ผลของดนตรีบำบัดรูปแบบเสมือนจริงที่มีต่อทักษะการคิดเชิงบริหารของเด็กที่มีภาวะออทิสซึม: การวิจัยกรณีศึกษาเดี่ยว

ธีร์ดา รูปสุวรรณ[1] นัทธี เชียงชะนา[2,*] และ อำไพ บูรณประพฤกษ์[3]
[1,2,3]วิทยาลัยดุริยางคศิลป์ มหาวิทยาลัยมหิดล
[*]ผู้ประพันธ์บรรณกิจ อีเมล natee.che@mahidol.ac.th

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บทคัดย่อ

การวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาประสิทธิผลของดนตรีบำบัดรูปแบบเสมือนจริงที่มีต่อทักษะการคิดเชิงบริหาร 5 ด้าน ประกอบด้วยความจำเพื่อการใช้งาน การยั้งคิดไตร่ตรอง การยืดหยุ่นความคิด การควบคุมอารมณ์ และการวางแผน โดยใช้ระเบียบวิธีวิจัยกรณีศึกษาเดี่ยวแบบผสมระหว่างการวิจัยแบบ ABA Single-Case Design และ Qualitative Single-Case Design ในเด็กที่มีภาวะออทิสซึม กิจกรรมดนตรีบำบัดออนไลน์จัดขึ้นทั้งสิ้น 8 ครั้งสำหรับเด็กชายที่มีภาวะออทิสซึมอายุ 5 ปีและมารดา เครื่องมือที่ใช้ในการวัดผลได้แก่ แบบประเมินพัฒนาการด้านความคิดเชิงบริหาร (MU.EF-101) และแบบประเมินปัญหาพฤติกรรมด้านความคิดเชิงบริหาร (MU.EF-102) คะแนนของทักษะการคิดเชิงบริหารถูกวิเคราะห์โดยใช้กราฟ แบบบันทึกการสังเกต และแบบสัมภาษณ์ผู้ปกครองถูกนำมาใช้เก็บข้อมูลเชิงคุณภาพของพฤติกรรมที่เกี่ยวข้องกับทักษะการคิดเชิงบริหารของเด็ก ผลวิจัยพบว่า ในช่วง Baseline A1 คะแนนเฉลี่ยของพัฒนาการด้านความคิดเชิงบริหารจาก MU.EF-101 เท่ากับ 94.50 และคะแนนเฉลี่ยของปัญหาพฤติกรรมด้านความคิดเชิงบริหารจาก MU.EF-102 เท่ากับ 60 ระหว่างช่วงบำบัด คะแนน MU.EF-101 เพิ่มมากขึ้นจนถึง 111 และคะแนน MU.EF-102 ลดลงจนถึง 38.5 ในช่วง Baseline A2 คะแนนเฉลี่ยของ MU.EF-101 เท่ากับ 112.50 และ MU.EF-102 เท่ากับ 34.67 จากผลวิจัยสรุปได้ว่า ดนตรีบำบัดรูปแบบเสมือนจริงมีผลต่อการส่งเสริมทักษะการคิดเชิงบริหารในเด็กที่มีภาวะออทิสซึม

คำสำคัญ: ดนตรีบำบัดรูปแบบเสมือนจริง ทักษะการคิดเชิงบริหาร ภาวะออทิสซึม

The Effect of Virtual Music Therapy Interventions on the Executive Function of a Child with Autism Spectrum Disorder: A Single-Case Study

Teeda Rupsuwan[1], Natee Chiengchana[2], *, and Ampai Buranaprapuk[3]

[1,2,3]College of Music, Mahidol University

* Corresponding Author, Email: natee.che@mahidol.ac.th

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Abstract

The purpose of this study was to investigate the effectiveness of Virtual Music Therapy Interventions on the Executive Function (EF) of five areas: working memory, inhibitory control, cognitive flexibility, emotional control, and planning of a child with an autism spectrum disorder. This study employed a mixed-method design of the ABA Single-Case and Qualitative research by using interviews. Eight online Music Therapy sessions were provided to the five-year-old boy with ASD. Executive Function Development Assessment (MU.EF-101) and Executive Function Behavior Assessment (MU.EF-102) were used to measure the EF. The EF scores were analyzed using visual inspection. Parent interviewing was used to collect qualitative data on the child's behaviors related to the EF. The results showed that during the baseline A1 phase, the mean score of EF development from MU.EF-101 was 94.50 and EF's problematic behaviors from MU.EF-102 was 60. Between the intervention phase, the score of MU.EF-101 continuously grew over time to 111, while the score of MU.EF-102 declined gradually to 38.5. During the baseline A2 phase, the mean score of MU.EF-101 was 112.50 and MU.EF-102 was 34.67. According to the findings, Virtual Music Therapy Interventions can enhance the executive functions of a child with an autism spectrum disorder.

