



Should teaching strategies emphasize emotion or competence? Enhancing audience acceptance of children with autism through online music performances - evidence from China

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ABSTRACT

This study investigates the experiences and perceptions of audiences watching online music performances by children with autism, focusing on how the emotions and competence displayed by the children during the performances affect the audience's sense of immersion and acceptance. We conducted an online survey with 949 respondents, *t*-tests was used to compare the differences before and after the respondents watching the performance, and structural equation modeling was used to analyzed the path relationships among variables. The results showed that audience acceptance was significantly higher after watching the music performances ($t = -6.104, p < 0.05$). We found that the competence demonstrated during the performances had a medium effect on both the audience's sense of immersion ($\beta = 0.337, p < 0.05$) and acceptance ($\beta = 0.211, p < 0.05$). Emotions expressed through the performances also significantly influenced the audience's immersion ($\beta = 0.323, p < 0.05$) and had a large effect on their acceptance ($\beta = 0.401, p < 0.05$). Based on these findings, we propose the Music-Driven Acceptance Model (MDAM), which suggests that while fostering the competence of children with autism, teachers might consider placing instructional emphasis on guiding children to learn methods of expressing emotions through music.

1. Introduction

1.1. Research background

According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), autism is characterized by social communication impairments in children, along with restricted and repetitive behaviors (Bradley, Noble, & Hendricks, 2023). Additionally, co-occurring developmental issues, mental disorders, and emotional disturbances are common (Hirota & King, 2023). Autism is increasingly recognized as part of neurodiversity. Within this framework, autism should be seen as a natural form of human variation, not something that requires a cure or normalization (Bottema-Beutel, Kapp, Lester, Sasson, & Hand, 2021). Therefore, from a social science research perspective, exploring effective ways to promote a more inclusive society and enhance the quality of life for children with autism is an important

research topic.

Music is considered a potential educational strategy to impact the behavior and social skills of children with autism (Marquez-Garcia et al., 2021). Although definitive and robust statements cannot be made based on current evidence, the trends reported in previous studies are promising. Brancatisano, Baird, and Thompson (2020) reviewed four widely studied neurological conditions, including autism, and suggested that music possesses multiple properties that interact with brain functions, contributing to improvements in cognitive, psychosocial, behavioral, and motor skills. Mayer-Benarous, Benarous, Vonthron, and Cohen (2021) indicate that music may have positive implications for speech production and social skills in children with autism. These advancements affirm the benefits of engaging in music learning for children with autism. Notably, beyond its therapeutic effects, musical experiences are also believed to influence and evoke emotions in audiences (Sedikides, Leunissen, & Wildschut, 2022). However, the existing literature lacks in-

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depth discussion on the impact of musical performances by children with autism on audience perceptions. Particularly with the rapid development of information technology in recent years, online formats have reduced the cost of music performances and increased their accessibility (Rendell, 2021). One perspective suggests that targeted human-media interaction designs help online music performances create aesthetic meaning, which aids users in adapting to and engaging with them (Wilson, 2023). In contrast, another viewpoint is that online music performances struggle to replicate the sense of connection and cultural immersion that comes from engaging in multiple social relationships offline (Zhao, 2023). We believe that, compared to offline events, online music performances can reduce the need for venue coordination, commuting, and on-site services related to cultural and arts management. Online performances allow audiences to watch or replay at any time and from any location. As Cayari (2018) indicated, people no longer need to gather in the same physical space to listen to music. This makes music performances by children with autism more feasible, highlighting the necessity of this research.

We have observed that some socially responsible musicians and art groups are already making efforts to create socially interactive settings and opportunities for self-expression for children with autism by organizing music learning and performances, including online music performances. For example, Cao Peng, a renowned and experienced symphony artist from China, founded the Angel Music Salon in 2008, focusing on providing support to children with autism purely on a philanthropic basis (China Central Television, 2024). The American rock band Coldplay has also invited children with autism to join them on stage during concerts on multiple occasions, allowing them to share in those magnificent and magical moments (Infobae, 2022). Audiences are often moved by particularly expressive performances, indicating that the key factors that make performers stand out include not only strong competence but also the emotional elements within their expressiveness (Juslin, Karlsson, Lindström, Friberg, & Schoonderwaldt, 2006). One of the main issues teachers facing is whether the instructional focus should be on encouraging children to continually express emotions through music or to provide sufficient competence training. For most beginners in music, effectively expressing emotions in their performances or developing a high level of competence requires continuous effort. Encouragingly, many children with autism have shown a talent for music and a keen interest in participating in music-related activities (Masataka, 2017). These children have the potential to become excellent performers, but there is still insufficient educational theoretical support provided by the academic community, particularly in terms of balancing curriculum emphasis between emotional expression and competence. Understanding the relationship between the focus of a music performance and audience acceptance could not only lead to better performance outcomes but also serve as a reference for further exploring standardized approaches to music education.

Audience experience is considered one of the key standards for evaluating the quality of artistic performances (Radbourne, Johanson, Glow, & White, 2009). Previous studies have explored audience experiences from a technical perspective, using tools like virtual reality (Young, O'Dwyer, Moynihan, & Smolic, 2022), augmented reality (Lim, Goh, Downing, & Sra, 2021), and haptic feedback (Young, O'Dwyer, Vargas, Donnell, & Smolic, 2023) in music performances. However, there is still a lack of evaluations, particularly in the digital context, that assess audience acceptance from the perspective of the performers' emotions and competence. In summary, this study focuses on methods to enhance audience experience, aiming to understand the relationship between viewing online music performances and the level of audience acceptance of children with autism, and to explore and verify the underlying mechanisms. Specifically, we derive key points for curriculum design and establish reasonable music curriculum design strategies centered on audience behavior. This research is particularly urgent because online formats of music performances have seen rapid growth in recent years (Bermúdez, 2023). Music helps establish broad channels of

communication (Cross, 2014) and plays a significant role in fostering mutual understanding, as well as promoting social inclusivity and equity. While special education research in the music field often focuses on the cognition and actions of children, our study primarily evaluates audience perceptions and preferences regarding musical performances. By investigating and analyzing audience experiences, this study aims to expand the value of music for children with autism, facilitating more positive and substantial social feedback for their music learning and performances.

1.2. Research purposes

There are two research objectives for this study. First, we compared the audience's acceptance before and after watching online music performances by children with autism to confirm the feasibility of this performance type. Second, a structural equation model was developed to evaluate the impact of the emotions conveyed and the competence displayed by children with autism through online music performances on audience acceptance.

