



**MUSIC-BASED INTERVENTION  
FOR AUTISM: A TWO-YEAR LONGITUDINAL  
CASE STUDY WITH PARENTAL COLLABORATION**

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**Abstract:**

Music therapy (MT) has been increasingly recognized as a supportive intervention for individuals with autism spectrum disorder (ASD), particularly in encouraging social communication, emotional regulation, and engagement. Research studies suggest that music therapy is most effective when it emphasizes individualized pacing, empathetic resonance, and active caregiver involvement. Building on this literature, the present study reports a two-year longitudinal case study of an individualized piano based music program for a child with autism and intellectual disability. Using parent interview data, weekly documentation of instructional materials, review of recorded piano practice, and reflective qualitative analysis, the study examines how sustained musical engagement, supported by structured home practice and parental collaboration, contributed to executive functioning, emotional resilience, and social bonding. Findings highlight the value of personalized instruction, consistency over time, and parent-mediated learning in extending therapeutic benefits beyond formal sessions. Implications for music-based intervention practice and family-centered approaches are discussed.

**Keywords:** music therapy, autism spectrum disorder, neurobiology of musical cognition, parent-child interaction, emotional regulation, social communication

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## 1. Introduction

The National Institute of Neurological Disorders and Stroke (2019) defines Autism Spectrum Disorder (ASD) as a “*complex neurodevelopment disorder characterized by repetitive and characteristic patterns of behavior and difficulties with social communication and interaction.*” Autism spectrum disorder (ASD) involves core challenges in social communication, sensory integration, and behavioral flexibility (American Academy of Pediatrics, 2020). These challenges often extend beyond the individual, influencing family relationships and daily dynamics. Families with autistic children may experience heightened levels of stress due to behavioral regulation difficulties, sibling relationships, limitations on leisure activities, and disrupted social opportunities.

Over the past two decades, music therapy (MT) has been gaining acknowledgement as a therapeutic method that combines the rhythmic, emotional, and relational dimensions of music to promote engagement, communication, and socioemotional development (Kim *et al.*, 2008). Neuroscientific research demonstrates that music engages brain networks involved in emotion regulation, attention, and auditory–motor coordination, supporting its potential as an integrative intervention (Koelsch, 2014). Despite variations in intervention protocols, an abundance of evidence converges on the effectiveness of music therapy in improving attention, social responsiveness, and parent–child interaction, while also supporting broader emotional and behavioral regulation in autistic children (Geretsegger *et al.*, 2022).

## 2. Purpose of Study

Although many pieces of literature document the potential benefits of music therapy for individuals with autism spectrum disorder, fewer studies examine how individualized, long-term music-based methods develop in instructional contexts with sustained parental involvement. Without enough music knowledge or skills, parents of children with autism may unintentionally implement music activities inappropriately or beyond their child’s developmental capabilities. In addition, little research exists to investigate the effect of music programs designed specifically for parents of children with autism. The purpose of this study is to explore how a two-year individualized piano-and theory-based music therapy with parental involvement supported the cognitive, emotional, and relational development of a child with autism and intellectual disability.

This case study focuses on the lived experiences of both the child and the parent, with particular attention to instructional methods, relational attention, and home-based practice. The study seeks to address the following research questions:

- 1) How did sustained participation in an individualized music-based program influence the child’s attention, learning behaviors, and emotional regulation over time?
- 2) What role did parental involvement play in supporting engagement, skill development, and emotional resilience?

- 3) What is the lived experience of a parent engaging in their autistic child's music-based intervention?

### 3. Literature Review

Music-based interventions have been widely explored as supportive approaches for children with autism spectrum disorder (ASD), especially in social communication, emotional regulation, and engagement. Across randomized controlled trials and mixed-method studies, music therapy has demonstrated consistent benefits for foundational social behaviors such as joint attention, eye contact, participation, and turn-taking. However, effects on global symptom severity have been more variable, suggesting that outcomes may depend less on intervention type alone and more on individualization, relational quality, and contextual factors.