Keywords: Virtual Music Therapy, Executive Function, Autism Spectrum Disorder

Background of the study

Executive Function is the function of the brain associated with cognitive skills. EF helps people with the planning and organization of daily activities, as well as problem-solving and language abilities. There are three fundamental cores of EF: inhibitory control, working memory, and cognitive flexibility (also called shifting) (Collins & Koechlin, 2012). Preschool children's readiness and academic achievement are depending on EF (Welsh, Nix, Blair, Bierman, & Nelson, 2010). As a result, preschool intervention programs aiming to improve EF are necessary. Repeated training, increasing difficulty, bimanual coordination, and a positive social/emotional context are essential components of effective treatments for young children. These components were combined to create programs that were most likely to affect children's Executive Function (Diamond & Lee, 2011). All those elements should be included in a comprehensive early childhood music program. Early childhood music training that emphasizes bimanual coordination in gross motor movements may help with inhibiting performance on complex tasks (Bugos & Demarie, 2017). Learning to play a musical instrument has been related to improved cognitive skills and Executive Function (Preda-Uliţă, 2016). In the brain areas, music, and movement activities, as well as Executive Function skills, are linked to prefrontal cortex regions. When listening to rhythms, brain networks were activated. If children were given adequate activities (such as music and movement), they could develop stimulation in the prefrontal cortex's brain region, brain network, and neural activity, specifically in the Executive Function parts of the brain (Artprom, Chumchua, Jutapakdeegul, & Thanasethakon, 2014)

Executive Function developmental impairment is common in children with autism spectrum disorder (Hill, 2004). These problems may result in aggressive behavior, planning difficulties, and difficulty adapting to changing situations, and they may impact children's everyday activities and learning. Granader et al. (2014) found EF issues in children with ASD. They have trouble adapting to new environments, accepting changes, and altering their focus. As a result, EF interventions are required for them.

EF treatments for people with autism spectrum disorders include Cognitive Behavioral Therapy (CBT), computer training, medications, and biofeedback (Wallace et al., 2016). There have been a few studies from music therapists that used music programs or interventions to improve working memory and inhibitory control components of EF. Music Therapy appears to affect EF in non-targeted ASDs, according to meta-analysis research. Häring (2018) reported that the study participants in 10 out of 12 Music Therapy research articles were healthy children and senior groups who actively participated in the music-making process. The other two studied people who have EF problems resulting from traumatic brain injuries. It was shown that Music Therapy might be used as an alternative method to train EF and assist those with EF impairments. Nevertheless, there was lacking research studies for a child with ASD to enhance all fives components of EF: working memory, inhibitory control, cognitive flexibility, emotional control, and planning in one intervention conducted by certified music therapists

For children with ASD, Music Therapy is an effective intervention. Music Therapy interventions with children with ASD have been demonstrated to be useful for a variety of goals, including social, communication, and behavior, as well as emotional, physical, intellectual, and leisure skills (Thaut & Hoemberg, 2014). Music Therapy was applied to promote positive behavior in children with ASD. (Wigram, Pedersen, & Bonde, 2002) found that Music Therapy had an impact on the children's behavior. Music was used to change and shape children's behaviors.

In this research, the researcher examined interventions based on the Principles for EF rehabilitation, Behavioral Music Therapy approach, and Virtual Music Therapy (VMT) model to improve EF in children with ASD. This study can contribute to music interventions to enhance working memory, inhibitory control, cognitive flexibility, emotional control, and planning components of Executive Function for children with ASD while considering the use of virtual Music Therapy services.

Purpose of the study

The purpose of this study was to investigate the effectiveness of Virtual Music Therapy Interventions on Executive Function consisting of five areas: working memory,

inhibitory control, cognitive flexibility, emotional control, and planning of a child with an autism spectrum disorder.

Definition of terms

Music Therapy is the clinical use of music including music elements with therapeutic relationships to enhance an individual's non-musical goal. The physical, emotional, social, communication, and spiritual needs of a client will be achieved through music activities, listening, singing, instrument playing, composing, and song analysis which are based on evidence and designed appropriately for individuals, families, communities and/or organizations. All Music Therapy sessions must be provided by credentialed music therapists (Davis, Gfeller, Thaut, & American Music Therapy, 2008).

