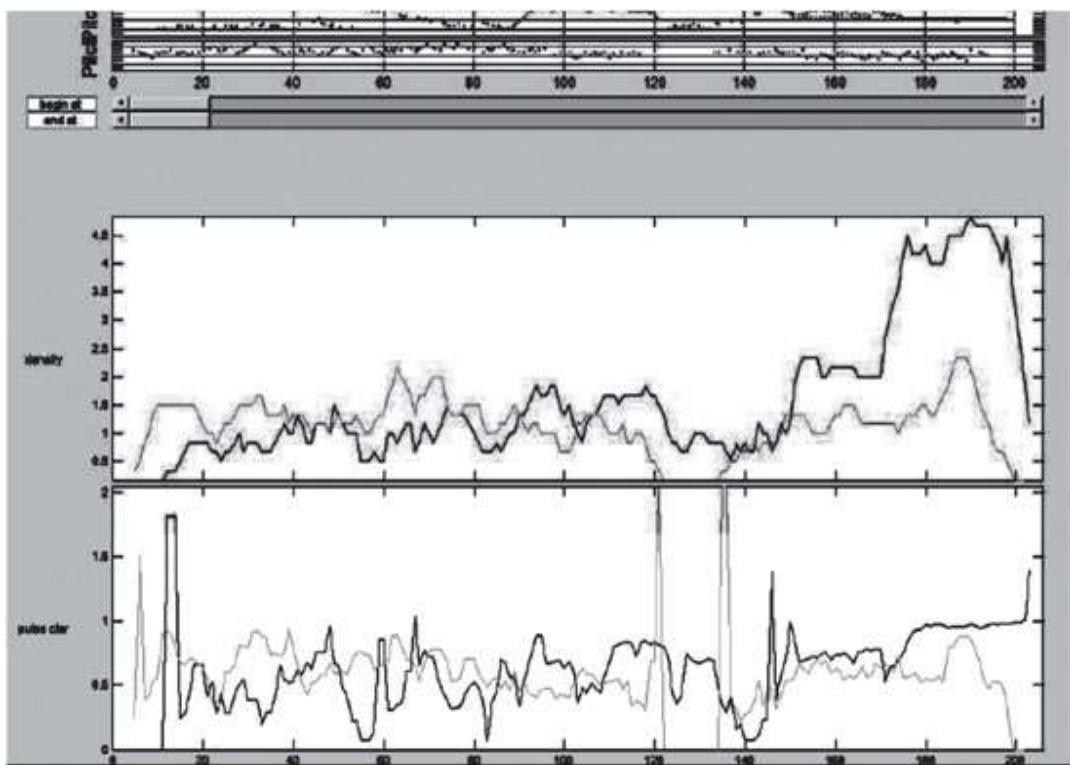
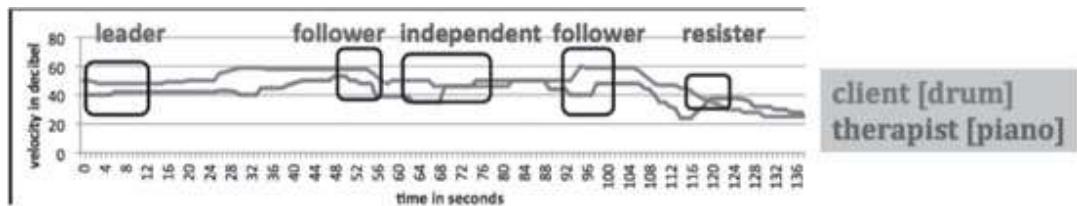


Figure 15.4: Example of leader and follower in MTTB feature density

An example of changes of role relationship between client and therapist in clinical improvisation can be seen in [Figure 15.5](#). The music therapist

marked the levels in the MTTB graph here. The color of the level defines whether this role belongs to the client (bottom line) or the therapist (top line). In determining leading and following, it is very important to note who begins the change or keeps the musical feature of main velocity and who follows this change afterwards.



*Figure 15.5: Change in role relationship in MTTB feature mean velocity
(Jonscher and Wosch 2012; Magee and Wosch 2017)*

The interpretation of this MTTB assessment will be described in two different contexts of clinical practice. The first context is the clinical practice of individual music therapy for children with developmental disorders. In a case example of a client with developmental delays in motor activities, language, and cognitive capabilities, music therapy focused on additional social behavior symptoms. The MTTB assessment of six levels of role relationship was used here for assessing the role relationship of the client. In most of the musical features of the MTTB, the role of *leader* was assessed in the first clinical improvisations with this client. However, the role of *resister* could not be identified. This led to the interpretation that the client had social needs. Moreover, in the musical feature of pulse clarity, the client was assessed continuously in the role of *follower*. In the musical feature of tempo, the client was assessed also in the role of *independent* (see [Figure 15.3](#)). These two resources did increase in individual music therapy for this client according to this assessment. Within the context of developmental disorders, independence is an important resource. The assessment of *follower* is very important for role flexibility as a social skill of the client within the context of the main role of *leader*. The assessment of these resources in the rhythmic ground features of pulse clarity and tempo guided the music therapist in her clinical improvisation. Focusing on the rhythmic features of clinical improvisation supported the therapy of social behavior symptoms.