Controlled and randomized studies have consistently shown the benefits of music therapy on social behavior. One of the earliest controlled investigations demonstrated that improvisational music therapy established significantly greater improvements in nonverbal joint attention behaviors compared to toy-based play, including increased eye contact and sustained turn-taking (Kim *et al.*, 2008). These findings suggested that musical interaction may be particularly effective in engaging children who struggle with conventional social demands.

However, large-scale trials have tempered expectations regarding generalized symptom reduction. The TIME-A multicenter randomized clinical trial, involving over 360 children across nine countries, found no significant differences between improvisational music therapy and enhanced standard care on global autism symptom severity (Bieleninik *et al.*, 2017). Although modest improvements occurred across both groups, they fell below clinically meaningful thresholds. This study underscored the limitations of uniform intervention models and emphasized the need for individualized, context-responsive approaches.

More recent studies suggest that structured and culturally adapted music-based programs may yield stronger outcomes for specific social and communicative skills. Group-based interventions incorporating rhythmic play, turn-taking routines, and predictable musical structures have demonstrated improvements in communication, sociability, and language development in preschool-aged children (Zhou *et al.*, 2025; Fan *et al.*, 2024). Collectively, these findings indicate that music-based therapy may be most effective when they target clearly defined social processes rather than global symptom severity.

Additionally, research underlines the significant role of relational engagement and caregiver involvement in music therapy. Family-centered music therapy models emphasize shared musical experiences, parental involvement, and the integration of music into everyday routines. In a randomized controlled study of young children with severe ASD, family-centered music therapy produced significant improvements in social-

emotional functioning and parent-child bonding, even when broader language and social responsiveness measures showed limited change (Thompson *et al.*, 2013).

Similarly, mixed-method studies integrating parent-child music therapy with established behavioral interventions have reported mutual benefits for children and caregivers. For example, parent-child Orff-based music therapy combined with applied behavior analysis resulted in reduced autism symptom severity, lower parenting stress, and improved family functioning, ultimately increasing emotional connection and engagement (He *et al.*, 2024).

Relational music therapy methods further support this perspective by emphasizing moment-to-moment interaction, emotional co-regulation, and nonverbal communication. Research has shown that such relational musical engagement can selectively enhance nonverbal communicative behaviors in children with autism, particularly when interventions are responsive and flexible rather than performance-driven (Gattino *et al.*, 2011).

Across the literature, individualized pacing and active engagement consistently emerge as key moderators of effectiveness. Studies comparing instructional-based music therapy with passive music listening demonstrate that active musical interaction leads to greater improvements in global functioning and reductions in stereotyped behaviors (Rabeyron *et al.*, 2020). These findings reinforce the importance of intentional, interactive musical experiences over passive exposure.

Advances in neurological music therapy and technology-enhanced interventions further illustrate how music-based approaches can be adapted to specific developmental needs. Research integrating rhythmic movement, motor training, and digital musical interfaces has shown promising improvements in coordination, motor planning, and engagement, particularly for children with more severe support needs (Cibrian *et al.*, 2020; Williams *et al.*, 2024). Although many of these studies remain preliminary, they point toward the flexibility of music-based interventions across settings.

Neuroscientific evidence provides additional support for individualized and sustained engagement. Randomized studies incorporating neuroimaging have demonstrated that music-based interventions can strengthen auditory-motor connectivity and reduce atypical neural overconnectivity, with observed neural changes corresponding to improvements in social communication (Sharda *et al.*, 2018). These findings suggest that music-based interventions may support learning and regulation, especially when participation is sustained over time.

Taken together, prior research indicates that music-based interventions offer meaningful benefits for social engagement, emotional regulation, and parent-child interaction, while effects on global autism symptom severity remain mixed. Literature increasingly points to the importance of individualized instruction, relational understanding, active participation, and caregiver involvement in shaping outcomes. However, most controlled studies are limited in duration and cannot capture how music-based learning unfolds longitudinally within families.

To address this gap, the present study adopts a longitudinal case study approach to examine how an individualized piano-and music theory-based intervention with parental collaboration, impacted a child's learning behaviors, emotional regulation, and relational development over two years. The purposes of this study were:

- 1) to examine how an individualized music program influenced the child's behavior and development,
- 2) to examine the parent's use of educational materials from the lessons within their child's daily routines, and
- 3) to investigate the parent's perceptions regarding the benefits of program participation.

