Approaches: An Interdisciplinary Journal of Music Therapy
13 (2) 2021

ISSN: 2459-3338 | www.approaches.gr

ARTICLE

Using music-adapted technology to explore Bruscia's clinical techniques introduced in autism research: Pilot study

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ABSTRACT

This pilot research investigated eight most commonly used Bruscia's (1987) clinical improvisation techniques utilised in music therapy with autistic clients: imitating, reflecting, synchronising, extending, symbolising, holding, incorporating, and rhythmic grounding (Skinner, Kurkjian & Ahonen, 2020). The techniques were explored with research participants (music students), by isolating and implementing each technique in eight short improvisations. Improvisations were recorded using LogicPro connected to MalletKAT instruments. Improvisations were analysed using music-adapted technology, the MIDI Toolbox designed for MATLAB, a multi-paradigm numerical computing environment and proprietary programming language developed by MathWorks, and the Music Therapy Toolbox (MTTB) (Erkkilä, Lartillot, Luck, Riikkila & Toiviainen, 2004). In addition, participants provided their subjective experience of each improvisation in a questionnaire format. The research questions included: 1) How will Bruscia's eight fundamental clinical improvisation techniques be represented in MATLAB/MTTB in terms of both individual ways of playing and musical relationships? 2) How will the use of each isolated improvisation technique impact the participant's experience of musical connection, influence, and expression? Through the combination of musical analysis and qualitative thematic analysis, insights relating to the effective implementation and purposeful use of imitation, synchronisation, holding, and rhythmic grounding were realised. The musical data generated from MATLAB/MTTB demonstrated how researchers implemented the techniques and trends in the participant's playing. In addition, the questionnaires provided insights into how each technique influenced the participant's ability to express and connect, as well as their perception of the researchers' musical influence. These results may be used to inform both music therapists and future related research.

KEYWORDS

autism,
Bruscia's clinical improvisational techniques,
improvisation,
music therapy

Publication history:
Submitted 5 Mar 2019
Accepted 8 Mar 2020
First published 20 May 2020

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INTRODUCTION

To date, the majority of music therapy research with autistic clients has sought to demonstrate efficacy of musical interventions and deepen understanding by examining the practice of music therapy. Very little research has extrapolated and experimented with the individual elements of therapy, such as varying clinical improvisation techniques, and their characteristics. Furthermore, music therapy research with autistic clients rarely focuses on isolating and examining clinical improvisational techniques in an experimental setting. Practically, this may result in unclear definitions of the techniques, as well as discrepancies in how they are used and identified both in research and clinical work (Skinner, Kurkjian & Ahonen, 2020).

This pilot study explored, in an experimental setting, how some of the most commonly utilised improvisational techniques can be represented in terms of individual ways of playing, musical relationships; and how the use of the techniques impacts the participant's experience of musical connection, influence, and expression. The study was conducted with Bachelor of Music students as participants. In the future, it is our intention to duplicate the research with autistic clients. We chose not to recruit autistic participants as we first wanted to investigate whether it is possible to explore and analyse the certain elements of improvisation experience with the Music Therapy Tool Box (MTTB) (Erkkilä, Lartillot, Luck, Riikkila & Toiviainen, 2004).

LITERATURE REVIEW

In *Improvisational Models of Music Therapy*, Bruscia introduced a taxonomy of 64 clinical techniques he believed to be fundamental to improvisational music therapy (Bruscia, 1987, pp. 533-557). Bruscia developed this taxonomy in an attempt to create consistent vocabulary to be used in all models of clinical improvisation, translating to increased clarity in music therapy practice and literature. The techniques are named and categorised based on the focus, clinical objectives, and mode of implementation. The categories are as follows: techniques of empathy, structuring, intimacy, elicitation, redirection, procedural, emotional exploration, referential, and discussion techniques (Bruscia, 1987, p. 535)[1].

Skinner et al.'s (2020) scoping review explored Bruscia's (1987) clinical techniques for improvisational music therapy as they relate to music therapy in autism research to determine the most commonly used clinical techniques in music therapy with clients with autism. To be included in the review, the research articles had to employ improvisational music therapy with clients with

[1] A complete listing and description of the 64 techniques can be found in Chapter 37 of *Improvisational Models of Music Therapy* (Bruscia, 1987).

autism, and articles either had to label techniques used or provide a clear description of techniques used. In addition, it was required that articles were published in a peer-reviewed journal. Eight articles were chosen, including: Geretsegger, Elefant, Mossler and Gold (2014), Geretsegger, Holck, Carpente, Elefant and Kim, (2015), Bieleninik et al. (2017), Knapik-Szweda (2015), Vaiouli, Grimmett, and Ruich, (2015), Ghasemtabar et al. (2015), Banks (1982), and Schumacher (2013). Based on the thematic analysis, the current most commonly used clinical improvisation techniques with autistic clients are as follows: imitating, reflecting, synchronising, extending, symbolising, holding, incorporating, and rhythmic grounding.[2] We noted differences in the definition and application of Bruscia's techniques in research with new terms and definitions being coined in an attempt to describe the technique being utilised. This may be because different therapists and researchers may be informed by different theoretical frameworks and cultural contexts, and therefore both understand and implement the improvisation descriptions differently. In this study, these eight improvisation techniques are further explored in an experimental setting.

Integrative Improvisational Music Therapy, the clinical intervention utilised in this study, was first noted in 2011 (Erkkilä et al., 2011). The defining component of this intervention style is that "the improvisations created in the sessions were recorded either as MIDI-data or as digital audio", making it possible to "play back the improvisations for further processing and discussion" (Erkkilä et al., 2011, p. 134). Erkkilä et al. aimed to determine whether incorporating music therapy (using improvisations on MIDI-controlled mallet instruments and an acoustic djembe) into standard care for clients with depression would be effective in their recovery journey. The same intervention technique was also used in Brabant, Solati, Letule, Liarmakopoulou and Erkkilä's study "Favouring emotional processing in improvisational music therapy through resonance frequency breathing: A single-case experimental study with a healthy client" (2017), during which the improvisations were also done on MalletKAT instruments and recorded into Logic Pro both to be exported into statistical software and for the ability to listen back to the improvisations for further exploration.

RESEARCH QUESTIONS

This study sought to address the gap in experimental studies relating to clinical improvisation techniques, and to explore Bruscia's clinical techniques from a new perspective. In this pilot research, each of the eight techniques determined to be relevant to music therapy work with people who have autism (Skinner et al., 2020), *imitating, reflecting, synchronising, extending, holding, incorporating, and rhythmic grounding*, were explored with music student participants utilising music-adapted technology and analysed with specialised software to generate insights into their use, implementation and related outcomes.

The research questions were as follows: 1) How will Bruscia's eight fundamental clinical improvisation techniques (imitating, reflecting, synchronising, extending, holding, incorporating, and rhythmic grounding) be represented in MATLAB/MTTB in terms of both individual ways of playing and musical relationships? 2) How will the use of each isolated improvisation technique impact the participant's experience of musical connection, influence, and expression?

[2] The eight different techniques have been defined and further described in Skinner et al. (2020).

According to Geretsegger et al. (2015, pp. 270-271), the elements of musical connection, musical influence and emotional expression are crucial "moments of musical attunement that may develop into affective and emotional attunement and emotional sharing" when working with clients with autism. This is why these elements were chosen for the second question.

Research methodology

This explorative study combines musical microanalysis (Wosch, Trondalen & Erkkilä, 2016) with qualitative thematic analysis (Braun & Clark, 2006). The data was collected in an experimental setting in the Manfred and Penny Conrad Institute for Music Therapy Research (CIMTR) Improvisation Laboratory at Wilfrid Laurier University (WLU) by utilising MalletKAT MIDI instruments which resemble a digital marimba. The microanalysis section was conducted by utilising Logic Pro, the MIDI Toolbox designed for MATLAB, a multi-paradigm numerical computing environment and proprietary programming language developed by MathWorks, as well as the Music Therapy Toolbox (MTTB) (Erkkilä et al., 2004). There was a total of five research participants (Bachelor of Music students, three males, two females). None of the participants had any prior experience with the MalletKATs.

Each research participant took part in two separate improvisation sets, each lasting approximately 1.5 hours and consisting of eight short (2-4 minutes) improvisations. Researchers implemented one clinical technique per improvisation. Two participants improvised with Researcher One (R1) in their first session, and with Researcher Two (R2) in their second session. Three participants improvised R2 in their first session, and two with R1 in their second session.[3] After each individual improvisation, the participants answered a few questions related to that particular improvisation experience.[4]

Research setting

The MalletKAT instruments were arranged across from each other and the research participants were given two mallets before each improvisation. The randomly selected order of improvisations that took place with each participant during both of the improvisation sessions was: 1) imitation, 2) reflecting, 3) synchronising, 4) extending, 5) symbolising, 6) holding, 7) incorporating, and 8) rhythmic grounding. The participants were asked to play the MalletKAT with the researcher but were not given any instruction prior to beginning on how to play them. They were asked to improvise freely, with no planned musical structure. Participants were also asked to begin the improvisation, and once the participant began, the researcher joined them on a separate MalletKAT. The only exception to this was before the "symbolising" improvisation. In that improvisation, participants were asked to select

[3] Because the participants experienced the same procedures in both sessions, there could be test-retest bias influencing musical and survey responses. The decision to balance the number of participants starting with each researcher was made in order to better analyse individual differences in the researcher's implementation of techniques. Any trends found in differences between each participant's sessions can be more confidently attributed to researcher differences as opposed to bias from already having participated in experimental conditions once.

[4] This study was approved by the WLU ethics board.

something they could see within the lab or through the windows to symbolise musically. In addition, participants did not know which improvisation technique the researcher would be implementing. There was a short break between each improvisation to answer the post-improvisation questions:

a) In your own words, what happened during this improvisation?
b) How did the researchers' playing influence your playing?
c) Did you feel a musical connection with the researchers? Why or why not?
d) Did you feel like you were able to effectively express yourself musically?

The questions could be answered in prose, which allowed for the participants to answer authentically without feeling the need to conform their answers to a standard question format. Participants told researchers when they had answered the questions and were ready to begin playing again.

Photograph 1 and 2: The Manfred and Penny Conrad Institute for Music Therapy Research (CIMTR) Improvisation Laboratory at Wilfrid Laurier University (WLU)

Data analysis and interpretation

The analysis and interpretation of the data included qualitative thematic analysis (Braun & Clarke, 2006) of the textual data; and micro-analysis of improvised music via MTTB in MATLAB. The qualitative written responses were analysed using NVIVO, qualitative data analysis software, to generate themes relating to the participant's subjective experience of each technique. The responses for each individual improvisation technique were first grouped together and, from this, different themes were created relating to individual ways of playing, influence of the researcher, musical expression, and musical connection. The participant's awareness of his or her own playing, musical connection, researcher influence and expression were the focus in regard to participant experience,

as they are critical components of a music therapy session with clients with autism. The qualitative thematic analysis guided the musical MIDI-data analysis, with the intention of representing both individual ways of playing and musical relationship.