2. Literature review and research hypotheses

2.1. Emotion

Leo Tolstoy once said, "Music is the shorthand of emotion," highlighting its pivotal role as a means of conveying emotions (Rajesh & Nalini, 2020). In musical activities, performers can endeavor to establish emotional connections with audiences to enhance the quality of their performances. Music has the capability to modulate and guide emotions, which is considered a primary reason why people choose to listen (Váradi, 2022). Therefore, evaluating musical performances seems inherently intertwined with emotional factors. Emotions are recognized as crucial components in conveying intentions through music, encompassing basic emotional exchanges and variations in emotional tension (Bonastre & Timmers, 2021). In this study, emotions are defined as the richness of emotional expression in musical performances, reflecting the ability to control and express emotions. Performers encode and express specific emotions during their performance, which are then decoded and recognized by the audience (Micallef Grimaud & Eerola, 2022). It is worth noting that the emotional expression of performers and the audience's perception may be influenced by factors such as venue, equipment, and differences in upbringing and culture. Therefore, when analyzing how audience respond to the emotions that performers aim to express through sound cues, it is essential to distinguish between online and offline performances and consider objective conditions related to people and the environment. Pandeya and Lee (2021) suggest that online music can integrate performers' inner feelings with rhythm and melody, thereby evoking emotions in the music. This may differ from offline performances, as it removes elements accompanying the musical content, such as atmosphere, ritualistic experiences, and interactions with other audience members and performers (Zhao, 2023). This necessitates children with autism gradually learning to understand and incorporate emotions from within into their musical performances. Specifically, different combinations of musical cues; such as amplitude envelope, mode, tempo, loudness, melodic range, variations in loudness, articulation, pitch level, and timbre are common; may correspond to varying emotional valence (negative to positive) and arousal (low to high) (Kragness & Trainor, 2019). Once audiences connect with these emotions, they may experience a range of positive outcomes, such as reminiscence, empathy, a sense of communication, connection with others, and increased identification (Ziv & Hollander-Shabtai, 2022). We firmly believe that children with autism can express stronger emotions in music through training. As Meissner and Timmers (2019) assert, deliberate cultivation of students' ability to express emotions is feasible across various stages of music education.

2.2. Competence

Competence is considered a composite quality of musical perception and performance, shaped by both innate abilities and environmental influences (Swaminathan, Kragness, & Schellenberg, 2021). This means that an performer's competence is indeed related to talent, but it also significantly depends on systematic musical training. Martinelli (2021) describes competence in musical performance as "the ability to produce meaning with or about music," which can be divided into five levels: general codes, social practices, musical techniques, styles, and individuals. According to his description, these levels do not operate independently but rather complement and coordinate with each other, requiring multidimensional training that considers different dominant levels. Specifically, objective assessment indicators such as pitch, timing, and timbre, as well as the accuracy of notes and rhythms, are related to competence (Kragness, Swaminathan, Cirelli, & Schellenberg, 2021). In this study, the competence of children with autism in musical performances is defined as the level of technical proficiency and creativity. According to Snir and Regev (2013), this construct reflects performers' self-assessment of their abilities when dealing with artistic tasks, with creativity being regarded as a key component. Results based on functional magnetic resonance imaging (fMRI) indicate that emotions during musical performance can modulate neural systems related to creativity, allowing performers to engage the limbic centers of their brain and enter flow states (McPherson, Barrett, Lopez-Gonzalez, Jiradejvong, & Limb, 2016). This suggests a connection between the two, rather than an inclusive relationship, which supports the rationale for this study's use of an oblique model to analyze the relationship between emotions and competence, including creativity. As Antonini Philippe et al. (2020) state, musical performance should ensure technical fluency, starting with mastering the necessary techniques for a piece, gradually refining details, overcoming technical challenges, and ultimately achieving a level where interpretation and subtle modifications can be made. Previous research has reported the positive impacts that competence can have on performers and their musical performance outcomes. For example, Meissner (2021) notes that once performers become aware of changes in their musical competence, they experience a sense of achievement when making progress or reaching goals. Osborne, McPherson, Miksza, and Evans (2021) found that performers with high levels of competence have increased confidence in their success in performances even before practicing and are more willing to seek help from others. Competence may be one of the important factors in the audience's evaluation of music, as fluent performance and precise execution of every note are often considered basic expectations (Williamson, Valentine, & Valentine, 2002). Audiences may be impressed by various aspects of a performer's competence, including playing long, complex pieces from memory with skill, creatively adding subtle variations that bring the music to life, and demonstrating speed, agility, and precision in their movements (Brown, Zatorre, & Penhune, 2015). This suggests that the musical competence of children with autism is likely to have the potential to influence audience experiences.

2.3. Immersion

Potter, Cvetković, and De Sena (2022) found that adding room acoustic rendering to head-tracked binaural audio enhances audience immersion to the same extent as increasing video resolution fivefold. This modeling approach mainly involves predicting and reproducing some of the most important characteristics of room acoustics, explaining acoustic phenomena based on the physical laws of sound wave propagation (Scerbo, Savioja, & De Sena, 2024). The positive audience response to sound suggests a strong correlation between the content and quality of sound and audience immersion. Immersion is a psychological state where users feel surrounded, included, and interactive with an environment that provides continuous stimuli and experiences (Wycisk et al., 2022). The fundamental differences between immersion and flow

include two main aspects. First, flow is an "all- or-nothing" experience (Cairns, Cox, & Nordin, 2014), it is an extreme experience (Frochot, Elliot, & Kreziak, 2017; Jennett et al., 2008). Whereas immersion is a progressive sensation, distinctly divided into different levels (E. Brown & Cairns, 2004). Second, users in a state of flow feel a balance between ability and task, with clear goals and immediate feedback (Fong, Zaleski, & Leach, 2015). In contrast, immersion may accompany interaction but is not necessarily dependent on it (Gu et al., 2022). Evidence shows that users may trigger immersion through simple activities like listening to music, reading books, or watching movies (Barrett, Pack, & Quaid, 2021). Music is often seen as a beneficial experience capable of producing high levels of immersion, including temporary loss of self-awareness or even spatial and temporal distortion, known as transcendence or absorption in music (Cardona, Ferreri, Lorenzo-Seva, Russo, & Rodriguez-Fornells, 2022). Although audiences in an immersive state may feel that time passes imperceptibly, the reverse is not always true. Rogers, Milo, Weber, and Nacke (2020) reported an example where music influenced audience time perception, making time seem to pass faster with music, but immersion levels remained unchanged. This suggests that immersion is a complex and comprehensive concept. In this study, immersion is evaluated based on the definition by Zhang, Zhang, Jang, and Pan (2024), considering audience perceptions of time, space, and the overall positive evaluation of the musical experience. Wang, Liang, Li, Li, and Yu (2020) argue that during multimedia usage, suitable music significantly enhances audience immersion compared to silent conditions, enriching their experience and providing new forms of communication through listening. Therefore, the more specific question should be how musical performances can generate high levels of immersion for the audience. Ultimately, immersion implies that the audience is mentally invested, accompanied by identification and pleasure (Gu et al., 2022). Thus, creating immersion is one of the primary goals of musical performances. Gasselseder (2015) indicates that users may experience immersion because the transmission and interaction of music in an environment meet their expectations, and this immersion is influenced by the degree of emotional arousal. Zhu and Cao (2024) also point out that by engaging multiple senses and a high level of emotional involvement, users can fully immerse themselves in an activity or environment. This suggests that emotions in musical performances may be related to immersion. On the other hand, the appropriate use of timbre (Di Stefano, 2023) and pitch (Zhexuan & Zhong, 2022) may help enhance audience immersion. This requires performers to have skilled technique and precise control. As Coimbra, Davidson, and Kokotsaki (2001) stated, high-level performers can capture the audience's attention by demonstrating their competence. Based on the literature discussion, we propose the following hypotheses:

- H1.** Emotion in musical performance has a positive influence on audience immersion.
- H2.** Competence in musical performance has a positive influence on audience immersion.