Virtual Music Therapy (VMT) is an alternative method of conducting Music Therapy online sessions, based on telehealth services. VMT services are usually offered virtually via phone and video conferencing. Knott and Block (2020a) developed a model designed to support VMT services. The model represents an approach to develop accessible and appropriate VMT services for clinicians' goals of care. In this study, the interventions were blended between the cognitive rehabilitation of EFs principles and the Behavioral Music Therapy approach. And, they were delivered based on the VMT model to consider the clinical goals and assure that the online platform is as accessible, appropriate (taking into consideration the patient's abilities), and effective as possible to meet the patient's needs.

Executive Function is the brain function involved with cognitive skills. EF include ability to control responses (Inhibition), to manipulate information (Working Memory), to adapt (Cognitive Flexibility), and to plan (Planning) (Goldstein & Naglieri, 2014). EF are important skills for mental and physical health; success in school and in life; and cognitive, social, and psychological development. In this study, there are five EF components to be selected including:

1. Working memory is the ability to store and handle information for a short duration of time to perceive situations and come up with solutions.

2. Inhibitory control refers to the ability to inhibit or control impulsive thoughts, actions, or feelings that irritate or annoy others. It includes the ability to focus on work and avoid thinking about unrelated topics.

3. Cognitive flexibility (also called shifting) refers to the ability to transit between several thoughts, tasks, or tactics.

4. Emotional control is the ability to deal with emotions by expressing or responding emotionally to the situation in an appropriate way.

5. Planning is the ability to think about the future or reasonably assume the best approach to complete a task or achieve a goal. It contains the operation process until a task is accomplished, breaking a task into steps, management tools, and time efficiently and flexibly.

Autism spectrum disorder is a group of complex neurodevelopmental disorders presented with the impairment of social communication, interaction, and restricted, repetitive behavior and interest. The child with an autism spectrum disorder in this study was a five-year-old child who had been diagnosed by a doctor and had been in daycare, kindergarten, or school for at least 3 months.

Conceptual framework

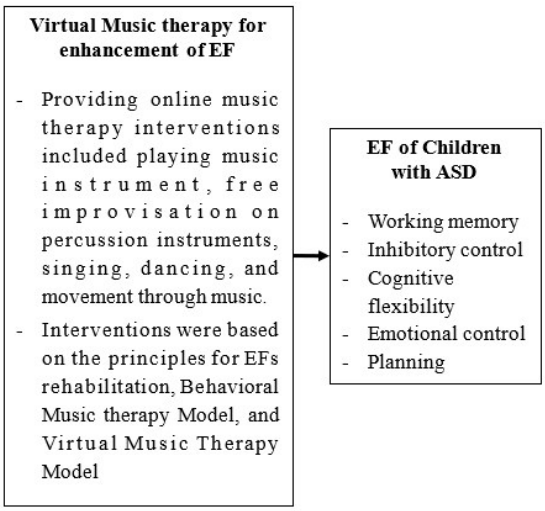

Figure 1 Conceptual framework

Methodology

This study is a part of a Master's thesis, College of Music, Mahidol University and received ethical approval from The Committee for Research Ethic (Social Sciences), Faculty of Social Sciences and Humanities, Mahidol University [MUSSIRB No.2021/068

(B1)]. The single-case experimental design and the qualitative design were employed to answer the research questions as a mixed-method design that involves the collection, analysis, and combining in of both quantitative and qualitative data to best understand a research problem (Creswell, 2008). The single-case experimental design is a quasi-experimental design in which an intervention (or independent variable) is delivered to a small number of participants. (Lobo, Moeyaert, Baraldi Cunha, & Babik, 2017). For this study, a reversal ABA single-case design was employed to study the effects of Music Therapy interventions on the Executive Function of the child with ASD. A reversal design consisted of an alternation of two baselines (A1, A2) and one intervention (B) phase. The baseline condition (A1, A2) was operated to observe the child's EF. The interventions (B) were music interventions designed to improve the EF of the child with ASD. The reversal design allows the determination of a causal relationship between the intervention and result because this design presents two different points in the relationship (from A1 to B and from B to A2).

In terms of the qualitative design, interview method was used to examine the child's behaviors related to the EF before and after the Music Therapy interventions. The interview data were collected from the mother.