The MTTB in MATLAB was used to analyse the musical data retrieved from the research sessions. To complete this data analysis, the recorded Logic files were converted into a MIDI file format and imported into MATLAB, to be analysed through the MTTB. The MTTB provided data about the density of the improvisation, mean duration, mean pitch, pitch variance, mean velocity, pulse clarity, tempo, synchronicity, synchronised tempo, tonal clarity (seen as "tonality" in MTTB), and major or minor tonalities (seen as "majorness" and "minorness" in MTTB). The toolbox utilised graphs to display this data, representing the participant and researcher's voice as different-coloured lines (with the exception of synchronicity and synchronicity of tempo, which are displayed as a single line). Furthermore, the software analysed multiple aspects of the improvisations and displayed them in graphics and visuals.

In this study, the graphs generated in the MTTB were used to generate a deeper understanding of the clinical techniques and their clinical implications, relating to the connection between a participant and researcher, and musical expression on behalf of the participant.

RESULTS

We investigated the ways that selected improvisational techniques (Bruscia, 1987) could be represented in MATLAB in terms of both individual ways of playing and musical relationships, and how the use of each isolated improvisation technique impacted the participants' experiences of musical connection, influence, and expression. The following sections will introduce the results based on each technique.

Imitating

Bruscia (1987) explains that imitation has occurred in a session when a therapist echoes a client's response. These responses were represented in the MTTB graphs as phase shifts, or a replication of participants' waveform evident in the researcher's waveform. The selection of graphs shown in Figure 1 demonstrates these phase shifts, evident in all participants' improvisations and the aforementioned parameters.

In their written responses, the participants noted a reciprocal nature to the improvisations. Participants Three and Four (P3 and P4) used the term "call-and-response", P3 used the term "mimick" and P3 used the term "duet" to describe the nature of the improvisation. Participant Two (P2) explained that boundaries were laid out by R2 when imitating the participant's playing. Overall 60% of participants suggested there was not a lot of influence on their playing, with 50% of the responses elaborating that they felt more supported than influenced by the researchers' contributions to the improvisation, once the participant realised that the researchers were playing along with them.

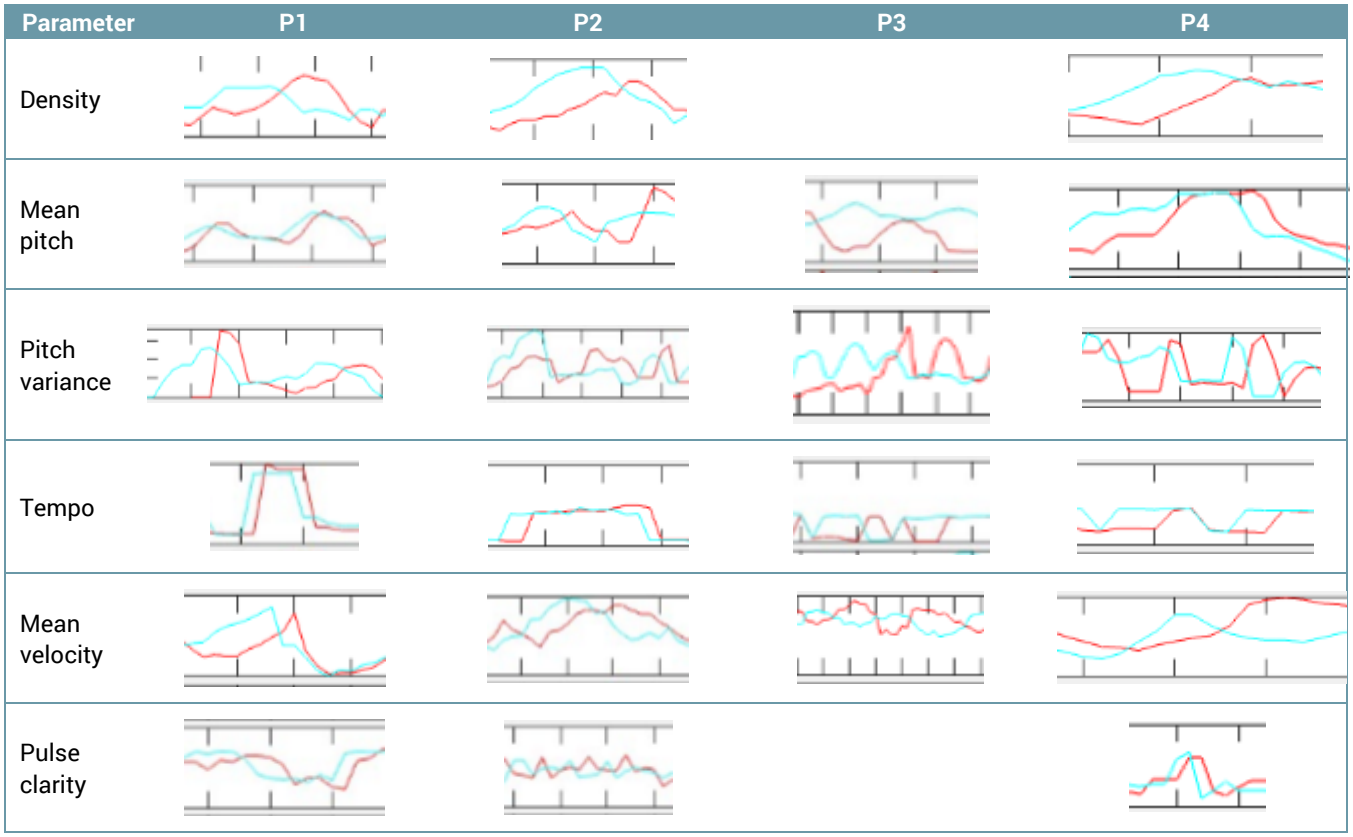

Figure 1: Evidence of imitation through phase shifts between the Researcher (red) and the Participant (blue) observed at different times throughout the participant's improvisations. The X axis indicates time and the Y axis indicates the notes played per second (density), note pitch in MIDI note numbers (mean pitch), the numerical variance between two sequential notes (pitch variance), the numerical change in note subdivision (tempo), note pitch in MIDI note numbers (mean velocity), and notes per second (pulse clarity). Imitation, as evidenced by phase shifts, was most evident in density, mean pitch, pitch variance, tempo, mean velocity and pulse clarity. Phase shifts were not as apparent in mean note duration, tonal clarity, major or minor tonalities, or synchronicity in tempo. This is likely because these parameters apply to the improvisation as a whole, rather than individual melodic or rhythmic elements of the improvisation. Phase shifts in pulse clarity and density were not evident in P3's improvisation.

Reflecting

According to Bruscia (1987, p.540) reflecting occurs when "the therapist expresses the same moods or feelings that the client is expressing". Reflecting is meant to encompass not only the client's music, but their overall presence in the session. In addition, the therapist may use movement, music, lyrics, and/or verbalisation to accomplish the reflection (Bruscia, 1987). Because of the nature of this research, it was only possible to examine the musical reflection occurring in the MTTB graphs. In almost all improvisations, the tonality of the researcher and participant were highly correlated. This is demonstrated in Figure 2.

The researcher's mean pitch was either below the participant's or synchronised. There were only brief musical moments in which the researcher's mean pitch was above that of the participant's. Beyond the trends related to mean pitch and tonality, there were few similar patterns in the MTTB graphs, especially when compared to other improvisational techniques. The few similarities in the

musical measures could relate to the inability to capture affect and emotional content, which will be explored further in discussion.

Despite few musical similarities, almost all participants indicated they were able to express themselves musically, and 70% of responses indicated a musical connection between the participant and researcher. These participants related the feelings of connection to the experience of creating the music together, as indicated by P3: "it felt like we were two parts of one piece that was being created together". Three participants also indicated they felt the most connection in this improvisation when considering the overall experience.

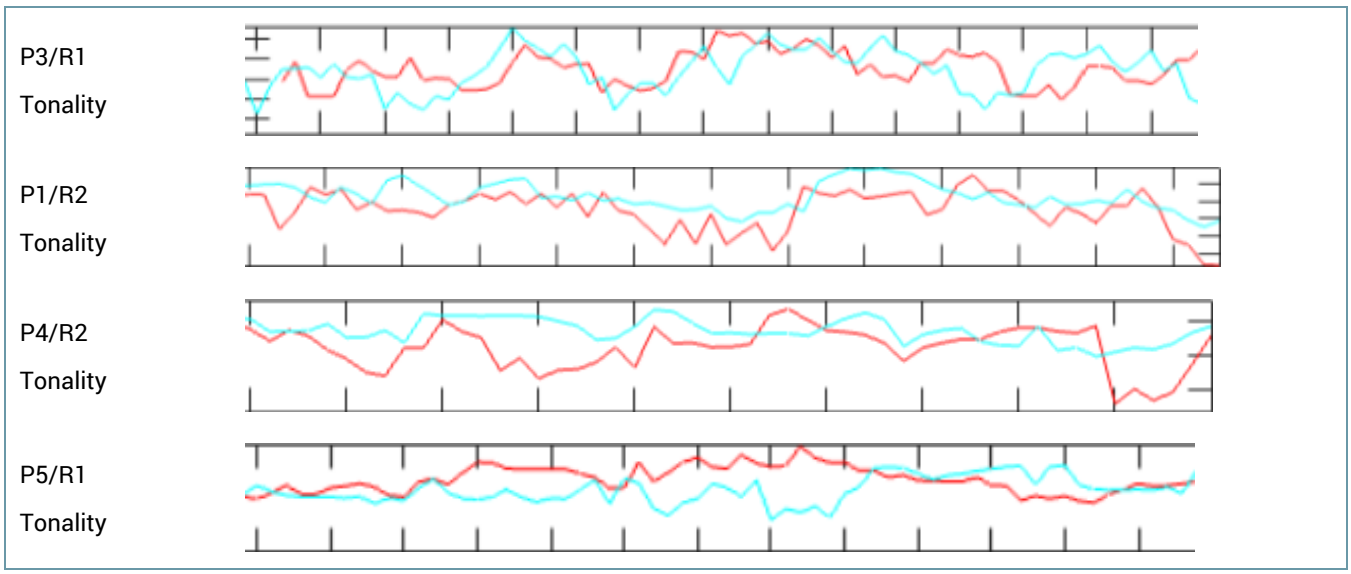

Figure 2: Graphical representation of the levels of tonality in reflecting improvisations. The X axis represents time, with each graphic being an excerpt of the total time of the improvisation. The Y axis represents a tonality correlation coefficient from 0-1, with 0 being atonal and 1 being completely within a tonal structure. A high level of correlation between researcher's (red) trend and participant's (blue) trend is observed. Graphical evidence was most evident in tonality (shown above).