2.4. Acceptance

Currently, enhancing public acceptance of people with autism is an urgent social issue. Incorrect perceptions of autism among the public can lead to stigmatization, increased marginalization, and cause people with autism to internalize negative self-beliefs (Bottema-Beutel et al., 2021). This is not limited to adults with autism, children with autism also face similar challenges, which can cause significant distress in their daily lives. If society does not take on the responsibility of driving positive change, negative social experiences can affect people with autism in many aspects, such as forming friendships, developing romantic relationships, education, and employment, leading to problems that persist throughout their lifetime (Matson, Cervantes, & Peters, 2016). Locke, Ishijima, Kasari, and London (2010) used questionnaires to map the social network centrality score of each student in a classroom,

assessing the integration of children with autism across four levels: isolated, peripheral, secondary, and core. The results showed that 92.4 % of typically developing children were at the secondary or core level, while 71.4 % of adolescents with autism were either isolated or on the periphery in the classroom. To address this situation, many governments and public service organizations are attempting to foster more inclusive environments, aiming to reduce stereotypes and negative attitudes stemming from a lack of understanding through increased direct contact with children with autism. For example, the Chinese Ministry of Education encourages mainstream schools to adopt a more positive attitude towards neurodiversity and proposes measures such as inter-school cooperation, pilot programs, textbook and curricula revisions, and exemplary teaching demonstration selection to meet the needs of children (Qu, 2022; The General Office of the State Council, 2024). In Japan, the government allocates dedicated financial resources to prefectures to deploy specialists to classrooms, and it has also widely established specialized classes within mainstream schools (Ito, Chang-Leung, & Poudyal, 2023). Balaz, Byrne, and Miellet (2022) suggest that fostering peers' understanding and awareness helps increase empathy, thereby promoting positive social interactions and more inclusive peer relationships with children with autism. Tonnsen and Hahn (2016) state that increasing positive, public social experiences for children with autism may enhance peer acceptance. Online music performance is an intriguing method to help children with autism showcase their personalities and express their interest in art activities. Lian, Zhang, Ma, Wang, and Lin (2022) found that the positive image of people with different abilities in the minds of their peers correlates with the level of acceptance they receive. For children with autism, music can be a means to establish a positive image and gradually build connections with the audience. The more positive the impression, the fewer misunderstandings, the higher the expectations of their abilities, and the greater the social interest shown towards them (Jones, DeBrabander, & Sasson, 2021). Therefore, exploring the mechanisms by which online music performances can enhance audience acceptance of children with autism has been set as one of the main research objectives of this study. As Dean and Nordahl-Hansen (2022) state, promoting positive messages and accurate representations may reduce people's misunderstanding of autism, thereby increasing acceptance. A survey conducted by Williams, Jetten, and Dingle (2023) showed that choirs composed of people with different abilities enhanced the audience's positive emotions and acceptance through musical performances. King-O'Riain (2021) analyzed this from a humanities perspective, suggesting that when performers appear genuine and demonstrate skill and professionalism in their music, they can gain audience approval. However, it remains unclear whether these effects are robust and generalizable. Additionally, Wald-Fuhrmann et al. (2021) pointed out that music performances build relationships between audiences and performers; such as support, interest, recognition, and appreciation; by providing immersive musical experiences. This suggests that audience acceptance of performers may be influenced by the degree of immersion they experience while watching the performance. Based on the above discussion, we propose the following hypotheses:

- H3. Emotion in musical performance has a positive influence on audience acceptance.
- H4. Competence in musical performance has a positive influence on audience acceptance.
- H5. Immersion has a positive influence on acceptance.

3. Research method

3.1. Study design

This study was conducted through online surveys, aligning with our focus on measuring audience perceptions and intentions after watching

online music performances by children with autism. We selected Angel Music Salon, a music group based in Changsha, China, as a case study for our survey (Cao, 2022). The performers in this group are exclusively children with autism, and their daily activities aim to promote music learning and practice among them. Since its foundation in 2008, Angel Music Salon has involved hundreds of children with autism and performed in many countries, including the United Kingdom, Scotland, and Italy. The group has also been recognized as one of the top ten charity projects by the Shanghai Charity Foundation.

Upon commencement of the survey, participants were required to complete an acceptance questionnaire as a baseline measure. The data collected from this questionnaire served as the pre-test results, providing insights into audience acceptance of children with autism before watching the music performance. Subsequently, we played a publicly available video of Angel Music Salon's performance. The video, approximately 2 min long, featured children with autism performing music as a group. Gu et al. (2022) investigated user perceptions, showing that audience could provide a valid and differentiated assessment of immersion after watching just 1 min of each video sample. Bigand, Filipic, and Lalitte (2005) conducted multiple comparisons on the duration of music needed to evoke emotional responses from the audience. Their research supports the idea that music lasting <25 s is sufficient for listeners to perceive it as "moving." Lee-Harris, Timmers, Humberstone, and Blackburn (2018) measured the relaxing and soothing effects of music, asking participants to rate each piece after listening for 3 min. Based on these studies, we determined that a 2-min watching time for the music performance video was reasonable. Following this, participants were asked to complete the second questionnaire assessing their emotional and competence evaluations of the performers, their sense of immersion during the watching process, and their acceptance of children with autism after watching the performance. The results of the second questionnaire constituted the post-test results, which were compared with the pre-test results to determine whether online music performances by children with autism contribute to increased audience acceptance. Additionally, we included a monitoring group sampled from the same population as the main group. This group was asked to watch the performance directly and complete the acceptance questionnaire. These data were used to detect any potential social desirability bias that might influence responses when participants are repeatedly surveyed. Furthermore, we established a structural equation model to assess the path relationships among emotional, competence, immersion, and acceptance, and develop music teaching strategies tailored to children with autism based on audience feedback.