There were seven steps of research procedure as follows: 1) Recruiting the participant. 2) Interviewing the mother before the baseline A1 data collection. 3) Instructing the father and the mother to use MU. EF-101 and MU. EF-102 assessment tools 4) Testing the reliability of the father and mother (try-out phase for determining the reliability) 5) Collecting baseline A1 data from the first to the third session. 6) Providing Music Therapy Intervention (B) from the fourth to the eleventh session. 7) Collecting baseline A2 data from the twelfth to the fourteenth session. 8) Interviewing the mother after the baseline A2 data collection.

Participants

There were two types of participants.

1. The child: A five-year-old boy who was diagnosed with autistic spectrum disorder by a physician. Based on the SCERTS Model (Barry et al., 2006), the inclusion criteria encompassed using words and word combinations to express meanings, understanding relational words without contextual cues, and following at least three different instructions.

The child's mother found an online invitation poster given to Mahidol University's National Institute for Children and Family Development and contacted the researcher to participate in this study. The child was the only child in his family. He used to attend a kindergarten and studied in the kindergarten level two (K2) program. He has less social connection with his classmates. During the COVID-19 pandemic, he did not go to the kindergarten because it was temporarily shuttered. He continued to have online kindergarten classes twice a week.

2. The parents: The father and mother of the child were included in this study. The purpose was to evaluate the child's EF behavior before, during, and after the intervention. The mother attended every music intervention session with the child to prepare the material and room for the session and support him during music activities.

Dependent Measures

Executive Function Development Assessment (MU.EF-101) and Executive Function Behavior Assessment (MU.EF-102) are EF assessment tools for childcare or kindergarten teachers developed by the Institute of Molecular Biosciences, Mahidol University. These tools are standardized rating scales that evaluate the frequency of EF behavior of children aged 2-6 years old in a classroom setting. MU. EF-101 measures the frequency of EF positive behaviors, while MU. EF-102 can be used to assess EF's problematic behaviors.

Each tool comprises a total of thirty-two questions that cover all five domains of EF which include inhibiting, flexibility in thought (shifting), emotional control, working memory, and planning (Jutaphakdeegul, Thanasethakorn, & Lerdawasadatrakul, 2017). The assessment tools were published in Thai language. The scores were graded from 0 to 4 according to how often the child's certain behavior appears, for example:

0 means never

1 means rarely (1-2 times/month)

2 means sometimes (1-2 times/week)

3 means often (3-4 times/week)

4 means always (every day, every time)

The researcher had permission from the owner of MU.EF-101 and MU.EF-102 to alter the assessment scorer from a teacher to two parents (the father and the mother)

because, in this COVID-19 situation, Thailand's Ministry of Education declared the closure of educational institutions, and the child was unable to attend a school or meet with a teacher. There is no change in the questionnaire of MU.EF-101 and MU.EF-102, but the researcher changed the assessment context from school to home instead.

Furthermore, the researcher conducted try-out phase of the assessment tools for determining the reliability with the father and the mother. The researcher used a video conference to instruct the father and the mother on how to score the MU.EF-101 and MU.EF-102 and explained the EF components, EF-related behaviors, and the details of the MU.EF-101 and MU.EF-102 questions. Clear guidelines and processes were presented for scoring and ensuring that behaviors are clearly described. The parents evaluated their child one time in this try-out phase. The researcher organized a second video conference with the parents to compare and discuss the scores.

During the try-out phase, inter-rater reliability of MU.EF-101 and MU.EF-102 was very high and statistically significant (MU.EF-101, $r = 0.886$, $p < .01$ and MU.EF-102: ($r = 0.852$, $p < .01$). From the first to the fourteenth session, the researcher continuously measured the reliability of the father and the mother. Inter-rater reliability of MU.EF-101 was a high and statistically significant correlation ($r = 0.807$, $p < .01$). Besides, the inter-rater reliability of MU.EF-102 was a very high and statistically significant correlation ($r = 0.913$, $p < .01$). The results revealed a significant relation between the father and the mother.

Interview protocols

In terms of qualitative research design, the interview was to collect qualitative data on the child’s EF behaviors. His mother was interviewed two times before the baseline data collection (A1) and after the baseline data collection (A2). Before the baseline data collection (A1), the researcher interviewed the mother about the child's general information, education, environment, routine, development, and EF behavior. The results of the interview were used to develop treatment and session plans for the child. After the baseline data collection (A2), the researcher questioned the mother to gather further thoughts regarding her child’s changes in EF behavior. It took about 45 minutes for each interview. During the interview, his mother was asked permission for recording the interviews.