Synchronisation

Revisiting Bruscia's definition of synchronisation, the purpose of this technique is to promote self-awareness and develop relationship, through synchronised playing. While improvising, the researchers attempted to play what the participants were playing, at the same time. Due to the nature of the technique, the researchers were unable to replicate all elements of the student's playing; in certain parts of the improvisation, the researchers would focus on synchronising with certain elements (i.e. synchronising rhythmic patterns versus synchronising melodic patterns) or would synchronise with certain fragments of the phrase. In addition, some elements were more successfully predicted than others, leading to higher levels of synchronisation in that particular element. Finally, the researchers synchronised more successfully in some improvisations compared to others, depending on the complexity and composition of the improvisation. These findings are evident when analysing density, mean duration, mean pitch, mean velocity, pulse clarity, tempo, tonal clarity, major and minor tonality, synchronicity, and synchronised tempo in MTTB.

To generate synchronicity, the MTTB software combines the level of togetherness in both voices, for each individual element. For the software to generate 100% synchronicity, the researcher and student would have to be exactly together in all elements of the music generated. For this reason, many of the synchronicity lines vary, with erratic peaks and dips as the improvisation progressed; as mentioned previously, the researchers did not synchronise with all elements of the music, or would synchronise with fragments of the phrase, for logistical reasons.

According to the MTTB graphs, the element that was most successfully synchronised with by the researcher is density. In almost all improvisations, the researcher matched the note density of the student, within a similar timeframe, for the majority of the music. This is demonstrated in Figure 3.

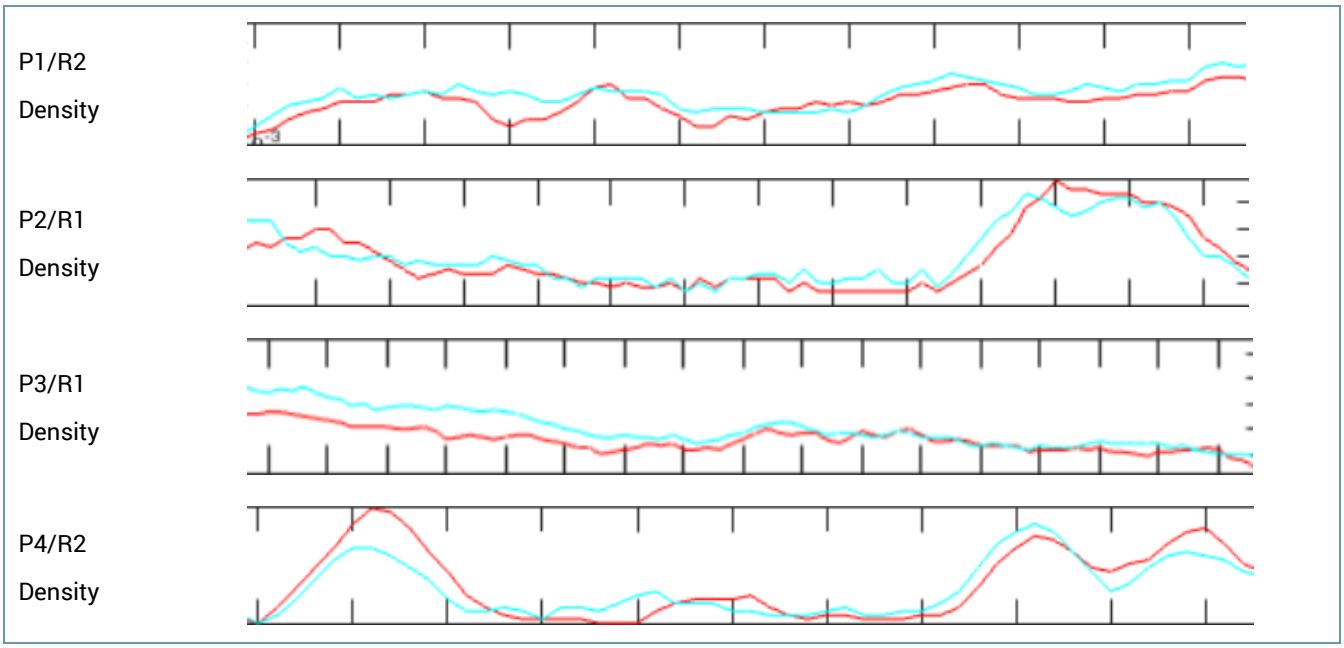

Figure 3: Graphical representation of density in synchronising improvisations: The X axis represents time, with each graphic being an excerpt of the total time of the improvisation. The Y axis represents notes played per second. Researcher's (red) trend and participant's (blue) trend match as close as possible. Researchers could not synchronise every musical element (melody, rhythm); synchronicity was most apparent in note density (shown above).

The final, and potentially most significant, finding is that synchronisation was considerably more successful in some improvisations than others, and this influenced the participants' subjective experiences of connection and influence of the researchers' playing. When synchronicity was high, participants reported high levels of connection with the researchers and positive feelings regarding the researchers' influence. Conversely, participants reported low levels of connection and a negative perception of the researchers' influence, after improvisations that were not successfully synchronised. For example, P3's improvisation with both R1 and R2 contained high levels of synchronisation throughout. This is demonstrated in Figures 4 and 5, showing the synchronicity throughout the improvisations:

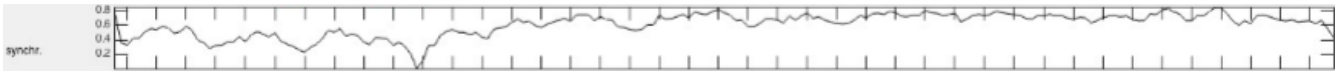

Figure 4: Synchronicity in synchronising improvisation between R2 and P3.

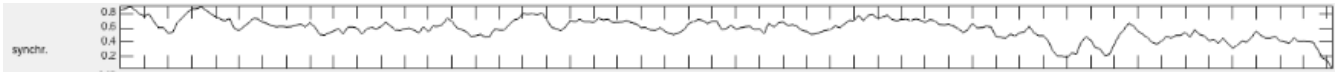

Figure 5: Synchronicity in synchronising improvisation between R1 and P3.

The high level of synchronisation led participants to a positive subjective experience in both improvisations. P3 provided the following response to the question "How did the researcher's playing influence your playing?" after improvising with R1: "with her playing similarly, I felt content to do my own things knowing that she would be there" (P3, 2018). Following the improvisation with R2, P3 responded to "did you feel a musical connection" with "yes, it definitely felt like she was basing her movements on what I was playing". Both responses indicate that, when successful, synchronising is an effective technique for developing connection and musical relationship.

On the contrary, P1 had low levels of synchronisation throughout the improvisation with R2. The following figure shows the synchronisation between P1 and R2:

Figure 6: Synchronicity in synchronising improvisation between R2 and P1.

P1 reported low levels of connection, saying, "not too much [connection] besides having similar ideas in the improv". In addition, his response to "how did the researcher's playing influence your playing?" was as follows: "not too much, I was trying to get out of the way at times so we didn't clash, but I found it slightly difficult". The latter response indicates that the researcher's playing was not contributing to a positive subjective experience, potentially contributing to a lack of connection with the researcher.

Similar results occurred with P4 and R1, with the improvisation synchronisation displayed in the following figure:

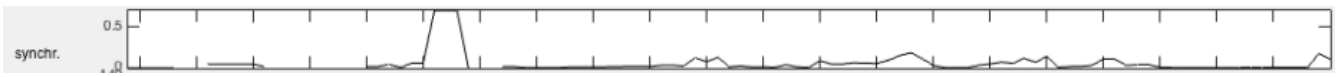

Figure 7: Synchronicity in synchronising improvisation between R1 and P4.

P4 reported feeling "musically chased" and in response to the question about connection said, "a little; it was a bit of a 'tag, you're it' sort of feeling". Although P4's subjective experience of being chased could be considered positive and playful, it could also mean a negative type of 'chasing'. As both P1 and P4's experiences could be interpreted as negative, this may indicate that this technique is the most effective when implemented as close to Bruscia's definition as possible, with high levels of synchronisation.

Extending

According to Bruscia (1987), extending is used to lengthen a client's musical phrase with the intention of aiding the client's expression of a complete idea. Extending may involve adding to the end of the client's phrase or creating an overlapping phrase to supplement the client's music. In most of the MTTB graphs, this was demonstrated by moments of synchronicity in mean pitch, followed by individual playing. This is demonstrated in Figure 8.

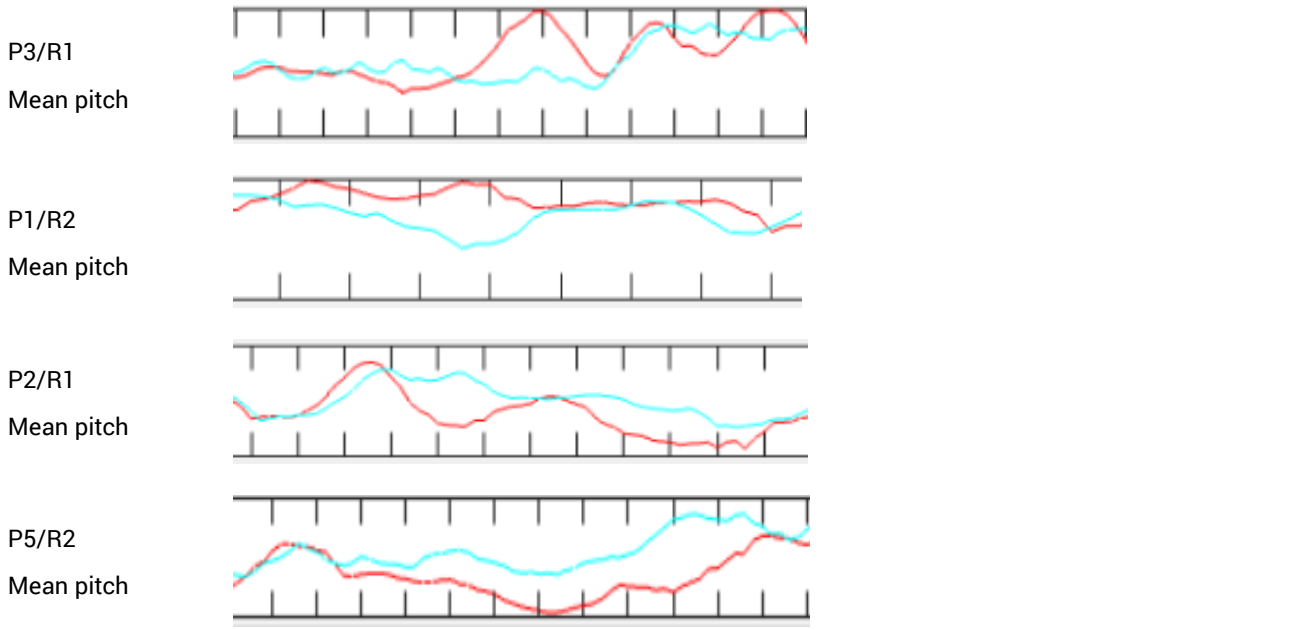

Figure 8: Graphical representation of mean pitch in extending improvisations: The X axis represents time, with each graphic being an excerpt of the total time of the improvisation. The Y axis represents the MIDI value of pitches. Researchers' (red) trend and participant's (blue) trend match to begin, then branch off individually. Extending was most apparent in mean pitch (shown above).