3.2. Data collection

We commissioned a professional data collection company to recruit participants from various cities in China, and the survey was conducted in June 2024. The survey was carried out anonymously. Regarding the main group, a total of 949 questionnaires were distributed. We included 4 reverse-scored items and employed real-time attention checks. After excluding logically inconsistent responses and invalid samples that were not answered seriously, we retained 514 valid samples, achieving an effective rate of 54.2 %. In terms of the monitoring group, 146 questionnaires were distributed, and 117 valid responses were collected, resulting in an effective rate of 80.1 %. This group also included two sets of reverse-scored items. The higher response rate may have been due to fewer steps required for participation and a shorter questionnaire, which helped maintain higher levels of attention among respondents. According to the findings of Grebosz-Haring and Weichbold (2020), the audience composition at multimedia concerts tends to be predominantly female, accounting for about 60 %, which informed our survey design. The study also highlighted that traditional concert audiences are predominantly over 30 years old. However, in their research on audiences using smartphones to watch live concerts online, Hödl, Bartmann, Kayali, Löw, and Purgathofer (2020) focused primarily on younger

respondents aged 20 to 30 years. Taking these insights into account, we targeted participants primarily aged between 23 and 39 years. Thus, by considering these studies' recommendations, our sample closely aligns with the demographic characteristics of online music performance audiences, providing a solid basis for our sampling survey. The demographic information of the sample is presented in Table 1.

3.3. Questionnaire design

We referred to previous research to design the questionnaire used as the survey tool in this study, as shown in Table 2. It is noteworthy that the immersion construct originally comprised six items; however, due to the very low factor loading of the sixth item, it was excluded from our study. Furthermore, through data analysis, we found that after removing the first item from the immersion construct, the reliability and validity of all constructs met the recommended standards from prior research. Specifically, we used Cronbach's alpha to calculate the reliability of each construct, and the results showed that the alpha values exceeded the acceptable standard of 0.6 (Taber, 2018). We performed exploratory factor analysis for further analysis, which confirmed the unidimensionality of each construct, with item communalities above 0.5 and factor loadings above 0.6, meeting the recommended standards from previous studies (Schreiber, 2021). We then used confirmatory factor analysis to calculate the convergent and discriminant validity of the data. The results showed that the average variance extracted (AVE) was >0.36, and the composite reliability (CR) was >0.6 (Fornell & Larcker, 1981a). Additionally, the square root of the AVE for each construct was greater than its correlation with any other construct (Fornell & Larcker, 1981b), and the heterotrait-monotrait ratio (HTMT) was <0.85 (Henseler, Ringle, & Sarstedt, 2015). The questionnaire was designed using the Likert's five-point scale, where "strongly disagree" corresponded to 1 point and "strongly agree" to 5 points. Questions were adjusted slightly to align with the context of this study without altering their original meaning and inquiry method. The revised questionnaire was reviewed by three experts in the humanities and social science

discipline to ensure alignment with the original intent as cited in the literature and clarity in expression. The review and discussion focused on aspects such as sentence fluency, grammatical accuracy, and whether the translation was too rigid. For example, common issues included the omission of structural particles in initial translations or sentence breaks that made comprehension difficult. We edited and finalized the survey questionnaire according to suggestions from the experts so that to ensure the expert content validity of the measurement scale.

4. Result

4.1. The impact of online music performances on acceptance

To address the first research objective, we compared audience acceptance of children with autism before and after watching online music performances. Acceptance before watching was designated as the pre-test results, while acceptance after watching constituted the post-test results. An additional group that directly watched the performance and completed the questionnaire was designated as the monitoring group. The Levene's test results of the post-test results and the monitoring group results showed equal variances between the two groups ($F = 0.063, p = 0.801$), suggesting that a t-test with equal variances assumed should be used for differential analysis. This also allowed for the calculation of partial eta squared to reflect effect size (Richardson, 2011). The other Levene's test results of the pre-test results and the post-test results showed that the hypothesis of equal variances between groups was rejected ($F = 113.570, p = 0.000$), thus indicating the appropriateness of using a t-test with equal variances not assumed should be used for differential analysis. Similarly, we utilized Hedges' g to calculate effect size - a method that, unlike other formulas, does not require equal variances (Marfo & Okyere, 2019). The specific calculation is shown in Formula 1, where M represents mean, n denotes sample size, and s signifies standard deviation.

Table 1
Demographic information of the sample.

Sample	Category	Main group		Monitoring group	
		Number	Percentage (%)	Number	Percentage (%)
Gender	Male	193	37.549 %	46	39.655 %
	Female	321	62.451 %	70	60.345 %
Age	Under 22	38	7.393 %	4	3.448 %
	23–29	179	34.825 %	42	36.207 %
	30–39	247	48.054 %	59	50.862 %
	40–49	33	6.420 %	8	6.897 %
	Over 50	17	3.307 %	3	2.586 %
Marital status	Married	122	23.735 %	95	81.897 %
	Unmarried	392	76.265 %	21	18.103 %
Monthly Income	Below 4000	62	12.062 %	6	5.172 %
	4001–6000	112	21.790 %	20	17.241 %
	6001–12,000	230	44.747 %	46	39.655 %
	12,001–18,000	85	16.537 %	36	31.034 %
	18,001 or more	25	4.864 %	8	6.897 %
Education	Junior high school or below	4	0.778 %	1	0.862 %
	High school or secondary school	22	4.280 %	6	5.172 %
	Undergraduate or college	436	84.825 %	97	83.621 %
	Institute including above	52	10.117 %	12	10.345 %
Occupation	Civil servant	49	9.533 %	5	4.310 %
	Clerk	270	52.529 %	70	60.345 %
	Worker	82	15.953 %	18	15.517 %
	Public service agency	35	6.809 %	6	5.172 %
	Student	45	8.755 %	3	2.586 %
	Self-employed	33	6.420 %	14	12.069 %
	Eastern China	282	54.864 %	81	69.828 %
	Central China	110	21.401 %	15	12.931 %
Area	Western China	93	18.093 %	13	11.207 %
	Northeast China	28	5.447 %	6	5.172 %
	Hong Kong, Macao and Taiwan	1	0.195 %	1	0.862 %

Table 2
Content of measurement scale.