## **4. Method of Study**

### **4.1 Research Design**

Previous studies on music-based interventions have typically ranged in duration from approximately three weeks to a maximum of five months. In contrast, the present study seeks to explore the long-term effects of a music-based intervention on a child's behavior, social interaction, and family bonding. This study used a qualitative longitudinal case study design to examine the processes and outcomes of an individualized music-based intervention for a child with autism and intellectual disability. A case study approach was selected to allow for in-depth exploration of instructional practices, relational dynamics, and parent-mediated learning across two years. Informed consent was obtained from the participant's parent, and all identifying information was anonymized.

### **4.2 Participant**

The participant, referred to as Carl, was a child diagnosed with autism spectrum disorder and intellectual disability. He participated in weekly individualized piano and music theory sessions over a two-year period. His mother, referred to as Yang, played an active role in supporting practice and learning at home.

### **4.3 Intervention Context and Materials**

The intervention consisted of weekly individualized piano and music theory instruction delivered by the author. Sessions emphasize structured scaffolding, repetition, ear training, and gradual progression, with adaptations made to accommodate attention, pacing, and sensory needs. Model recordings were provided to support independent practice. Instructional materials included Basics of Keyboard Theory (Levels 1–4; Johnson, 2019) and Keith Snell Piano Repertoire (Preparatory Level–Level 1; Snell, 1997). These materials were deliberately selected to support sequential skill development and reinforce foundational musical concepts over time.

#### 4.4 Data Collection

Primary data was collected through a parent interview conducted after the completion of the two-year period. The interview consisted of 20 open-ended questions designed to reflect on instructional methods, parental involvement, child engagement, skill development, and emotional changes over time. Informed consent was obtained, and identifying details were removed to maintain confidentiality. In addition to interview data, the weekly documentation of instructional material usage and video-recorded the child's piano practice and performance activities throughout the intervention period, providing longitudinal data to support the analysis.

#### 4.5 Data Analysis

Interview responses were analyzed using thematic analysis. Recurring patterns related to learning processes, emotional regulation, parental mediation, and relational growth were identified and organized into key themes that structure the presentation of findings. Weekly documentation of music assignments and video recordings served as supplementary data sources to enhance the credibility and depth of the thematic interpretations and to provide longitudinal evidence of instructional engagement, skill progression, and behavioral changes over time.

To strengthen the credibility and trustworthiness of this qualitative case study, multiple data sources were used to triangulate findings and capture the child's development over time. Data sources included:

- 1) A semi-structured parent interview consisting of 20 open-ended questions was conducted at the conclusion of the two-year intervention.
- 2) Video recordings of piano practice and performances, collected weekly across the two-year period, allowing for longitudinal observation of musical, attentional, and behavioral development.
- 3) Instructional artifacts, including annotated lesson notes and assigned repertoire materials.
- 4) Observational reflections written by the instructor following weekly sessions, focusing on attention, emotional regulation, persistence, and interaction.

Using multiple sources enabled methodological triangulation by comparing parent perceptions with direct observational and recorded evidence. This approach provided a more comprehensive understanding of developmental progress than interview data alone, allowing patterns to be examined across time and contexts.

### 5. Results

Carl, a child with autism and intellectual disability, engaged in two years of individualized piano and music theory sessions with the first author, a pianist sensitive to neurodiversity. Initially reliant on imitation and rote memory, Carl gradually began integrating auditory, visual, and motor information. Weekly sessions included review, ear training, and theory work, while his mother, Yang, provided structured support at

home. The instructor's model recordings enhanced auditory discrimination and supported independent practice, allowing Carl to self-correct and develop metacognitive awareness. Over time, Carl's attention span, resilience, and musical expressivity improved markedly. The process nurtured emotional stability and strengthened the mother-child bond, echoing findings that parent engagement amplifies therapeutic effects (He *et al.*, 2024).