According to Bruscia's definition, these examples represent extending by overlapping the phrase. It was not as clear how extending by adding to the end of the phrase would be represented within the MTTB graphs. In addition to alternating between synchronicity and individual playing in mean pitch, the pulse clarity was generally very high in the improvisations and there was high synchronicity in mean velocity.

There were very few consistencies or patterns in the individuals' responses to the improvisations. Some participants noted similar ideas of call-and-response, imitation, and playing off each other in response to "how did the researchers' playing influence your playing?" There were varied answers relating to feelings of connection in the music. For example, P1 responded to the question about musical connection with, "Yes, I did. I felt like I was supporting them in the music making. I also felt that I was the one copying the researchers' choices and that led to further discovery of the music." In comparison, P2 and P3 said "not as much as the last few times" and "not particularly" respectively. Finally, many of the participants' responses indicated that they were able to express themselves musically to a certain extent, but not as effectively as previous

improvisations. For example, some participants' responses were as follows "I think so; almost; partly".

Participants' experiences of musical expression, influence, and connection were inconsistent. Because of this, it is difficult to draw conclusions about the potential clinical implications and applications in relation to these three elements.

Symbolising

Bruscia (1987, p. 536) states that symbolising is "having the client use something musical (e.g. instrument, motif) to stand for or represent something else (e.g. event or person)". To maintain consistency across all improvisations, the researchers instructed the participants to think of an object in the room that could be represented musically, and not to let the researchers know of what they were thinking. This allowed the researchers to respond to the improvisation without the risk of influencing the improvisation, which led to a wide variety of improvisations that may not have been accurately depicted in the graphs. Because of this, while there is evidence of imitation and holding (as seen in Figure 9) depending on the nature of the improvisation, there is no consistent trend or pattern, such as a phase shift observed in imitating or matching graphs found in synchronising, that emerged from the graphs.

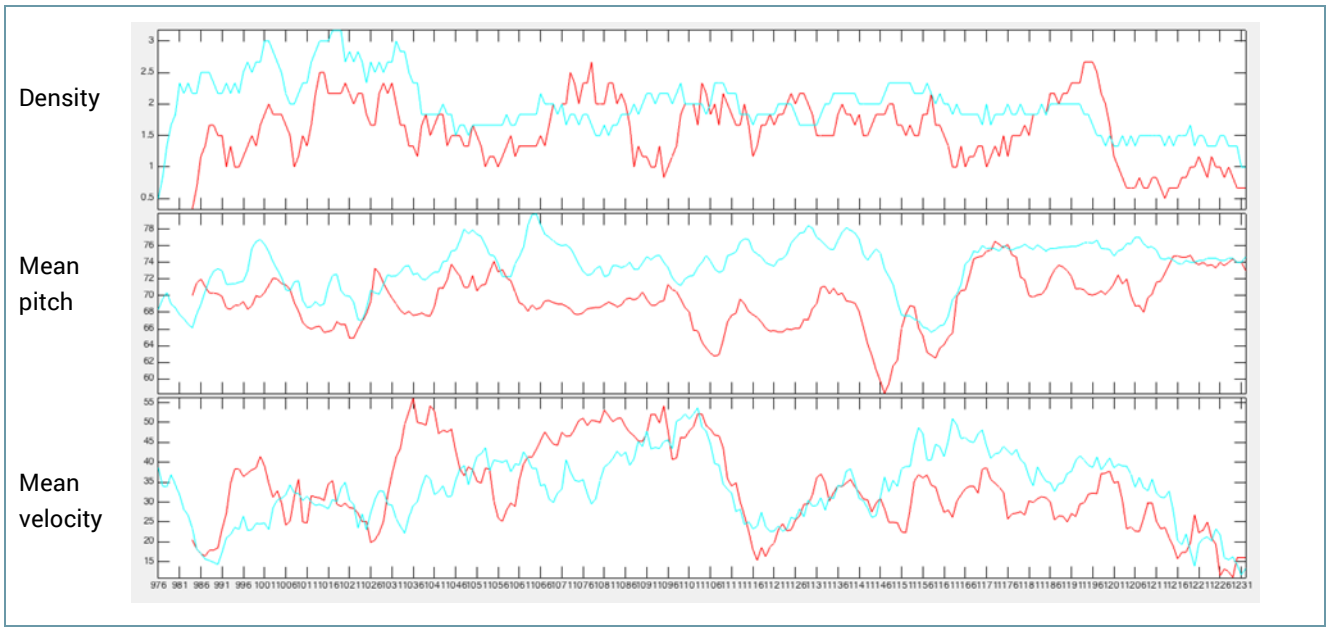

Figure 9: Most evident trends observed in symbolising, between R2 (red) and P3 (blue). The X axis represents time, and the Y axes represent notes per second (density, mean velocity) and pitch in MIDI note numbers (Mean Pitch). In this particular improvisation, imitation (phase shifts) between the researcher and the participant can be observed in note density, mean pitch and mean note velocity. Furthermore, holding can be observed in Mean Pitch. Due to the high level of variance in each improvisation implementing symbolising, each improvisation graph looked different, demonstrating a lack of consistency in trends between improvisations. The high level of variance found in improvisations can be paralleled with a high level of emotional attunement that may not necessarily be found in a computer-generated graph.

Responses to symbolising improvisations were mixed, with some of the participants indicating that the researcher did not influence their playing. P4 further explained that they "felt like the leader, but the ending had more balance" when playing with R1. Most indicated a musical connection with the researcher, with P1 explaining that they "felt happy with the playing and even though [R1] didn't know the main idea she was able to gain feeling of it". Most participants felt able to express themselves musically. Those who did not feel a musical connection or felt that the researcher influenced their playing described themselves as "being in their own head" or "fixated on an idea" rather than listening to the researcher's musical responses. The participants who stated that they could not express themselves musically suggested this was linked to challenges associated to learning how the MalletKAT instrument worked. Two participants in two separate improvisation sets felt the most connection in this technique.

Holding

According to Bruscia, to successfully use the clinical technique holding, one must integrate reflecting, pacing, grounding and centring in order to both reflect and contain the client's music (p. 552). The nature of the integration and implementation of grounding may depend on both the client's needs and the therapist's interpretation of how to reflect and contain. As a result, the operational definition of holding is abstract and may be carried out differently depending on various factors such as therapist's theoretical approach, clinical experience, and musical training. For this reason, the researchers did not have agreed-upon concrete parameters for their playing. Instead, they attempted to play in a way that both reflected and contained the student's playing.

In 'holding', therefore, there were few continuities. In the results reported above, trends were most often found between individual elements of music, across all improvisations. In order to realise the trends that align with the nature of holding, it was necessary to examine trends and patterns found in different elements within the graphs. In order to do so, researchers analysed trends and patterns across different elements of music for each graph, comparing all graphs to each other. After broadening the analysis, it became clear that there are musical representations of both reflection and containing within each improvisation, but in different elements depending on the improvisation. In addition, there is evidence of researcher differences in the interpretation of reflection versus containing.

In every improvisation, there was at least one element with a high level of synchronicity for the majority of the improvisation. This synchronicity is seen most often in pulse clarity, but also in mean pitch, density, pitch standard deviation, and mean duration. In the graphs, this is visually represented by similarities in researcher and participant line contour. Based on previous results, synchronicity in the MTTB graphs may be a representation of musical reflection which in turn generates feelings of support in the participant. In addition, in the majority of improvisations, the researcher's music was underneath or less than the student's music in at least one element of the music. This is seen in mean pitch, mean velocity, pitch variation, and density.

In the graphs, this is visually represented by the researcher's line being below the participant's line; what this relates to musically depends on the element itself. For example, if the researcher's density line is below the participant's, it means that the researcher played less notes at any given

time. If mean pitch is lower, it indicates that the researcher was playing lower notes than the participant while improvising. Based on previous results and the subjective interpretations of the participants, this is likely a representation of containing or grounding. According to these results, it is likely that the researchers attempted to use one element of the music to provide support and reflect the participant while using another to contain and ground the music. The following graphs demonstrate this visually, with each one isolating two "reflecting" elements and one "containing" element.

It is also important to note the researcher differences represented in the graphs above. In both improvisations, R1 remained below the participants in mean pitch, meaning that she consistently played lower notes than the participant. In a follow-up discussion regarding these results, R1 articulated that her perception of containing and grounding involves using the lower register of an instrument. The element that R1 used to reflect and support was dependent on the individual. There were no consistencies in the elements R2 used to reflect and ground, beyond synchronisation in pulse clarity.

Our findings demonstrated in Figures 10 to 13 suggest the researchers seemed to effectively reflect and contain the participant's music in most improvisations, using mean pitch, mean velocity, pitch variation, and density, pitch standard deviation, and mean duration to do so. In response to the first three questions, participants provided a variety of responses, with little consistency. Some participants expressed that the researcher had little influence on their playing, while others felt there was a significant amount of interaction within the music. In addition, some felt a connection stemming from musical dialogue, while others felt little to no connection. The most consistency occurred in response to "did you feel that you were able to effectively express yourself musically?" In two of the ten responses, participants indicated difficulty expressing themselves musically.