Construct	Item	Content	Source
Emotion	EM1	I believe the children with autism participating in this online performance can make me experience a wide range of emotions through their music.	(Wanzer, Finley, Zarian, & Cortez, 2020)
	EM2	As I continue to watch the online performance of children with autism, my emotions change.	
	EM3	I believe the children with autism participating in this online performance can make me feel moved through their music.	
	EM4	I believe the children with autism participating in this online performance can make me experience a physical reaction through their music.	
Competence	CO1	I believe that the children with autism participating in this online performance can easily realize their musical ideas.	(Snir & Regev, 2013)
	CO2	I believe that the children with autism participating in this online performance are good at music.	
	CO3	I believe that the children with autism participating in this online performance are very creative.	
	CO4	I believe that the children with autism participating in this online performance can perform beautiful and expressive musical pieces effortlessly.	
	CO5	I believe that the children with autism participating in this online performance are not limited by a lack of ability.	
Immersion	IM1	I spend more time watching the online performance of children with autism than I expected. (Deleted)	(Zhang et al., 2024)
	IM2	When watching the online performance of children with autism, my awareness of the surrounding environment decreases.	
	IM3	When watching the online performance of children with autism, I am not influenced by the surrounding real environment.	
	IM4	When watching the online performance of children with autism, I lose track of time.	
	IM5	I prefer watching online performances by children with autism over others.	
Acceptance	AC1	Children with autism don't make me feel afraid.	(Gardiner & Iarocci, 2014)
	AC2	Children with autism are probably as smart as I am.	
	AC3	I wouldn't mind having children with autism living on the same floor or in the same building as me.	
	AC4	I am willing to hang out with children with autism in my free time.	
	AC5	I would feel comfortable around children with autism.	
	AC6	Children with autism are not different from me. (Deleted)	
	AC7	Overall, I think I (would) like children with autism.	

Table 3
Comparison results of acceptance.

Group	Mean	Mean Difference	t	Sig.	Effect Size
Monitoring	3.797	0.016	−0.234	0.815	0.000
Post-test	3.813				
Pre-test	3.606	−0.207	−6.393	0.000*	0.398
Post-test	3.813				

* The level of significance is 0.05.

Hedges' $g = \frac{|M_1 - M_2|}{\sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 - 1) + (n_2 - 1)}}}$ (1)

The results of the differential analysis are presented in Table 3. According to Hofmann, Wu, Boettcher, and Sturm (2014), effect sizes of 0.2, 0.5, and 0.8 correspond to small, medium, and large effects, respectively. The results indicate no significant difference in mean scores between the post-test results and the monitoring group, suggesting that respondents were not noticeably influenced by social desirability or subjective norms. Moreover, we found that the post-test results exhibited significantly higher acceptance of children with autism compared to the pre-test results, with an effect size indicating a small effect. In other words, audience acceptance of children with autism increased after watching the online music performance.

4.2. Specific strategies to enhance acceptance

To address the second research objective, which was to determine the impact of emotions and competence displayed by children with autism in online music performances on audience immersion and acceptance, we conducted a path analysis. Descriptive statistics are presented in Table 4. Skewness values for all constructs ranged from −3 to 3, and kurtosis values ranged from −7 to 7, meeting the univariate normality criterion as proposed by Kline (2005).

We conducted reliability analysis using Cronbach's alpha for the scales. The results indicated that Corrected Item Total Correlation (CITC) values ranged from 0.588 to 0.808. This indice measures the degree of alignment between each item and its corresponding construct by calculating the correlation between each item and the sum of the remaining items, with an acceptable threshold of 0.3 (Yusoff, Rahim, & Yaacob, 2010). The reliability coefficients for all scales exceeded 0.6, and the removal of any item did not increase reliability beyond the current calculations, indicating high internal consistency within each scale (Taber, 2018). The reliability analysis results are presented in Table 5.

Table 6 shows the results of the exploratory factor analysis conducted to further examine the data. The maximum variance method was selected for rotation and new factors with eigenvalues >1 were extracted. Following recommendations from previous research, we initially performed the Kaiser-Meyer-Olkin (KMO) test and Bartlett's sphericity test. The results indicated KMO values above 0.5 and a significance level below 0.05 for Bartlett's sphericity test, indicating that the correlation matrix among variables is not an identity matrix and is suitable for further analysis. We found that each construct could extract only one new factor, with total variation explained for each construct exceeding 60 %. Additionally, the communalities for each item were above 0.5, and factor loadings exceeded 0.6, meeting acceptable standards. Overall, these findings suggest the data exhibit unidimensionality (Kohli, Shervani, & Challagalla, 1998).

We established a confirmatory factor analysis (CFA) model and established a control model based on the calculated common latent factor method (CLF) to check for the presence of common method bias. The fit indices for both models are shown in Table 7, with all indices falling within acceptable ranges, indicating good model fit (Hair, 2009). Importantly, compared to the CFA model, the GFI, TFI, NFI, and CFI values of the CLF model did not show an improvement exceeding 0.1,

Table 4
Results of descriptive statistics.

Construct	Item	Skewness (item)	Kurtosis (item)	Skewness (construct)	Kurtosis (construct)	Mean	SD	Variance
EM	EM1	−0.530	0.852	−1.189	2.006	4.107	0.657	0.431
	EM2	−0.598	0.490			4.099	0.715	0.511
	EM3	−0.458	−0.015			4.202	0.674	0.454
	EM4	−0.491	0.761			3.992	0.690	0.476
CO	CO1	−0.357	0.238	−0.522	0.210	3.730	0.779	0.607
	CO2	−0.341	0.277			3.757	0.745	0.555
	CO3	−0.217	−0.047			3.728	0.746	0.557
	CO4	−0.305	−0.110			3.504	0.773	0.597
	CO5	−0.366	0.072			3.634	0.855	0.731
IM	IM2	−0.289	0.045	−0.243	−0.203	3.257	0.782	0.612
	IM3	−0.082	−0.155			3.286	0.839	0.704
	IM4	−0.122	−0.191			3.337	0.839	0.703
	IM5	−0.196	0.166			3.200	0.763	0.582
AC	AC1	−0.611	0.586	−0.857	0.989	3.982	0.750	0.563
	AC2	−0.574	0.784			3.918	0.737	0.543
	AC3	−0.547	0.521			3.959	0.760	0.577
	AC4	−0.490	0.527			3.804	0.716	0.513
	AC5	−0.503	0.562			3.554	0.771	0.594
	AC7	−0.314	0.059			3.660	0.741	0.549

Table 5
Results of reliability analysis.

Construct	Item	Corrected Item Total Correlation	Cronbach's Alpha If Item Deleted	Cronbach's Alpha
EM	EM1	0.623	0.748	0.802
	EM2	0.588	0.766	
	EM3	0.634	0.743	
	EM4	0.616	0.751	
CO	CO1	0.732	0.882	0.900
	CO2	0.740	0.880	
	CO3	0.790	0.870	
	CO4	0.777	0.872	
	CO5	0.725	0.885	
IM	IM2	0.740	0.874	0.894
	IM3	0.803	0.850	
	IM4	0.786	0.857	
	IM5	0.739	0.874	
AC	AC1	0.798	0.915	0.929
	AC2	0.782	0.917	
	AC3	0.808	0.914	
	AC4	0.791	0.916	
	AC5	0.803	0.914	
	AC7	0.769	0.919	

Table 6
Results of exploratory factor analysis.