Another context of clinical practice is the use of the MTTB assessment in individual music therapy for adults with affective disorders. In one case, a client with a major depression worked in a symbolic way in the process using clinical improvisation in relationship with a primary object. At the beginning of this therapy, the MTTB assessment assessed a role change of the client from *leader* to *follower*, for example in the musical feature of density (see [Figure 15.4](#)). At the end of this psychodynamic music therapy treatment, the MTTB assessment assessed the continuous role of the client in the role of *leader* in clinical improvisation. In the verbal reflection on this individual music therapy, the client talked about change of relationship in everyday life. Moreover, the intensity of density (higher numbers) increased when the role of *leader* was assessed. In this case, within the context of a psychodynamic paradigm, *leader* and *follower* had an individual meaning for the client. Here, the assessment and treatment of the intermusical relationship are an assessment and treatment of the interpersonal relationship of the client. The MTTB assessment could illustrate this understanding musically.

ASSESSMENT OF CLIENT-THERAPIST RELATIONSHIP

A strong feature of the MTTB is that it shows objectively and exactly what happens in music based on its own logic and algorithms. We shall now extend and deepen the meaning of MTTB features within relationship, going beyond synchronicity and the Autonomy levels. There is a need for theorizing these kinds of objective findings—that is, trying to understand their meaning from the therapeutic relevance point of view. In a study by Luck *et al.* (2008), listeners (undergraduate students) were asked to provide ratings of perceived emotional content of clinical improvisations, created by mentally retarded clients together with their music therapists. By using the MTTB, a total of nine musical features were extracted from the improvisations. In addition to other findings, the researchers found that the experienced *activity* was best predicted by high note density and high pulse clarity, *pleasantness* by low note density and high tonal clarity, and *strength* by high mean velocity and low note density. This is an example of how raising the level of abstraction may help in understanding the core meaning of a musical feature or, as in this study, feature combinations. In terms of

the client-therapist relationship, looking at improvisers' musical activity, strength, or pleasantness may make more sense than to keep an eye on a single, perhaps less communicative feature such as musical density or sensory dissonance. This use of the MTTB has to be further developed in music therapy research for final application in the assessment of clinical practice.

Music therapy approaches, client groups, and limitations

As the IAPs are not limited in specific music therapy approaches and methods, so the MTTB can be used in different theoretical and clinical contexts. The aim and theoretical orientations of the IAPs are described by Bruscia:

Their aim is to enhance the therapist's understanding of the client through objective methods of data collection, while also stimulating interpretations of the data according to pertinent psychological theories... The intent has been to keep the content and vocabulary of the IAPs free from a specific theoretical orientation. (Bruscia 1987, p. 411)

The IAPs and the MTTB can only analyze and assess clinical improvisations, but all approaches and methods of music therapy using clinical improvisation can be assisted with analysis and assessment using the MTTB. Another limitation besides clinical improvisation is the focus on musical analysis. If behavior other than the musical behavior of the client is important and of interest for analysis and assessment, other assessment tools are needed, for example those based on video analysis. One example may be music therapy for severe developmental disorders and severe learning disabilities. In these cases, multisensory data about the client is needed, including motor activities, mimic, gaze, and vocal expression, beyond musical activities and interaction. So far, the MTTB has been applied in music therapy for major depression (Erkkilä *et al.* 2014; Wosch and Erkkilä 2016), for mental retardation (Luck *et al.* 2006), and for developmental disorders (Jonscher and Wosch 2012; Magee and Wosch

2017). In music therapy for major depression, clients did stay with the same instrument.

Finally, the following limitations of the MTTB are based on the current “state of the art” of the MTTB. There are a number of background factors that affect MTTB results and interpretation, including the client-therapist relationship. Some of them are described here.

Instrumentation

A musical instrument strongly affects the way of playing. If client and therapist have different instruments, with different sounds and musical capacity, it affects greatly the interpretation of MTTB results. This must be taken into account in interpretation in cases of use of more than one musical instrument.

Using various instruments or sounds over the course of therapy

Longitudinal considerations are challenging and are valid only if improvisations compared over time are based on usage of the same instruments and sounds.