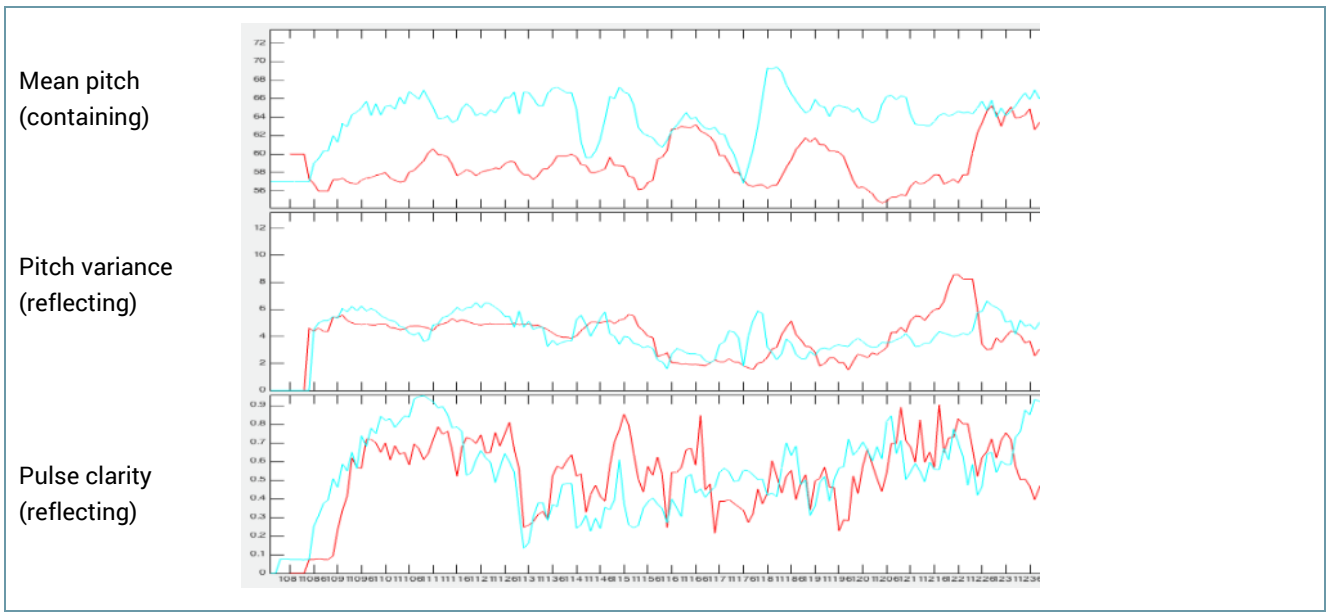

Figure 10: Evidence of reflection and containing in holding improvisation: R1 and P1. In all graphs the X axis represents time, with each graphic being an excerpt of the total time of the improvisation. The Y axis represents the MIDI note value for pitches, standard deviation of MIDI note values, and note subdivisions within the pulse respectively.

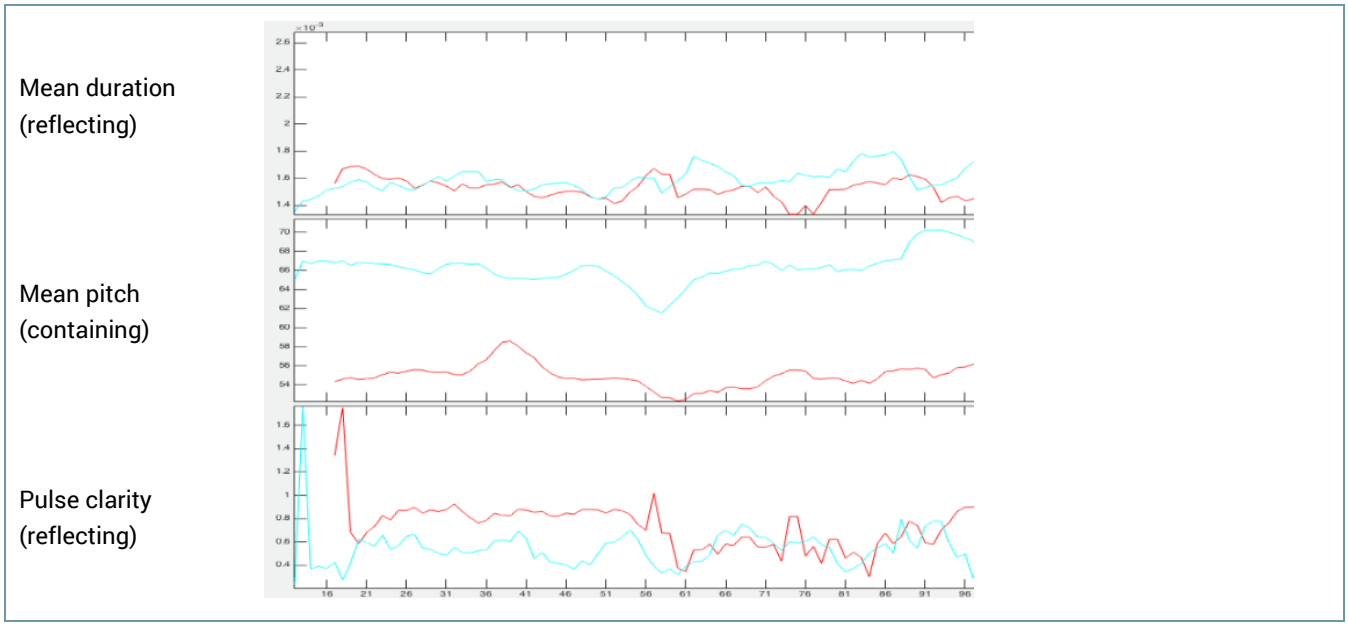

Figure 11: Evidence of reflection and containing in holding improvisation: R1 and P2. In all graphs the X axis represents time, with each graphic being an excerpt of the total time of the improvisation. The Y axis represents the duration the note is held, the MIDI value for pitches, and note subdivisions within the pulse respectively.

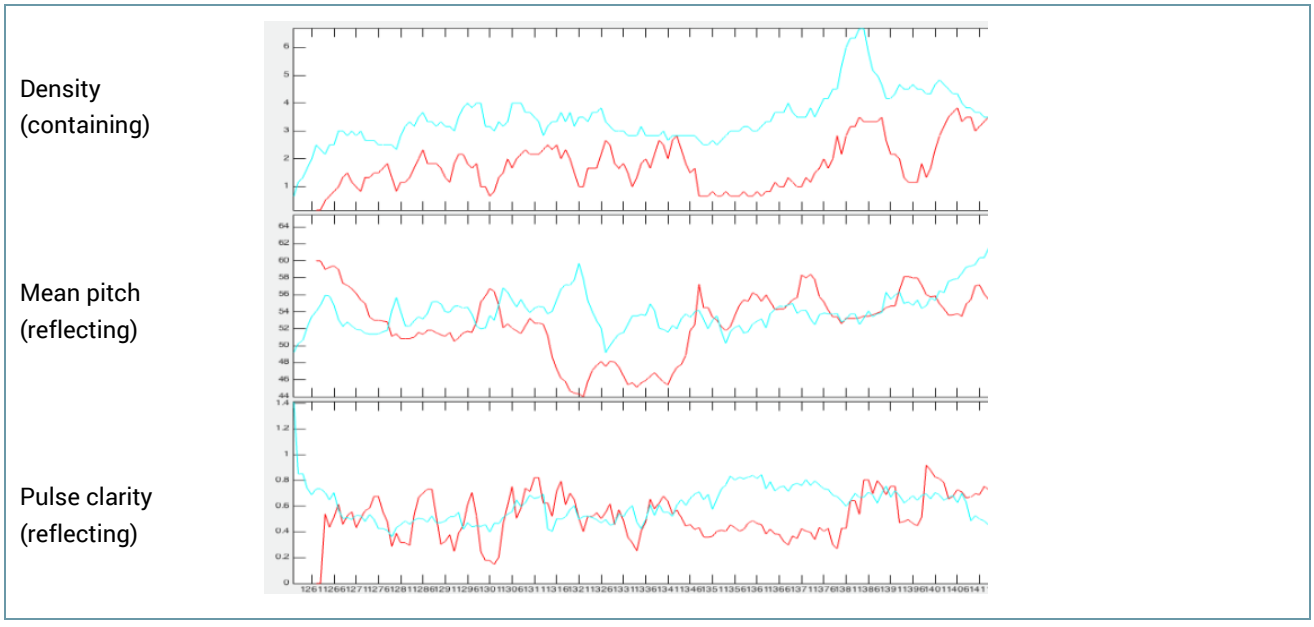

Figure 12: Evidence of reflection and containing in holding improvisation: R2 and P3. In all graphs the X axis represents time, with each graphic being an excerpt of the total time of the improvisation The Y axis represents note played per second, the MIDI value for pitches and note subdivisions within the pulse respectively.

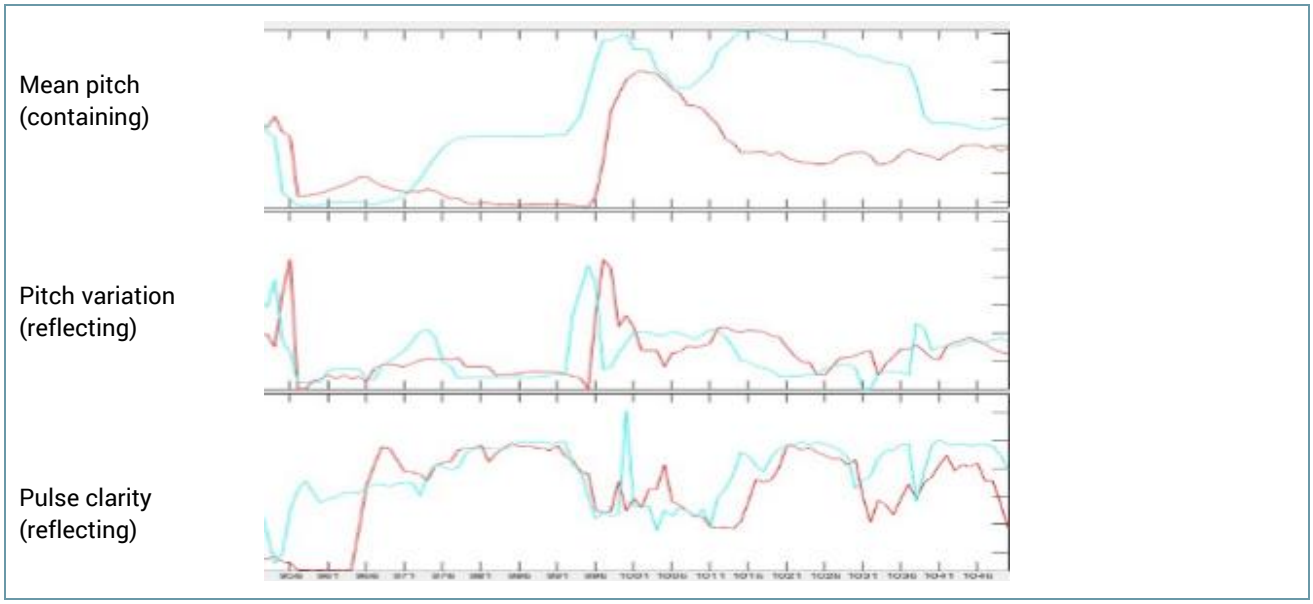

Figure 13: Evidence of reflection and containing in holding improvisation: R1 and P1. In all graphs the X axis represents time, with each graphic being an excerpt of the total time of the improvisation. The Y axis represents the MIDI value for pitches, standard deviation of MIDI note values and note subdivisions within the pulse respectively.