Construct	KMO value	Bartlett's Sphere Test	Item	Commonality	Factor Loading	Eigenvalue	Total Variation Explained
EM	0.772	0.000*	EM1	0.641	0.801	2.512	62.806 %
			EM2	0.592	0.769		
			EM3	0.653	0.808		
			EM4	0.626	0.792		
CO	0.889	0.000*	CO1	0.691	0.831	3.583	71.654 %
			CO2	0.700	0.837		
			CO3	0.763	0.873		
			CO4	0.747	0.864		
			CO5	0.681	0.825		
IM	0.837	0.000*	IM2	0.728	0.853	3.040	75.992 %
			IM3	0.801	0.895		
			IM4	0.782	0.885		
			IM5	0.728	0.853		
			AC1	0.746	0.864		
AC	0.917	0.000*	AC2	0.725	0.852	4.426	73.765 %
			AC3	0.759	0.871		
			AC4	0.736	0.858		
			AC5	0.752	0.867		
			AC7	0.707	0.841		

* The level of significance is 0.05.

and RMSEA and SRMR values did not decrease by >0.05 , indicating no significant common method bias in the data (Lee, Lee, & Suh, 2016).

The detailed results of the confirmatory factor analysis are shown in Table 8. We found that the factor loadings for all items were above 0.6, with their corresponding squared multiple correlations (SMC) all exceeding 0.3, indicating acceptable correlations between items and constructs (Al-Hakim & Lu, 2017). Additionally, we computed the AVE for each construct, all of which exceeded 0.36, and the composite reliability (CR) for each construct, all of which exceeded 0.6 (Fernandes, Moori, & Vitorino Filho, 2018). These findings collectively indicate good convergent validity for the data.

We assessed discriminant validity using the Fornell-Larcker criterion and the heterotrait-monotrait ratio (HTMT). As shown in Table 9, the square root of the AVE for each construct exceeded the correlations between that construct and any other construct (Fornell & Larcker, 1981b). Additionally, as presented in Table 10, the HTMT values for each pair of constructs were all below 0.85 (Peralta & Rubalcaba, 2021). These results collectively indicate good discriminant validity for the data.

The model fit results of the structural equation model (SEM) are presented in Table 11. We used AMOS for model fitting and conducted 2000 bootstrap samples to calculate the significance of coefficients. The

Table 7

Model fit indices of the CFA and CLF model.

Common indices	χ^2/df	RMSEA	GFI	TLI	NFI	CFI	SRMR
Judgment criteria	<3	<0.08	>0.9	>0.9	>0.9	>0.9	<0.08
CFA Value	1.944	0.043	0.943	0.974	0.955	0.977	0.034
CLF Value	1.858	0.041	0.946	0.976	0.957	0.980	0.034

Table 8

Results of confirmatory factor analysis.

Construct	Items	Factor loading	t value	SE	p value	SMC	AVE	CR
EM	EM1	0.738	17.7801	0.029	0.001*	0.545	0.505	0.803
	EM2	0.677	15.918	0.032	0.001*	0.458		
	EM3	0.735	17.698	0.027	0.001*	0.540		
	EM4	0.689	16.290	0.032	0.001*	0.475		
CO	CO1	0.782	20.484	0.020	0.001*	0.611	0.647	0.902
	CO2	0.789	20.760	0.019	0.001*	0.622		
	CO3	0.847	23.124	0.015	0.001*	0.718		
	CO4	0.828	22.333	0.015	0.001*	0.686		
	CO5	0.773	20.135	0.023	0.001*	0.597		
IM	IM2	0.787	20.605	0.018	0.001*	0.619	0.681	0.895
	IM3	0.861	23.613	0.014	0.001*	0.741		
	IM4	0.849	23.127	0.015	0.001*	0.722		
	IM5	0.802	21.220	0.019	0.001*	0.644		
AC	AC1	0.833	22.819	0.018	0.001*	0.693	0.686	0.929
	AC2	0.820	22.267	0.018	0.002*	0.672		
	AC3	0.847	23.460	0.015	0.002*	0.718		
	AC4	0.825	22.505	0.016	0.001*	0.681		
	AC5	0.837	23.020	0.015	0.001*	0.701		
	AC7	0.805	21.656	0.019	0.001*	0.647		

* The level of significance is 0.05.

Table 9

Results of Fornell-Larcker criterion.

	EM	CO	IM	AC
EM	0.711			
CO	0.391*	0.804		
IM	0.412*	0.438*	0.825	
AC	0.523*	0.457*	0.461*	0.828

* The level of significance is 0.05.

Table 10

Results of the heterotrait-monotrait ratio.

	EM	CO	IM	AC
EM				
CO	0.461			
IM	0.484	0.488		
AC	0.607	0.499	0.507	

results indicate that all fit indices meet the recommended standards from prior research, indicating a good model fit (Hair, 2009).

The results of the structural equation model are depicted in Fig. 1. Following the recommendations of Aparicio, Bacao, and Oliveira (2017), path coefficients ranging of 0.15 to 0.2 represent a small effect, 0.2 to 0.35 indicate a medium effect, and values exceeding 0.35 indicate a large effect. We found that emotional has a large effect on acceptance, while the remaining four relationship paths exhibit medium effects.

We calculated the direct effects, indirect effects, and total effects among the constructs, as shown in Table 12. Each path exhibits

significant direct effects. Specifically, both emotion and competence significantly and positively influence immersion, supporting H1 and H2. Emotion, competence, and immersion all significantly contribute to acceptance, thus supporting H3, H4, and H5. Notably, while the indirect effects indicate that emotion and competence significantly influence acceptance through the mediation of immersion, these effects, though indicating partial mediation, are practically limited given that the path coefficients are <0.1 in a well-fitted model.

We further examined the moderating effects of gender by calculating path coefficients separately for each gender and establishing a control model in which the coefficients for both genders are constrained to be equal. This allowed us to compare whether significant differences exist between this model and the original model. The results of the moderation analysis are shown in Table 13. We found that only the effect of emotional on immersion showed an approximately significant difference in path coefficients between different genders, while gender does not significantly moderate the other path relationships.

The detailed results of the moderation analysis are presented in Table 14. We found that both male and female audiences show a significant positive result of emotional on immersion. However, for female audiences, the effect of emotional on immersion is stronger compared to male audiences.

5. Discussion

This study focuses on audience experience and perception, exploring the significance of online music performances in enhancing acceptance of children with autism. This research is particularly urgent and important as it provides valuable insights into music education activities

Table 11

Model fit indices of the structural equation model.