Baseline data collection (A)

During the baseline data collection (A), there was no Music Therapy Intervention for the child. the father and the mother observed the child's EF behaviors and assessed him with MU.EF-101 and MU.EF-102 in his daily routine and play situation at home. From the first to the third session, baseline data A1 were collected three times, and baseline data A2 were obtained from the twelfth to the fourteenth session.

Music Therapy Intervention (B)

Music Therapy Intervention is based on three approaches: EFs rehabilitation principle, Behavioral Music Therapy approach, and Virtual Music Therapy (VMT) Model. In EF training, music integrates emotional and cognitive processes and stimulates the person to stay on task (Thaut & Hoemberg, 2014). Music affects the brain region associated with EF during the rehabilitation process. When linked to specific tasks, music provides cues and reminders. Music also allows a person to stay on target by providing time, grouping, and organizing for an activity framework. In the Behavioral Music Therapy approach, music can serve as a cue, a structure for physical movement, a focus of attention, and a reward. To promote behavior changes, a music therapist uses both music and the therapist's self (Wigram, Pedersen, & Bonde, 2002). Furthermore, because the worldwide coronavirus pandemic has disrupted standard intervention delivery models, the researcher needed to modify Music Therapy into a virtual Music Therapy (VMT) intervention to lower the danger of contracting or spreading the coronavirus. Music therapists from the United States of America, Knott, and Block (2020b), have devised a three-tiered scaffold model to enable the development of virtual Music Therapy (VMT) services based on telehealth services. The model outlines a method for establishing accessible and appropriate VMT services that help clinicians achieve their objectives.

The child and the mother attended virtual Music Therapy sessions twice a week for four weeks (30-45 minutes each session), for a total of eight sessions, from the fourth to the eleventh session. In all sessions, the researcher was the music therapist.

By asking the child or the mother, the music therapist selected music from the child's musical preferences. The music was mainly live because its elements can be

changed during a session. Tempos and dynamics were changed by the child' s emotional expression and his movement. In a session, live music allows the child to interact with the therapist (Robb, Burns, & Carpenter, 2011). The online sessions were recorded by a video calling application.

Every session included the following strategies:

Before beginning the session, the researcher explained the activities and the role of the mother in the session. Sessions were regularly divided into three parts.

The first part began with a greeting. The music therapist sang a hello song to orient the child, create a friendly environment, and develop therapeutic relationship.

The second part was mainly focused on developing EF behavior in five areas. Thaut and Hoemberg (2014) explained that music brings several dimensions to the process of developing EF. It activates the brain and shared brain circuits that help the frontal lobes in the EF area and increases the level of brain activity required to complete the EF task. It provides real cues and prompts to complete required tasks. It provides timing, grouping, and structure to help the person stay focused. Therapeutic music activities provide a task process and task product in real time. Music connects affective and cognitive processes in EF training and increases motivation to keep the person on task. Activities in this part consisted of music-making activities such as instrument playing, singing, movement through music, and musical games. The therapist played live music by singing and playing the guitar and delivering cues to help the child sing together. The therapist adjusted the rhythm, tempo (speed), and dynamics in the same song as the child became familiar with it. Then, the therapist allowed the child to select his musical instruments and played together under the session plan structure. The child's favorite music played a major part in motivating him to complete the task. The therapist provided live or recorded music for music-based movement and musical games. The child was supported in moving together by the therapist and the mother. The music's speed and rhythm set a time frame for body movement, while lyrics instruct movement direction and phrases indicate stop-and-go cues. The therapist created a musical game by combining movement and cognitive skills. The child and the mother were encouraged to participate after the therapist demonstrated the game rules.

The final part was a farewell. The researcher ended the session by singing a goodbye song.

After the session, the researcher provided feedback to the mother and discussed the child's behavior in the session, particularly EF-related behaviors, and interviewed her about the session feedback and advised her to use music interventions with children as a daily routine at their home.

Data Analysis

1. Visual Analysis: Within each phase, the data were evaluated for level, trend, and stability, followed by an examination of the immediacy of effect, consistency of data patterns, and overlap of data between baseline and intervention phases (i.e., between-phase comparisons). Matthew et.al., (2008) concluded that the changes in behavior are the result of the implemented treatment and are significant for improvement when the changes in level are in the desired direction, significant, immediately noticeable, and sustained over time.