Incorporating

Bruscia defines incorporating as "using a musical motif or behaviour of the client as a theme for one's own improvising or composing, and elaborating it" (1987 p. 535), and explains that using incorporation effectively can allow the client's music to be reinforced, accepted and also allow the client to work through specific feelings, musical or otherwise. In the MTTB graphs shown in Figure 14, phase shifts similar to those seen in imitating are observed at the beginning of most improvisations. As the improvisations progress, the trends vary due to the individual nature of each participant's improvisations. Phase shifts could be observed through the improvisations depending on what ideas were incorporated in the moment.

Participants had varied responses to the 'incorporating' technique. Those who found that the researcher did have an influence on their playing noted that the improvisations felt more collaborative and that the researchers had opportunities to present their ideas. For example, P2 explained that they "feel more comfortable and relaxed to improvise, especially since [they] know more about this instrument." Most responses indicated that the participant did feel a musical connection with the researcher, with only two indicating a lower level of connection. Participant 5 explained that when playing with R2 they felt "like the researcher playing in and through my rhythms allowed me to listen to them play, which encouraged me to keep my own feel". Finally, the majority of responses indicated participants were able to express themselves musically, with P5 explaining that they and R1 were "a team playing alongside one another as opposed to making something together". Others indicated that they were able to express themselves "eventually" or "mostly". Finally, three participants across four improvisation sets felt the most connection in improvisations implementing this technique.

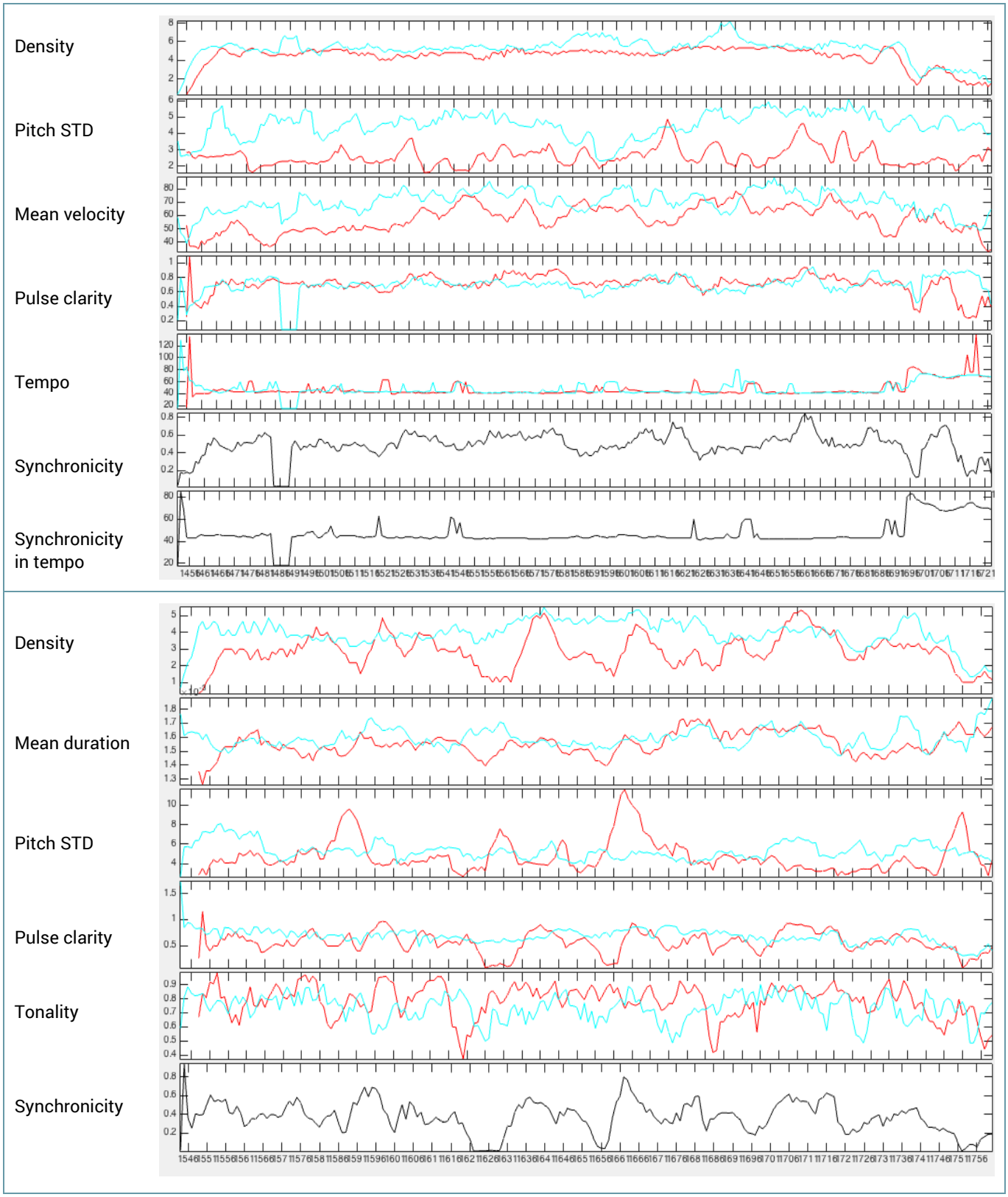

Figure 14: Incorporating in P3's improvisations with R1 (top) and R2 (bottom). The X axis represents time and the Y axis represents notes per second (density), pitches in MIDI note numbers (pitch STD, mean velocity), note subdivisions (tempo, pulse clarity) and correlation coefficients in tonality and synchronicity (tonality, synchronicity in tempo). Similar to symbolising, there is a high level of variance in trends evidenced in this technique after an initial phase shift, showing evidence of imitation. This is again likely due to the high level of variance in each improvisation.

Rhythmic grounding

Bruscia's (1987) definition of rhythmic grounding ensures that the therapist is maintaining meter throughout the improvisation and not meeting or matching the client's intensity. Interpretation of this technique was varied: the researchers maintained a steady beat with the participants for approximately half of the improvisations, shown in Figure 15, and the researchers appeared to follow the participants' tempo in the other half of the improvisations, shown in Figure 16. This phenomenon occurred equally across both researchers' playing.

When using rhythmic grounding, the researchers' mean note duration, pulse clarity and tempo were consistent throughout. In addition, there was evidence of high pulse clarity. Improvisations using rhythmic grounding found consistent playing of the researcher in mean note duration, pulse clarity, tempo, and there was evidence of high pulse clarity. Synchronicity in tempo varied depending on whether the researcher followed the participant or remained constant regardless of the participant's tempo. Furthermore, the software used was not entirely accurate in analysing tempos musically – there is a possibility that a highly rhythmic improvisation could be depicted differently on the graphs. Decreases and increases in tempo appear to be consistent regardless of the researchers' interpretation of the technique as well, which appear to be a doubling, or a halving of the note values used in improvisation.

Responses to this improvisation in regard to researcher influence were varied. P3 and P4 noticed that the researcher "supported" the improvisation while "still leading"; P3 also noted that the researcher was "supporting [them] and allowing [them] to do [their] own thing". Other participants noted that the researcher had a "strong influence" on the improvisation, as well as a sense of "modelling ideas" for the participants. P3 in particular explained that there was "not too much" influence on their improvisation with one researcher - this improvisation in particular was very rhythmic to begin with and did not necessarily require rhythmic grounding during the improvisation. The participants' perception of this technique aligns with Bruscia's intent for rhythmic grounding, as it is meant to be a structuring technique rather than one to elicit an emotional response.

DISCUSSION

This exploratory study explored eight of Bruscia's (1987) clinical improvisation techniques that are often used with autistic clients (Skinner et al., 2020). The techniques were investigated by using music-adapted technology and the MIDI Toolbox designed for MATLAB, as well as MTTB (Erkkilä et al., 2004). In this study, the graphs generated in the MTTB were used to generate a deeper understanding of these techniques and their possible clinical implications, relating to the connection between a participant and researcher, and musical expression on behalf of the participant. The analysis also provided insights into how the techniques are implemented and how their implementation might be represented visually. This information may serve as a new perspective for a therapist to successfully implement the above-mentioned techniques into clinical sessions with autistic clients. The following paragraphs explore the clinical implications as well as the limitations of this study and ideas for future research.