Common indices	χ^2/df	RMSEA	GFI	TLI	NFI	CFI	SRMR
Judgment criteria	<3	<0.08	>0.9	>0.9	>0.9	>0.9	<0.08
SEM Value	1.944	0.043	0.943	0.974	0.955	0.977	0.034

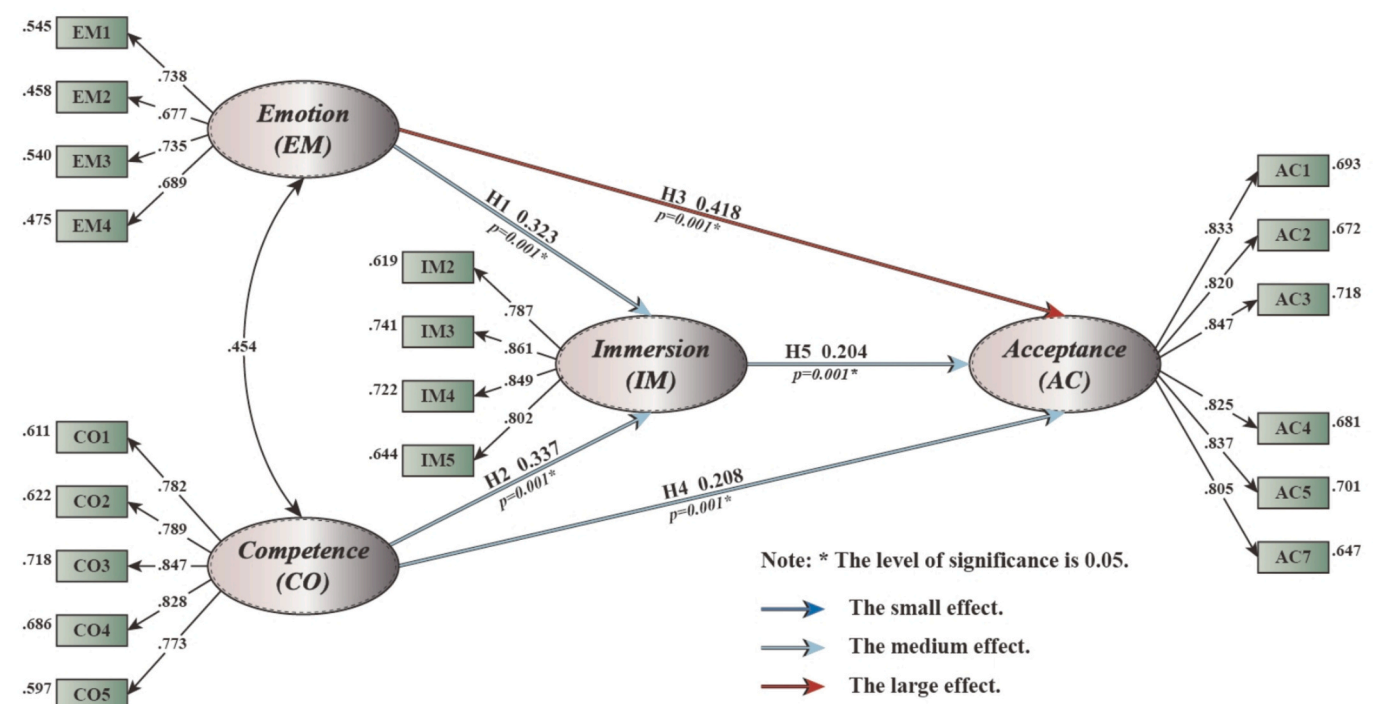


Fig. 1. Music-Driven Acceptance Model.

Table 12
Paths affect results.

Hypothesis	Path	Direct effect		Indirect effect		Total effect		Results
		β	Sig.	β	Sig.	β	Sig.	
H1	EM \rightarrow IM	0.323	0.001*	/	/	0.323	0.001*	Support
H2	CO \rightarrow IM	0.337	0.001*	/	/	0.337	0.001*	Support
H3	EM \rightarrow AC	0.418	0.001*	0.066	0.001*	0.483	0.001*	Support
H4	CO \rightarrow AC	0.208	0.001*	0.069	0.001*	0.277	0.001*	Support
H5	IM \rightarrow AC	0.204	0.001*	/	/	0.204	0.001*	Support

* The level of significance is 0.05.

Table 13
Results of moderating effect.

Path	Gender	
	CMIN	p
EM \rightarrow IM	3.647	0.056**
CO \rightarrow IM	1.379	0.240
EM \rightarrow AC	0.923	0.337
CO \rightarrow AC	0.247	0.619
IM \rightarrow AC	0.148	0.701

* The level of significance is 0.05.

** Approximately significant effect.

Table 14
Comparison results of path coefficients.

Moderating variable		Path	β	p
Gender	Male	EM \rightarrow IM	0.222	0.026*
	Female		0.401	0.001*

* The level of significance is 0.05.

in the context of the increasing prevalence of autism. Overall, we successfully addressed the research objectives and reached two key conclusions. First , watching online music performances is associated with

a higher level of audience acceptance of children with autism. Second, the emotions and competence displayed by children with autism during musical performances enhance audience immersion and acceptance, with emotions having a stronger influence on acceptance. Detailed discussions follow below.

Watching online music performances is associated with higher levels of audience acceptance of children with autism. Our study emphasizes music as a performative art form, innovatively focusing on the audience's perspective rather than solely examining its potential to improve social skills or offer therapeutic benefits, as seen in other studies (Marquez-Garcia et al., 2021). For children with autism, societal acceptance is a practical challenge that intersects with potential stereotypes, biases, and bullying. Learning music can support the active participation of children with autism in society, and preliminary findings suggest a positive association between audience watching of performances and increased acceptance levels. It is important to clarify that while learning music may be an effective strategy, it is not the only one. Additionally, our current findings are insufficient to definitively establish a causal relationship between watching performances and enhanced acceptance, nor do they offer strong evidence to further assess the strength of this relationship. This highlights the fundamental and meaningful value of music education. Our study provides novel insights into creating environments that respect and include neurodiverse groups. As Dawson, Franz, and Brandsen (2022) note, while adapting children's behaviors to align with neurotypical norms may enhance

future quality of life, the responsibility for fostering change in a diverse society lies with society itself—not solely with the autism community. We strongly advocate for inclusive environments for children with autism. We are encouraged by the finding that audience engagement with online music performances is associated with increased acceptance of children with autism. This conclusion underscores the promising potential of music education in advancing inclusive development.

Children with autism demonstrate both emotion and competence through online music performances, each of which positively influences audience immersion. While this conclusion appears balanced, it helps counter extremist views that place excessive emphasis on either emotion or competence, neglecting the importance of the other. This balanced perspective is essential for mitigating reduced learning outcomes caused by inappropriate educational strategies. As noted by Cardona et al. (2022), music can lead audiences into a state of full immersion. Audiences may be deeply moved by the rich emotions displayed by performers or captivated by their skilled and proficient competence. The core definition of immersion encompasses the audience's perception of time, space, and overall experience evaluation (Zhang et al., 2024), rooted in relatively complex mechanisms. Before this study, it was difficult to intuitively determine whether emotions or competence played a relatively greater role in fostering immersion. Our findings provide preliminary evidence, based on audience experiences within a specific context, to contribute to this ongoing debate in the field of performance art. Notably, in our model, two paths exhibit closely similar coefficients, further underscoring the importance of balancing emotional expression and competence training when developing music education strategies.