2. Interview Analysis: In addition, the researcher used interviewing at pre- and posttreatment to collect qualitative data on EF behaviors collected from the child's mother. The researcher followed Creswell (2013) six steps of qualitative data analysis. 1) Organizing the data through transcribing interviews. 2) Reading all data to understand the overall meaning. 3) Coding the data by categorizing text and labeling the categories with terms which are five components of EF: Working memory, inhibitory control, cognitive flexibility, emotional regulation, and planning. 4) Using the coding process to describe the participant, setting, and theme of EF behavior. 5) Advancing how themes and descriptions will be represented in the qualitative narrative. 6) Interpreting of the findings.

Results

The results were divided into two parts. 1) Result of the visual analysis of Executive Function presented the result from the dependent measure, MU.EF-101 and MU.EF-102. 2) Result of the interview analysis described the narrative results of the child with ASD's EF development.

1. Result of visual analysis of executive function

In all sessions, the scores from the Executive Function Development Assessment (MU.EF-101) and Executive Function Behavior Assessment (MU.EF-102) were analyzed using visual analysis. The MU.EF-101 assesses the frequency of EF positive behaviors, while the MU.EF-102 measures the frequency of EF's problematic behaviors.

Each score was the average of EF score from the father and the mother. Graphing lines between points were used to show changes in the level, slope, and trend of the EF score. A line graph showing the results from the first baseline session to the last treatment session is provided below.

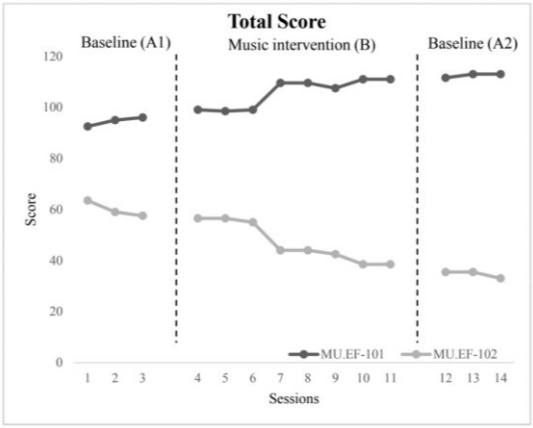

Figure 2 Overall scores of MU.EF-101 and MU.EF-102 during baseline phase and Music Therapy Intervention phase

During the baseline A1 phase, the mean score (out of 128) of MU.EF-101 was 94.50 and MU.EF-102 was 60. In intervention phase, data points of MU.EF-101 increased slightly above the mean of baseline sessions. Within the 4th session and the last session, MU.EF-101 score has risen consistently. At the start of the intervention period, the score was 99. It rose to a peak of 111 in the last intervention session. In contrast, MU.EF-102 score started at 56.50 and decreased steadily until the end of the intervention phase at the lowest score of 38.5. The mean of MU.EF-101 across intervention phase was 105.63, with a range of 98.50 to 111. On the contrary, the mean score of MU.EF-102 during sessions was 46.94, with a range of 38.50 to 56.50. During the baseline A2 phase, data points were quite stable. The mean score (out of 128) of MU.EF-101 was 112.50 and MU.EF-102 was 34.67.

The result of these opposing trend showed that Virtual Music Therapy Interventions improved the child EF development and decreased EF's problematic behaviors.

2. Result of interview

Parent interview before the interventions

The mother noticed that the child's EF skills were good because he remembered words and songs rapidly. When he had two or three procedures to a task, he was able to complete it correctly with some verbal prompt from parents. He normally worked for 2 to 5 minutes at a time.

In inhibitory control, he only engaged in his favorite activities, such as playing with toys, playing musical instruments, and listening to children's books. He could do fine motor skills activities and school paper sheets only for a brief period and then lost his interest. The surrounding environment easily distracted him. During his time in the room, he was completely ignorant that he was bothering others. He did not always stop when his parents told him to. Even though the parents had warned him, he interrupted them while they spoke.

In cognitive flexibility, he needed some time to adjust to new people. He did, however, adapt himself well when visiting new places. If he came across something interesting, he swiftly adapted himself and explored. He became irritated if the environment was excessively noisy or gloomy.

In emotional control, he was in a pleasant mood most of the time. Unless he was confronted with a frustrating situation, in which case he moaned loudly. He was not aggressive or hurting people. He gradually relaxed once his parents calmed him down or distracted him.

In planning, he completed assignments under the supervision of his parents. He could not start the tasks on his own. He struggled to do routine tasks efficiently. He usually refused to eat during mealtime.

Parent interview after the interventions

After the interventions, the child's EF skills were reported by the mother.

The mother found that a noticeable change was the child's attention which is based on working memory and inhibitory control skills. In the past, if he could not

complete a task or activity, he would quit it. He used to sit and do the table tasks for only 2-5 minutes before participating in this study. Recently, he could currently sit and do the activity for an average of 10 minutes.