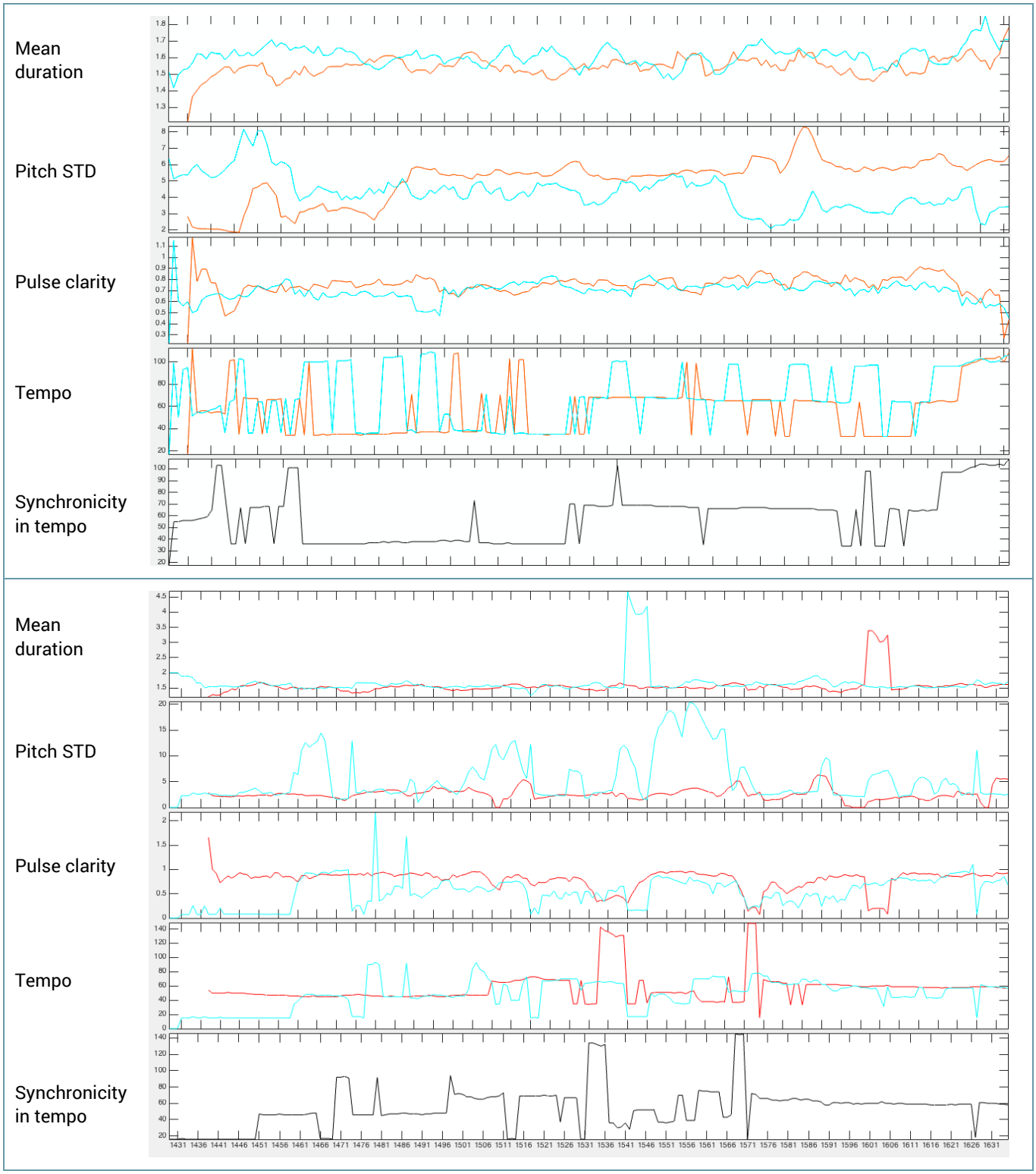

Figure 15: Evidence of the researcher following the participant: R1 and P3 (above) and R2 and P4 (below). The X axis represents time and the Y axis represents pitches in MIDI note numbers (Pitch STD, Mean Velocity), note subdivisions (Tempo, Pulse Clarity) and correlation coefficients in tonality and synchronicity (synchronicity in tempo). A high variance of synchronicity in tempo (bottommost graph) and phase shifts similar to those found in imitation can be observed.

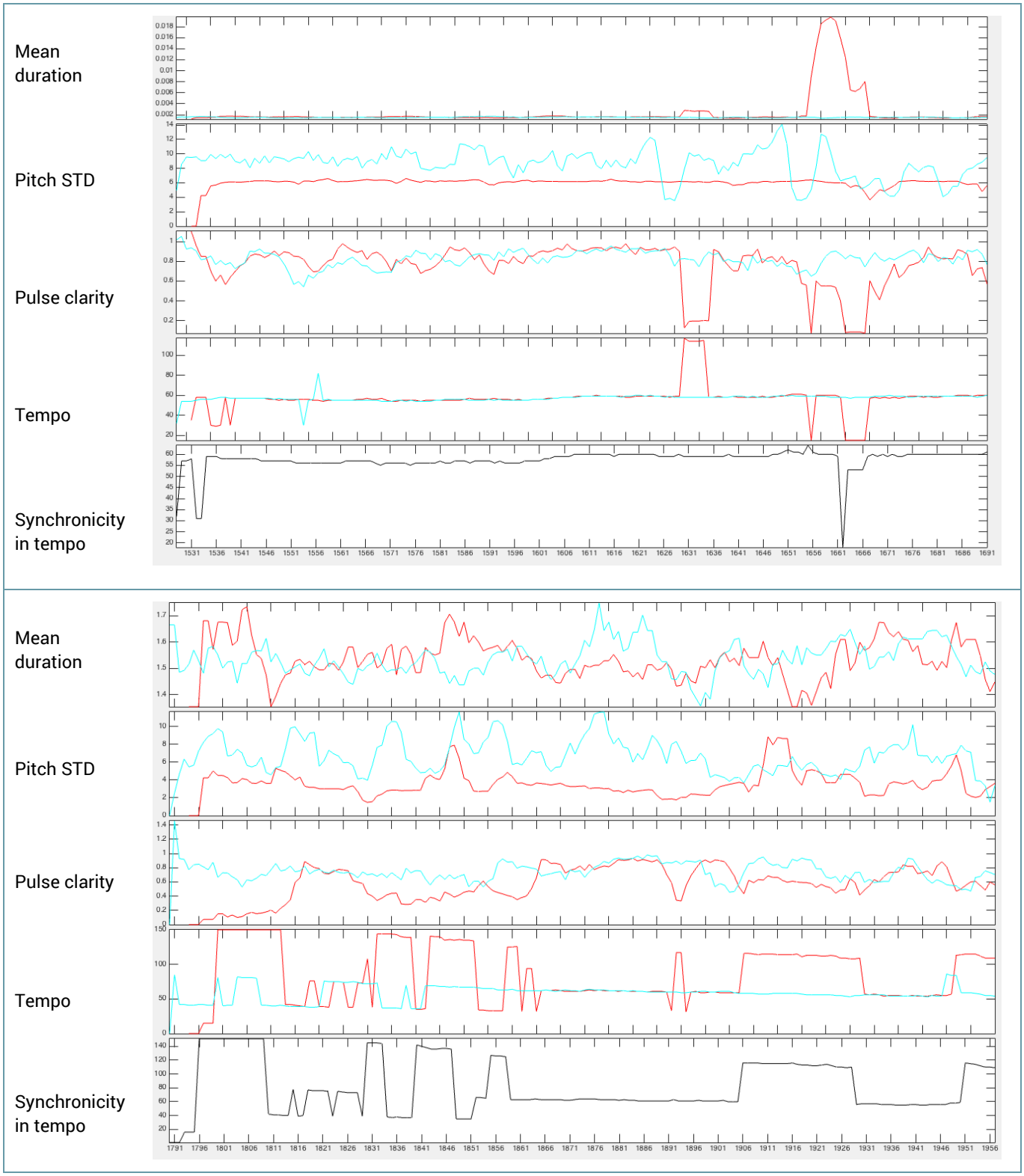

Figure 16: Evidence of the researcher maintaining a consistent tempo: R1 and P1 (above) and R2 and P3 (below). The X axis represents time and the Y axis represents notes per second. Synchronicity in tempo is high, and the therapist's playing is noted by the straighter (red) lines in both improvisations.

Imitating

According to the phase shifts identified in the data analysis and the use of descriptors such as "call-and-response" and "duet", the implementation of imitating in the improvisations matched the definition and outcomes listed in Bruscia's taxonomy. This is likely due to the concrete nature of the technique, which left little for the researcher to interpret when improvising with a participant. Furthermore, there is a variety of "responses" (Bruscia, 1987, p. 533) in which a therapist could imitate a client; for example, rhythmically or melodically. The imitation of any response was represented in the MTTB graphs regardless. Although this experimental study was conducted with music students and none of the participants identified as autistic, it could be speculated that imitation could be considered a safe starting technique when working with clients with autism. Participants noted the reciprocal nature of the music and half of participants reported feeling supported when imitating was used. Generally, participants did not feel influenced by the researcher's music. These are indications that imitation could build client rapport by demonstrating musical support and acceptance. By imitating phrases of the client's music, it may enable them to feel heard and accepted through their music-making. Through the eyes of the researcher, the concept of imitation is fairly concrete, allowing for less interpretation in regard to the researcher or clinician's contribution. Imitating can occur within different elements of music, allowing for some individual interpretation.

Reflecting

Our finding that most participants were able to express themselves musically and the majority felt a connection with the researcher suggests that reflecting could be an effective technique for fostering connection and encouraging client expression. Perhaps the effects related to connection and expression may heighten if the music therapist is able to adequately capture the individual in their musical reflection.

The lack of consistencies and trends in the musical data could relate to the definition of 'reflection' and its practical translation. As mentioned, Bruscia's definition of reflecting is "matching the moods, attitudes, and feelings exhibited by the client". Comparing the definition of reflecting to other techniques such as imitating, its abstract nature allows for individual interpretation and application. The graphs highlight few patterns and many inconsistencies, with the exception of tonality and mean pitch. In addition, it could be argued that certain elements of music, such as the emotionality experienced in music, are not able to be represented graphically. The element of music likely to do so would be tonality and key areas, which was the one main consistency throughout the reflecting graphs. There was a high level of synchronicity in tonality between the researcher and participant.

It is possible that the high level of synchronicity in tonality relates to the perception that the key chosen by the participant relates to their mood and feeling and thus the researcher synchronised with the key area in an effort to reflect what the participants were communicating. Variability in other elements of the music indicate that the researchers interpreted musical reflection differently and potentially implemented it differently depending on the participants. It is also possible that the

variability relates to the lack of therapeutic relationship and knowledge of the individual, making it difficult to reflect their moods and feelings. In other words, this may be a difficult technique to implement experimentally. Potential next steps for future research could be to further investigate the tonality in the improvisations using MATLAB functions, i.e. do we associate tonality with the identity of the music, potentially extending to the person's feelings/presentation? How can we effectively and succinctly demonstrate researcher differences in the interpretation of the technique?

Synchronisation

When implementing synchronisation in improvisation, researchers experienced a spectrum of success, ranging from high levels of synchronisation throughout the improvisation, to only brief moments of synchronisation. This is likely because the conditions in which synchronisation was implemented were not parallel with clinical situations. Bruscia explains that this technique is geared towards promoting self-awareness and relationship development (1987, p. 535), which would likely take place over a number of sessions, depending on the client. This technique was implemented third in the session, thus not likely replicating a trajectory of this technique should it be implemented in a clinical setting. Logistically, it is difficult and sometimes impossible to replicate an individual's playing at exactly the same time they are playing. Although unexpected, the lack of consistent and successful results provided insight into the clinical considerations associated with this technique.

As evidenced in the results section, synchronisation can be an effective technique for establishing musical connection, through musical support provided by the therapist. However, based on the results, there is evidence that ineffective use of synchronisation (low levels of musical synchronisation) may have a negative impact on the musical connection between the client and therapist and create a negative subjective experience for the client. Based on this, this technique should be used when there is a higher likelihood of successfully replicating the client's music-making. For example, this technique would likely be more effective when there is an established pattern in the music or the therapist is familiar with the client's style of playing.