### **5.1 Background and Context**

The case centers on Carl, a child with autism and an intellectual disability, who participated in two years of piano lessons and theory instruction with the author, a young pianist familiar with autism through personal family experience. Prior to this, Carl attended university-based community lessons that ended when no teacher was available. At the outset, his mother worried about pacing and compatibility. Over time, she observed that the instructor adapted instruction to Carl's needs while maintaining high expectations.

### **5.2 Learning Process and Structure**

Typical weekly sessions included feedback on assigned piano pieces, ear training, and theory review. The instructor revisited prior concepts, introduced new theory material, and identified focus areas for the following week. At home, Yang implemented these recommendations and scaffolded tasks into manageable steps.

### **5.3 Role of Model Recordings**

The instructor's model recordings were played multiple times. Carl, who possessed a strong ear, often identified errors independently. The recordings reinforced auditory-visual integration and notation recognition.

### **5.4 Challenges and Coping**

Periods of sleep disruption, behavior challenges, or family stress occasionally hindered focus. The family responded by proceeding patiently and incrementally.

### **5.5 Engagement and Motivation**

Carl's enthusiasm for music remained strong. The cycle of recording, feedback, and self-correction bolstered intrinsic motivation and self-monitoring.

### **5.6 Skill Development and Progress**

Over two years, Carl progressed from relying on muscle memory to reading and interpreting music with comprehension. He improved coordination, attention, and endurance, developing a deepening appreciation for musical structure.

### **5.7 Emotional, Social, and Daily Life Impact**

The experience brought enrichment, discipline, and meaning. Carl became more mature and resilient, less easily frustrated, and more focused on learning overall. The mother-son relationship strengthened as they worked as a cohesive team through music.

### **5.8 Reflections and Future**

Yang emphasized patience and persistence. Progress may be gradual but enduring. She expects music to remain an important and joyful part of Carl's life.

The results are organized around five major themes that emerged consistently across interview data, video recordings, and instructional observations. Together, these themes illustrate the child's progress and the role of parental involvement in sustaining progress.

#### **Theme 1: Growth in Attention and Learning Endurance**

Across data sources, sustained musical engagement was associated with marked improvements in attention span and task persistence. Early video recordings showed Carl disengaging after brief periods, frequently stopping mid-piece, or requiring external prompts. Over time, recordings documented longer, uninterrupted practice segments and increased tolerance for repetition.

Yang noted in the interview:

*"At the beginning, he could only focus for maybe a few minutes. Now he can sit through an entire lesson or practice session without frustration."*

Weekly practice recordings corroborated this shift, indicating gradual increases in focused practice duration from under five minutes to sustained 20 to 30-minute sessions by the second year.

#### **Theme 2: Development of Self-Regulation and Emotional Resilience**

Emotional regulation emerged as a central theme across all data sources. Early practice videos frequently captured visible frustration, including abrupt stopping and physical tension. Later recordings showed calmer responses to mistakes and greater willingness to repeat challenging sections.

Yang reflected:

*"When he makes a mistake now, he does not shut down like before. He takes a breath and tries again."*

Observational notes by the instructor further confirmed reduced emotional reactivity, increased tolerance for correction, and improved recovery following errors. These behavioral changes generalized beyond music, as described in the parent interview, into daily learning and routine activities.

### **Theme 3: Transition from Imitation to Independent Musical Understanding**

Longitudinal video evidence revealed a shift from reliance on rote imitation toward active reading, listening, and self-monitoring. Early recordings show Carl copying finger patterns with minimal visual reference to the score. Later recordings document his ability to track notation, identify rhythmic errors, and verbally label musical concepts.

Yang observed:

*“Before, he just memorized. Now he actually understands what he is playing and can tell when something sounds wrong.”*

Model recordings played a critical role in this transition. Review of practice videos showed Carl pausing recordings to compare his own playing, demonstrating emerging metacognitive awareness.

### **Theme 4: Central Role of Parental Mediation and Home Structure**

Parental involvement was a consistent and powerful mediator of progress. Practice recordings revealed structured routines implemented by Yang, including breaking tasks into smaller units, using recordings strategically, and adapting practice to the child’s emotional state.