Emotions, competence, and immersion are all effective factors in enhancing audience acceptance of children with autism, with emotions demonstrating the greatest impact. Therefore, if the goal is to improve audience acceptance, educational activities should emphasize emotional expression through music while also addressing competence training. Lai, Pantazatos, Schneider, and Hirsch (2012) found that children with autism show greater activation in the left inferior frontal gyrus when listening to music compared to typically developing children. Molnar-Szakacs and Heaton (2012) noted that many children with autism exhibit a strong preference for music and can recognize emotions within it. Similarly, Johnson and LaGasse (2022) argue that music processing is one of the strengths of children with autism. Therefore, the conclusions of this study are highly relevant for devising appropriate teaching progressions and methodologies. As Dean and Nordahl-Hansen (2022) suggest, increasing exposure to more genuine and positive information about autism benefits societal acceptance of the autism community. Our study aligns with this perspective, suggesting that online music performances may serve as an effective means for children with autism to present themselves and dispel negative associations arising from misunderstanding. Importantly, we found that emotions and competence displayed during performances directly influence acceptance, without necessarily requiring audience immersion as an mediating variable. This suggests that shifting audience attitudes may not solely depend on the musical performance itself but also on how the emotions and competence exhibited by children with autism are perceived as positive information, stimulating audiences and enhancing acceptance. Consequently, we advocate for the beneficial role of music education for children with autism and encourage the exploration of more performance-oriented activities in practical settings, such as autism arts festivals (Fletcher-Watson & May, 2020) and musical theater productions (Thompson & Burke, 2020).

6. Research limitations and future studies

This study has several limitations that should be addressed in future research to more comprehensively fill existing gaps and enhance contributions to the field. First, we used questionnaire surveys to assess participants' perceptual changes before and after watching

performances in a general setting, without incorporating behavioral analysis methods like laboratory environments, precision instruments, or more complex tasks. This means that our study offers suggestions primarily for educational psychology and should not be referenced in the context of developmental disabilities or specific mental health conditions.

Second, exploring a more systematic and rigorous approach to questionnaire design could be beneficial. One challenge we faced was whether to frame performers and music as equally important elements in the questions, which could influence participants' responses, or to focus solely on the music, which might underemphasize the performer as a key part of the performance. Determining how questionnaire design affects responses, and identifying ways to minimize potential biases through design, would benefit from more rigorous multivariate analyses in future research.

Third, there is potential bias due to public expectation. Participants may have rated their acceptance levels higher than their true feelings due to prevailing social norms and values. While we implemented countermeasures such as anonymous responses and additional groups to observe response shifts, we acknowledge that social desirability may still influence the results.

Fourth, the duration of the video samples used in the study was relatively short. We used single-track video samples rather than complete concert footage, which could impact audience immersion experiences and descriptions. Further studies are needed to identify the optimal video length for evaluating immersion.

Fifth, our study's conclusions are based on children with autism rather than adults. Prior research indicates that acceptance levels may decrease as individuals with autism transition into adulthood (Furrukh & Anjum, 2020). Therefore, additional studies could examine audience perceptions of adults with autism in online musical performances to compare potential model differences.

Sixth, both performers and audiences in our study predominantly came from China and share a largely homogeneous cultural background. Conducting surveys in more countries would help assess the generalizability of the model. Additionally, exploring whether cross-cultural online musical performances similarly improve audience acceptance could provide valuable insights.

Seventh, the selected musical performance videos in this study originated from a single autism music group and did not represent a wider range of performer characteristics. Future research could examine audience acceptance across children with autism at different learning stages and within various musical performance forms, such as vocal and instrumental.

Eighth, while immersion has received extensive attention in user experience research, this study focused primarily on emotions and competence. There are likely other variables that could positively influence immersion, warranting further exploration and validation.

7. Theoretical contributions

This study proposes a model, termed the Music-Driven Acceptance Model (MDAM), focusing on how children with autism influence audience acceptance through online music performances. The model effectively explains how emotions and competence, as antecedent variables in music performances, impact audience immersion and acceptance, outlining pathways of influence and effect sizes. Specifically, we found that while emotions and competence contribute similarly to enhancing immersion, emotional expression proves to be a more effective mechanism for increasing acceptance. Through MDAM, we establish a foundational theoretical framework for research in music education tailored to children with autism. This model holds potential for expanding educational theory into more complex and extensive contexts, allowing for a deeper exploration of user behaviors related to music performances and audience experiences.

8. Managerial implications

This study offers guidance for music teachers and educational administrators working with children with autism in selecting teaching priorities and designing curriculum progressions. Music need not be appreciated in isolation. Following systematic learning, children with autism should have opportunities to showcase their musical performance abilities to audiences. Such performances can enhance audience acceptance of children with autism. A key finding is that music education should incorporate both emotional expression and competence. However, greater emphasis on learning emotional expression can be beneficial, as it has a stronger impact on enhancing audience acceptance of children with autism.

9. Conclusion

Overall, we are committed to promoting greater societal inclusivity for people with autism and enhancing their mental health, well-being, and quality of life. During long-term field investigations, we observed that many children with autism demonstrated a willingness to engage with music. For example, they actively requested sustained interactions with musical instruments (or toy instruments) or naturally displayed joyful expressions and bodily movements upon hearing music. This indicates that musical performances may be one of the activities that interest children. This study, by examining changes in audience acceptance after watching musical performances, provides instructional recommendations for music courses designed for children with autism. We found that both the competence in playing music and the richness of emotion in musical performances were associated with the audience's immersion and acceptance. Their effects on immersion were similar, but the association between emotion and audience acceptance was stronger. Notably, we found that immersion was associated with acceptance, and that female users were more likely to experience immersion due to the emotions in musical performances. The research results seem to indicate that teachers can prioritize the establishment of course objectives focused on expressing emotions through music. We must emphasize that the responsibility for increasing inclusivity should be borne by society rather than by children with autism. In other words, the fundamental purpose of engaging in musical activities is to satisfy the individual interests of children with autism, rather than serving as a utilitarian, audience-centered performance. It would be ideal if this process could also reduce potential prejudice, oppression, and marginalization.

CRedit authorship contribution statement

Chao Gu: Writing – original draft, Methodology, Conceptualization. **Yingjie Zeng:** Writing – review & editing, Visualization. **Wei Wei:** Software, Data curation. **Jie Sun:** Investigation, Formal analysis. **Lie Zhang:** Validation, Supervision, Project administration.

Institutional review board statement

This study was conducted according to the guidelines of the Declaration of Helsinki and received academic ethics review and approval from the review committee of the Ministry of Social Science, Changshu Institute of Technology. Our experiments informed consent was obtained from all participants and all methods were performed per relevant guidelines and regulations.

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Declaration of competing interest

The authors declare no conflict of interest.

Data availability

Data will be made available on request.

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