Extending

The alternating moments of togetherness and individual playing in the mean pitch when extending likely relates to the definition and overall goal of extending, which is to add to the client's phrase in order to aid in the expression of a complete idea. The moments of synchronicity were likely imitation of the participant's musical ideas, followed by the addition of a musical idea which would break the synchronicity in mean pitch. Beyond the representation of extending in the music and MTTB graphs, clinical implications of the technique are not clear due to the varied responses to all questions with the questionnaire. It is possible that the participants did not require assistance extending and completing phrases, therefore this technique did not aid in expression. Because of this, it is difficult to draw conclusions about the clinical application of this technique from the combination of musical and other data. Further investigation would be necessary to gain further insight into how and why this technique could be used.

Symbolising

This technique yielded high levels of musical connection and expression. This is likely due to the high variance of the researchers' interpretations within the context of the improvisation as well as the method in which the researchers approached the participants' motifs. The success of this technique likely also lies in the lack of the researchers' abilities to attribute the musical motif to a non-musical entity. It might also depend on the participants' ability to make these connections; and in a clinical situation, for example, whether they can communicate verbally. Within the context of a clinical session, it appears as though symbolising may be effectively implemented once a client and a therapist have established rapport, with the goal of increasing emotional expression as sessions progress.

Holding

In combining the subjective experiences of the students with the improvisation data, multiple facets relating to the understanding and use of holding within clinical improvisation were realised. The first and potentially most significant finding relates to the definition, understanding and execution of holding (Bruscia, 1987), which may mean different things for different music therapists depending on their theoretical, cultural, and philosophical framework. In *Improvisational Models of Music Therapy*, Bruscia does not provide strategies in which to accomplish the difficult task of both reverberating "the client's feelings while also offering a musical structure for containing their release" (Bruscia, 1987, p. 522).

Through the analysis of improvisations, a concrete musical representation of the technique emerged; as discussed in the results, researchers accomplished both music reflection and musical containing by using different elements in the music for each purpose. The elements used for reflection versus containing differed for both the researcher and student. However, both were present in some combination of elements, in almost all improvisations. This knowledge may be used by clinicians moving forward, as well as by educators teaching the use of holding for clinical improvisation.

Incorporating

While the evidence of its effectiveness was not fully realised through the MTTB graphs, a high level of success was observed in the implementation of incorporation into the improvisations. Participants expressed an ability to play their ideas while still being supported by the researchers, as well as the ability to play off of the other's ideas. This is reflecting Bruscia's aim of accepting the client's music (1987) with a possibility of the participant wanting the researcher to have a voice within the improvisation as well.

Bruscia's definition and explanation of the technique notes that incorporating can be used to build a musical repertoire between a therapist and a client (1987). The concept of the technique shares the concrete nature of imitation with little interpretation. It also includes some flexibility and

the ability to explore musically to allow for deeper emotional expression or a stronger alliance between the client and the therapist.

Rhythmic grounding

The use of rhythmic grounding in improvisation was shown to be an effective support technique, with the goal of leading to increased expression. This was evident despite the different interpretations of the technique. Bruscia (1987) describes rhythmic grounding in *Improvisational Models of Music Therapy* as a "structuring technique" (p. 535), where the therapist must "avoid controlling or constricting the client's improvisation through rhythmic grounding" (p. 541). Following a client within the scope of rhythmic grounding could allow for more emotional expression, since the therapist would not be containing the music, rather meeting them in their current state. Maintaining a consistent tempo allows for more containing, with the opportunity for emotional expression once the client feels comfortable with the scaffolding laid out by the therapist. Though there was a variance in the extent to which the researchers structured the improvisation, connection was observed between the researchers and the participants in the questionnaire responses. The nature of this particular improvisation could have altered the results. If an improvisation was rhythmic to begin with, for example, rhythmic grounding might not be an effective technique for this improvisation in particular.

CONCLUDING THOUGHTS

In conclusion, using music-adapted technology and statistical software provided a new lens for understanding of elements of improvisational music therapy interventions. By combining graphic representations of the improvised music with the participants' subjective experience of the improvisation, we were able to gain insight into how improvisation techniques are represented in different elements of music, as well as potential clinical implications and applications. The analysis also provided insights into how the techniques are implemented and how their implementation can be represented. This information may serve as a foundation for a therapist to successfully implement the above-mentioned techniques into a clinical session.

The visual representation allowed us to draw conclusions on the representation of musical relationship, connections and emotional expression when paired with the participants' subjective responses. In addition, we were able to examine similarities and differences in the researchers' interpretation and implementation of the improvisation techniques. For the most part, the participants' subjective experiences had a tendency to align with the definitions put forth by Bruscia in his taxonomy of improvisation techniques. The graphic representation was varied depending on whether or not the technique was meant to structure a session for a client or to elicit an emotional response from a client.

As researchers we have also learned how to use each improvisational technique more effectively and more purposefully in a clinical session. We hope the knowledge gained in this study will benefit other music therapists in similar ways. The results of this research may also provide

some insights into the implementation of clinical improvisation techniques typically utilised in music therapy with autistic clients.

Limitations of the study

This research study had several limitations, such as the limitations created by the recruitment criterion of music students. For example, typical music therapy clients will normally not be musically experienced to degree level. The set order of improvisations the participants played presented another limitation of the study. For example, the placement of rhythmic grounding technique as the last one in the improvisation order could have presented a potential skew of the results. It was also noted that the participants felt more accustomed to the MalletKAT instrument at this point, which could have allowed for increased expression. Some participants also noted that they were running out of creative ideas at this point, which could have altered their perception of musical expression and connection with the researcher. Finally, a limitation of this study, as with any laboratory experiment, is the lack of genuine context: it is different to work in a clinical setting with a particular client's strengths and needs in mind.

FUTURE RESEARCH

In future, it would be interesting to conduct a clinical trial with autistic participants testing the same eight improvisation techniques. Potential next steps of future research could also include looking closer at melodic contour, which relates to Bruscia's goal for the technique, and comparing the MTTB graphs of individuals who felt connection and expressivity. Another potential next step for future research could be to further investigate the tonality in the improvisations using MATLAB functions, i.e. do we associate tonality with the identity of the music, potentially extending to the person's feelings/presentation? How can we effectively and succinctly demonstrate researcher differences in the interpretation of the technique?

FUNDING STATEMENT

This research was supported by the Manfred and Penny Conrad Institute for Music Therapy Research Grant.

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Ελληνική περίληψη | Greek abstract

Η χρήση μουσικά-προσαρμοσμένης τεχνολογίας για την εξερεύνηση των κλινικών τεχνικών του Bruscia που παρουσιάζονται στην έρευνα για τον αυτισμό: Μια πιλοτική μελέτη

Ashley Kurkjian | Kathleen Skinner | Heidi Ahonen

ΠΕΡΙΛΗΨΗ

Η παρούσα πιλοτική έρευνα μελετά τις οκτώ συνηθέστερες τεχνικές κλινικού αυτοσχεδιασμού του Bruscia (1987) που χρησιμοποιούνται στη μουσικοθεραπεία με άτομα με αυτισμό: μίμηση [imitating], αντανάκλαση [reflecting], συγχρονισμός [synchronizing], επέκταση [extending], συμβολισμός [symbolizing], κράτημα [holding], ενσωμάτωση [incorporating] και ρυθμική γείωση [rhythmic grounding] (Skinner, Kurkjian & Ahonen, 2020). Οι τεχνικές διερευνήθηκαν από κάθε συμμετέχοντα (φοιτητές μουσικής), απομονώνοντας και χρησιμοποιώντας την κάθε τεχνική σε οκτώ σύντομους αυτοσχεδιασμούς. Οι αυτοσχεδιασμοί ηχογραφήθηκαν με το λογισμικό LogicPro που ήταν συνδεδεμένο με MalletKAT όργανα. Στη συνέχεια, οι αυτοσχεδιασμοί αναλύθηκαν μέσω τεχνολογίας προσαρμοσμένης για τη μουσική, το MIDI Toolbox που είναι σχεδιασμένο για το MATLAB, ένα πολύ-παραγοντικό περιβάλλον αριθμητικής υπολογιστικής και προγραμματιστικής γλώσσας που έχει αναπτυχθεί από την MathWorks, καθώς και το Music Therapy Toolbox (MTTB) (Erkkilä, Lartillot, Luck, Riikkila & Toiviainen, 2004). Επιπλέον, οι συμμετέχοντες παρείχαν περιγραφή της προσωπικής τους εμπειρίας σε κάθε αυτοσχεδιασμό σε μορφή ερωτηματολογίου. Τα ερευνητικά ερωτήματα ήταν: 1) Πώς αντιστοιχίζονται οι οκτώ βασικές τεχνικές κλινικού αυτοσχεδιασμού του Bruscia στο MATLAB/MTTB ως προς τους προσωπικούς τρόπους παιξίματος αλλά και τις μουσικές σχέσεις; 2) Πώς επιδρά η χρήση της κάθε μεμονωμένης τεχνικής αυτοσχεδιασμού στην εμπειρία του συμμετέχοντα ως προς τη μουσική του διασύνδεση, επιρροή και έκφραση; Μέσα από έναν συνδυασμό μουσικής ανάλυσης και ποιοτικής θεματικής ανάλυσης, αναδύθηκαν προοπτικές που σχετίζονται με την αποτελεσματική εφαρμογή και σκόπιμη χρήση της μίμησης, του συγχρονισμού, του κρατήματος και της ρυθμικής γείωσης. Τα μουσικά δεδομένα που δημιουργήθηκαν από το MATLAB/MTTB ανέδειξαν το πώς οι ερευνητές εφάρμοσαν τις τεχνικές αλλά και τις τάσεις παιξίματος των συμμετεχόντων. Επιπλέον, τα ερωτηματολόγια προσέφεραν κατανόηση του πώς η κάθε τεχνική επηρέασε την δυνατότητα του συμμετέχοντα να εκφραστεί και να συνδεθεί, καθώς και την αντίληψή τους ως προς την μουσική επιρροή των ερευνητών. Τα αποτελέσματα

αυτής της μελέτης μπορούν να φανούν χρήσιμα τόσο στους μουσικοθεραπευτές όσο και σε σχετικές μελλοντικές έρευνες.

ΛΕΞΕΙΣ ΚΛΕΙΔΙΑ

αυτισμός, τεχνικές κλινικού αυτοσχεδιασμού του Bruscia, αυτοσχεδιασμός, μουσικοθεραπεία