Philosophy of therapeutic approach

There are music therapy models where instrumentation and musical roles are more or less fixed for the therapeutic approach. If a typical setting is piano (therapist) and percussion instruments (client), various aspects of MTTB analysis must be considered and many features of it cannot be utilized at all. Even if the client and therapist share an instrument, let's say piano, where a typical arrangement is the therapist sitting on the left side (lower register is approximately equal to accompaniment), the arrangement predetermines both the possible musical behaviors and MTTB analysis (and interpretation). However, this kind of arrangement can be therapeutically highly relevant and theoretically reasonable.

Understanding of clinical improvisation

Depending on the model and clinicians' personal preferences, clinical improvising can be highly spontaneous and free from any givens—or almost opposite to that. This may vary even within a single music therapy process, where improvisations may first be relatively structured (e.g. for holding and support-related reasons) and later on freer. Furthermore, professional musical interventions by the therapist play their own role in improvisational work. Naturally, these starting points and principles affect MTTB analysis and must be taken into account when interpreting the results.

Training

Training clinicians in using MTTB software is not the most crucial task. The MTTB is a computer application and people are used to working with many kinds of applications. One of the challenges with the MTTB currently is that there is no commercial version of it available. So, getting it working and having access to *MatLab* is a challenge for many.

An even bigger challenge is to connect the MTTB with clinical models and working styles. Improvisational music therapy is very divergent and we do not have too many clearly defined models in terms of musical interventions and techniques and their therapeutic dimensions. In addition, music therapists tend to favor various clinical methods, instruments, and working styles as a natural part of their therapeutic philosophy, which produces new challenges in terms of using the MTTB. With the Integrative Improvisational Music Therapy (IIMT) model, we are currently piloting the training for Finnish music therapists where understanding and using the MTTB is also a part of the skills to be acquired (based in the University of Jyväskylä). After finishing these pilots and gaining some new understanding on how to further synchronize the IIMT and MTTB, there might be room for starting training in other contexts as well. Moreover, in graduate and post-graduate research projects in Germany, the MTTB was synchronized in the first steps with Orff Music Therapy and Improvisational Psychodynamic Music Therapy (based at the University of Applied

Sciences, Würzburg-Schweinfurt, in collaboration with the University of Jyväskylä).

Research, psychometrics, and future plans

Research of the MTTB in musical analysis, microanalysis, and assessment of clinical improvisations has been named and described in previous sources (Erkkilä 2007; Erkkilä *et al.* 2004, 2005, 2014; Jonscher and Wosch 2012; Jonscher *et al.* 2010; Luck *et al.* 2006, 2008; Magee and Wosch 2017; Wosch and Erkkilä 2016).

The psychometrics of the MTTB as an assessment tool for clinical practice do not exist. The psychometrics of the MTTB assessment for clinical practice must be developed and implemented. With regard to the feature of synchronicity, this validation could include somatic measurements of heart rate and breathing. The use of these measures is based on rhythmic entrainment research (Trost, Labbé, and Grandjean 2017). However, validation regarding role relationship levels must include standardized observations of social behavior, relationship, and communication. In all cases, changes observed in the MTTB must be correlated with relevant outcome measurements. Another relevant analysis is the validation of MTTB assessment regarding the musical emotions of the client and the therapist in clinical improvisation (Jonscher and Wosch 2012). The change of musical emotions within a clinical improvisation has been calculated and assessed during the first steps of research. Although the results are promising, the validation of this assessment has not been carried out yet.

There are more future plans for the MTTB. One possibility is to export a data sheet consisting of numbers to be further analyzed by statistical software. This function is more for improvisation research. In addition, there is no continuous data on the data sheet but compressed values (mean, standard deviation, etc.) for each of the features. Thus, microanalysis is not possible based on data sheet values. However, it is possible to segment the improvisation into many parts, which is a way to get more detailed information from improvisations. Moreover, IAP Autonomy Micro Method

cluster analysis was used successfully for automatized calculation of improvisation segments (Wosch and Erkkilä 2016).

So far, the MTTB has only been applied to the individual setting (therapist-client improvisations) and more coding is necessary before it can be applied to the group context. Previous research in the MTTB and the IAPs' Autonomy profile showed differences between human assessment with the Autonomy profile and the automatized assessment with the MTTB. Two differences were flexibility in timeframes and in the assessed items. The MTTB calculates each musical feature in standardized timeframes. A future perspective in terms of timeframe is programming a flexible timeframe that adapts to changes within each musical feature.

The final future perspective for the further development of the MTTB is the development of a new feature of *leader* and *follower* as a new algorithm, based on the synchronicity feature of the MTTB. This can be extended to include more of the Autonomy levels.

The MTTB can be applied to everyday clinical work when a clinician finds the graphic notation mode practical and appropriate. It enables microanalytic (second by second) consideration and in addition saves the music therapist time, because instead of listening to the improvisation, one can see it visualized. After learning, reading, and interpreting the graphs, one can quickly compare different improvisations based on MTTB visualizations.

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