Yang explained:

*“I learned how to slow things down and adjust instead of pushing him. That made a huge difference.”*

This collaborative home-based reinforcement extended therapeutic processes beyond formal instruction, contributing to skill consolidation and emotional safety.

### **Theme 5: Strengthening of Parent–Child Relationship Through Shared Music-Making**

Music served as a relational bridge, strengthening the emotional connection between parent and child. Practice recordings and interview data highlighted shared pride, mutual patience, and emotional bonding during practice sessions.

Yang shared:

*“Music became something we did together, not something we argued about. It brought us closer.”*

Video recordings supported this theme, capturing moments of joint listening, shared celebration of progress, and relaxed interpersonal interaction.

## 5. Discussion

Systematic reviews consistently show that music therapy supports improvements in social interaction, emotional understanding, communication, and behavioral regulation (Applewhite *et al.*, 2022). Developmental and relational models of MT, such as DIR-based improvisational approaches, have demonstrated gains in self-regulation, engagement, and two-way purposeful communication (Carpente, 2016). Likewise, structured rhythmic and sensory-motor MT protocols support attentional and motor integration, contributing to broader functional improvements (Bharathi *et al.*, 2019). Music therapy also promotes social behavior, vocal communication, and nonverbal communication skills in autistic children, including improvements in joint attention and socioemotional reciprocity (Tsirigoti *et al.*, 2024).

This case study provides practical, real-life evidence that supports these findings. Over a two-year individualized music intervention, Carl's functional skills expanded over time, closely mirrored mechanisms described in controlled studies, illustrating how music-based interventions promote sustained attention, cognitive flexibility, and emotional resilience. Initially dependent on imitation and muscle memory, Carl gradually integrated auditory, visual, and motor information into his playing. Through consistent review of weekly practice videos and lesson notes, the instructor directly observed gradual increases in sustained attention, coordination, and persistence, which corroborated parental reports. His advancements paralleled research showing that MT enhances auditory-motor coupling and strengthens neural pathways involved in synchrony and planning (Sharda *et al.*, 2018). Music also helps with emotion regulation and development, as well as physiological coordination (Berger, 2017). The structured but adaptive instructional approach used-incorporating weekly review cycles, scaffolding, repetition, and incremental challenge-allowed Carl to transition from passive reproduction to active, reflective music learner. His increasing capacity for self-correction, error detection, and metacognition aligns with findings that MT fosters executive functioning and internal regulation through repeated exposure to rhythmic, predictable, and emotionally engaging stimuli.

A central theme in this case study is the critical role of parental involvement. Large-scale meta-analyses highlight that MT enhances the quality of parent-child relationships and improves global social adaptation when caregivers actively participate (Geretsegger *et al.*, 2014). In the case study, Carl's mother, Yang, emerged as a motivated collaborator who extended therapeutic processes into the home environment. Her role in organizing practice sessions, reinforcing stepwise tasks, and providing emotional co-regulation not only supported musical progress but also strengthened relational bonds and nurtured family resilience. This mirrors evidence from family-centered MT studies showing that parental engagement amplifies treatment gains, reduces caregiver stress, and improves family functioning (Thompson *et al.*, 2013; He *et al.*, 2024).

Furthermore, this study offers an example of how MT can cultivate emotional maturity. Yang described Carl as becoming calmer, less frustrated, more focused, and

more resilient over time, and these changes supported clinical findings that MT can benefit ASD individuals by reducing anxiety and facilitating adaptive emotional expression (Bharathi *et al.*, 2019). This emotional growth also extended beyond musical settings into daily life, reinforcing evidence that MT can generalize functional and behavioral improvements across contexts.

Importantly, this study highlights MT's capacity to promote identity development and intrinsic motivation. Carl's deepening appreciation of musical structure, along with his enthusiasm for sessions, reflects the motivational qualities of musical engagement described in the neuroscience literature, where music-related pleasure and reward activate dopamine pathways supporting sustained attention, learning, and emotional depth (Zatorre & Salimpoor, 2013). Carl's progression from compliance to authentic musical curiosity exemplifies these concepts.