In cognitive flexibility, he could adapt to a variety of situations. He could be in some loud settings, but he was not entirely at ease. He would occasionally mention about toys or books he wished to buy, but he did not whine. He could change the subject after his mother told him that he could not buy it and that he could only play it at school.

In emotional control, he had a noticeable ability to regulate his emotions. When he became frustrated while working on the task and realized that he could not complete it, he tried to do it without complaining.

In planning, the mother observed that the child's planning and organization skills had improved. He recently began putting his toys and stuff back in their proper places after completing his play or task. He recognized that there was the cleaning step he needed to do once everything else had been completed. When it was time for him to eat, his mother sang the "sit and eat" song. The child was more cooperative and came to the table to sit for a while. In the past, he often refused to sit at the table and eat. Recently, he came to sit more frequently now.

The findings from both visual analysis and parent interviewing indicated that the child had a positive outcome after attending the Virtual Music Therapy Intervention sessions. He had better EF development and fewer EF's problematic behaviors.

Discussion and Recommendation

Data points were constant during baseline sessions. After the child had the intervention sessions, the MU.EF-101 data points gradually increased above the mean of baseline sessions. On the other hand, the MU.EF-102 score declined continuously until the end of the intervention session.

The results could be discussed in five areas of EF. In working memory, singing and instrument playing activities were effective. The basic repetitive tune and lyrics could help individuals with autism spectrum disorder remember songs (Davis, Gfeller, Thaut, & American Music Therapy, 2008). When combined with modeling and cueing, it proved even more effective (Colwell & Murlless, 2002).

In inhibitory control, instrument playing and movement with music activities were often used to encourage the child to take a turn and play with a stop-and-go song. It was matched with (Thaut & Hoemberg, 2014) that songs encourage the child to focus and stay on task by providing time and organization.

In cognitive flexibility, instrument playing, movement with music activities, and musical games were usually selected. The researcher adjusted the rhythm, tempo (speed), lyrics, and especially dynamics to give vary of musical cue. The child learned to adapt himself to what he heard and to be flexible when playing with others.

In emotional control, singing and movement with music activities helped the child to calm down, express his feeling, and learn how to deal with his negative emotions. According to Saarikallio (2009), the results implied that music activities significantly helped young children at age 3 to 8 years old, to calm down, keep attention and interest.

In planning, singing and movement with music activities with newly composed songs about his behaviors and activities in daily living could helped him process his tasks. According to Fuster (2002), music and movement could increase the activation of the prefrontal cortex brain area, which related to Executive Function skills (i.e., planning/organization).

To discuss the intervention strategies, the researcher used EF rehabilitation principles (Burgess & Robertson, 2002) and Applied Behavior Analysis (ABA) (Wigram, Pedersen, & Bonde, 2002) principles to provide reinforcement, motive cue, structure, concentration, and a reward. There were various processes that EF rehabilitation and ABA have in common. First, when the child demonstrated positive EF behaviors, such as focusing on playing the song until it ended, the researcher immediately complimented him on his ability to focus and sometimes provided him the music he wanted when the activity was completed. Positive reinforcement was applied in the form of compliments and music to enhance EF behaviors and motivation. Second, the researcher prompted the child to do tasks when he did not want to or could not do, and to re-orient himself. Prompts included gestural, full physical, partly physical, verbal, visual, and positional prompts, as well as musical prompts, such as repeating the instruction, holding his hand to complete the activity, and providing a clear musical

phrase for him to continue.Third, when it came to the task process and teaching, the researcher used task analysis to break down the entire task into step-by-step activities, with easy and clear instructions to guide the child through each step. Furthermore, in EF principles, Burgess and Robertson (2002) suggested assessing and treating EF needs throughout the session. When the child's EF behaviors were examined, the researcher changed the stages of activities to meet his needs, such as when he couldn't control himself enough to play a song all the way through, the researcher chose only a few lines from the song to play. Burgess also recommended practicing basic skills such as working memory, inhibitory control, and cognitive flexibility, which are the three main cores of EF. Every activity was created with those three cores in mind, with additional skills on emotional control and planning.

Virtual Music Therapy (VMT) was used as another strategy. To meet the standard recommendations of telehealth service, the researcher followed the standards and practice considerations (Knott & Block, 2020b). To connect and access the session, the mother utilized a smartphone. As indicated by the VMT guideline, the researcher employed a laptop with a camera as the primary computer and a USB-powered condenser microphone to improve the quality of the therapist's audio conveyed to the client. The researcher used the VMT model to consider and prepare the appropriate sessions. But the VMT model does not mention about how MT should advise the client or caregiver to prepare themself for the session.