This study suggests that individualized pacing, shared emotional engagement, and parent collaboration are central to sustained progress. Parental involvement plays a critical role in enhancing children's musical engagement and supporting the quality of everyday caregiving. Music therapy has been used to assist parent-child bonding between children with autism and their parents, to promote attachment between mothers and children, and to facilitate parent-child interactions. The study's focus on the parent's perspective on music therapy for an autistic child highlights essential implications for practice. Active parental involvement is a foundation fostering a stronger parent-child bond and extending therapeutic benefits beyond sessions.

### **6.1 Limitations and Future Directions**

Despite offering rich, longitudinal insight into an individualized music-based intervention, this study has several limitations that should be acknowledged. Foremost, the research is based on a single-case qualitative design, which limits generalizability. While the extended two-year duration provides depth rarely achieved in short-term interventions, findings cannot be assumed to represent outcomes for all children with autism and intellectual disability. Future research should aim to replicate these findings across multiple case studies and incorporate controlled experimental designs. Second, the primary data source consisted of a retrospective parental interview, which may introduce recall bias and subjective interpretation. While these narrative data were supported by longitudinal practice video recordings, future studies would benefit from a greater emphasis on systematic direct behavioral observation, standardized outcome measures, and family-centered assessment tools. Such methodological enhancements would allow for a more comprehensive examination of how music therapy supports social communication, emotional regulation, and engagement across developmental stages and contexts.

### **6.2 Implications for Practice and Research**

The prominent role of the parent as a learning partner in this study highlights the value of caregiver-mediated practice. Providing families with concrete tools, such as model

recordings, structured practice guidance, and clear instructional goals, can empower parents to support learning in ways that extend beyond the lesson itself. For educators and music therapists, cultivating collaborative partnerships with families may enhance not only skill acquisition but also emotional regulation and relational bonding. Practitioners should emphasize individualized, family-centered protocols aligned with each child's sensory and communicative profile. Future research should use longitudinal designs incorporating direct observations and clinical assessments to examine sustained relational and behavioral changes. As we continue to advance our understanding and practices in music therapy, this study paves the way for future practitioners to maximize the potential of music as a meaningful therapeutic approach for autistic individuals and their families.

## **7. Conclusion**

This longitudinal case study contributes to a growing body of evidence suggesting that music-based interventions, when delivered with sensitivity, structure, and sustained relational commitment, may support developmental growth in children with autism and intellectual disability. Over the course of two years, individualized piano and music theory instructions supported not only musical skill acquisition but also improvements in attention, emotional regulation, resilience, and parent-child connection. Observed changes suggested increased emotional regulation, persistence, and engagement within the context of the intervention. Active parental participation also appeared to play a critical role in sustaining engagement and supporting continued progress. Continued research and practice refinement will help ensure that music remains an inclusive and effective therapy for people with autism.

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### **Conflict of Interest Statement**

The authors declare no conflicts of interest.

### About the Author(s)

Olivia Luan is a classically trained young pianist who began her musical studies at the age of four and currently studies with German concert pianist Markus Pawlik. She has performed at the Bankhead Theater in Livermore, California, and at Carnegie Hall in New York City, earned top honors in multiple national and international music competitions, and appeared as a soloist with the Livermore-Amador Symphony. In addition to her musical training, Olivia has developed a strong academic interest in cognitive science and neuroscience, particularly the intersection of music and neurodevelopment. Since August 2023, she has taught piano to children with developmental disabilities at Friends of Children with Special Needs in Fremont, California. In December 2025, she founded and led an adaptive music education program serving students with autism and their families. Building on her teaching experience, she conducted a case study examining the effects of music-based interventions on individuals with autism under the mentorship of Professor Yuankun Yao.

**Dr. Yuankun Yao** is a professor at the University of Central Missouri. He regularly teaches graduate level assessment and research courses. Dr. Yao's research interests include educational assessment and inclusive education. He has experience with both qualitative and quantitative methods, including surveys, interviews, self-studies, factor analysis, structural equation modeling, and meta-analysis.

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