Unlike the VMT model from Knott and Block (2020b), the researchers found a further consideration in the role of parents or caregivers. Because the child with ASD is unable to attend online sessions on his own, he must attend with his parent. As a result, parental roles were critical prior to, during, and following virtual Music Therapy procedures. Before the interventions, the researcher discussed her responsibilities with the mother, including setting up the equipment and room atmosphere, providing suitable cues to assist the child in the session, and encouraging and complimenting the child to enhance EF behaviors and motivation. The mother assisted the music therapist in developing a therapeutic relationship with her child in the early sessions by introducing him to the therapist. The researcher occasionally directed the mother to provide the child with a visual or physical prompt, such as a demonstration or holding

the child's hand to play the instrument. After the child finished the step and demonstrated EF behaviors, the mother praised him. When the child's attention was taken from the task, he stopped playing or singing and occasionally whined. By talking or hugging him, his mother was able to calm him down. As a result of the interaction between the child and his parent, he became calmer and more focused on the activity. This finding replicates an earlier study showing that interaction between parents and children created a safe environment for children (Bunt & Pavlicevic, 2001). After the interventions, the researcher suggested that the mother join the child in music activities at home and sing songs from the sessions to improve his behavior in everyday life. For instance, the "Put away" song, "Sit and Eat" song, and "Bedtime" song. This finding was consistent with the findings of Haine-Schlagel and Walsh (2015), who indicated that caregivers could have a significant influence in determining the course of treatment for kids.

For the advantages and disadvantages of virtual music therapy, the study discovered that VMT allowed children with autism to receive treatment without the risk of spreading coronavirus during the epidemic. Because the parent was required to participate in the sessions, the child and the parent could interact and form strong relationships. And the parent could see the beneficial effects of music therapy. VMT reduced the need to travel. It may reduce travel-related stress. As a result, the therapist and participants had more time to prepare and refresh themselves before the session. There was significantly more flexibility and time available for session planning due to the lack of travel time. VMT also enabled the use of digital media, such as recorded music, music videos, and images for a story or song selection. However, before using any media, the music therapist must consider music licensing and copyright considerations. Another advantage of VMT was the function to record the session video. The music therapist could simply record the session using the video conference application. It was also used to record the music therapist's original music video, which could then be given to the parents.

The primary disadvantage of VMT was the lack of physical contact because the researcher and the participants were not in the same room at the same time. The researcher could not always hear and interpret the individuals' nonverbal expressions. As

a result, the researcher was challenged to determine the appropriate timing for interventions and modify the music aspects to fit the child's behavior and need. This issue may interfere with interaction and engagement, as indicated by the child's occasional distraction. The narrow field of vision created an additional challenge. A camera displayed one perspective of the scene at a time, and it had few degrees of vision for people to look at each other. The music therapist could only view the child's front. If the child stepped away from the screen, the music therapist could not track him for a while until the mother turned the camera on him. Another concern was the time lag caused by an unstable internet connection, which made it more difficult to play with the child. The researcher must maintain a high level of concentration to play music and sing steadily.

One limitation of the study is the small number of subjects related to the absence of a parallel control group. Another limitation is that the assessment was done by two weeks after the intervention with no follow-up. The researcher recommended that future studies might conduct traditional (onsite) Music Therapy interventions for children with ASD of the same age and level of language, and behavior. The virtual Music Therapy Intervention improved five EF components in children with ASD, according to the findings. The effectiveness of interventions in other domains of EF could be studied in the future.

Conclusion

Virtual Music Therapy can enhance the Executive Function of a child with autism spectrum disorders. This child could practice his working memory, inhibitory control, cognitive flexibility, emotional control, and planning through various musical activities, including instrument playing, singing, movement through music, and musical games. The music therapist must build a therapeutic relationship with the child and encourage the parent to support the child with appropriate prompts. The use of music that the child was familiar with and newly composed songs that have simple melodies and lyrics motivated the child to join music activities, memorize the song, and develop EF behavior through music. VMT provided opportunities for the child with ASD to receive the interventions without the risk of spreading coronavirus during the pandemic. However, the lack of physical contact affected the interaction between the therapist and the

child. Thus, the therapist should work together with the parent. The mother had an important role to prompt, comforting, and encouraging her child while doing music activities.

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