

DOCTORAL THESIS

Building Musical Lives

The role of musical play in promoting interaction, creativity and social development for autistic children and their families

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Building Musical Lives: The role of musical play in promoting interaction, creativity and social development for autistic children and their families

By

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Abstract

Musical environments have been observed to be highly engaging for autistic children, ameliorating barriers often experienced in everyday communication and interaction. Musical play provides an ideal space in which to support and encourage engagement with caregivers and peers, as well as self-expression for this group. Over 12 months, 25 families with autistic children between the ages of three and eight years participated in an innovative home-based musical programme based on the Sounds of Intent in the Early Years framework of musical development, which was designed to encourage parents to help their children engage in musical play in everyday life. A mixed-methods approach was adopted, including the qualitative analysis of interviews and diaries, alongside observations of musical play and quantitative behavioural measures that explored the role of musical spaces for supporting interaction, creativity and development in autistic children. The findings showed that music was widely used as a tool by parents to orientate their children in their home environments, scaffolding routines, enhancing communication, and supporting emotional regulation. Significant changes in musical and interactive behaviours were observed over the course of the intervention, alongside significant improvements in social communication, highlighting possible interactions between musical play and wider development. More broadly music was found to facilitate shared enjoyment and emotional regulation. Crucially, the strategies were those that parents themselves could undertake with their children. There is a growing need to recognise and develop safe spaces to support autistic children and their families. This research highlights how a music programme using an accessible model can be implemented across community and informal educational settings.

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1 Introduction

As a social, creative, and expressive medium, music is pervasive across cultures and age groups. From the lullabies of infancy and the musical ‘doodlings’ of early childhood (Kartomi, 1991) we are embedded in our cultural and musical worlds, using music to regulate our emotions, form collective experiences and negotiate our environments (DeNora, 2000, 2014). Arts-in-health approaches have long utilised these dynamics of musical environments for multiple purposes, including to alleviate pain, build mental resilience, support regulation, and promote social connectivity (Ruud, 2010). For young and vulnerable groups, the experiences of music-making have also been linked to wider developmental outcomes, including supporting social development, promoting prosocial bonding, and nurturing self-regulation (Kim et al., 2008; Kirschner & Tomasello, 2010; Williams et al., 2015). These principles are embedded across music therapy and music education where musical experiences are recognised as both individual and participatory mediums for co-creation, empathetic understanding, and creative development, which can help people to flourish (DeNora & Ansdell, 2014). In the current project, the potential benefits of these myriad impacts were explored for autistic children, focusing particularly on how these benefits can be employed successfully with an accessible model of everyday music-making. Building on the evidence of arts-in-health approaches that recognise the wider impacts of music (Ruud, 2010; Fancourt, 2017), it sought to integrate musical strategies into the everyday lives of autistic children and their families through a programme of parent- and researcher-led home musical play. This builds upon the widespread and emphatic accounts from parents that highlight the heightened musical interests and abilities of their autistic children in comparison to their often limited verbal and cognitive abilities (Ockelford, 2013a; Lisboa et al., 2021).

My first interest in this area began through my own musical training, practicing in the presence of my autistic brother. I began to notice how he would gravitate to the rooms where I was playing,

peering through the window, sitting and listening in a rare moment of quiet. I could hear him starting to repeat the melodies, singing them to himself as he went to sleep. This interest grew as he began to work out these same melodies on the piano, trying to play many of the pieces that my siblings and I, as younger children, had learnt. These were always ‘together tasks’, time to spend with another and share in the working out and playing of the music. As he developed musically, those shared moments on the piano became increasingly as a way to thrive and excel, relishing in communicating and playing with others through his remarkable musical memory and interest. As I began my academic journey, first as an undergraduate and then in my master’s studying music, the uniqueness autistic individual’s perception of music was therefore of particular interest to me, and it’s capacity to scaffold important spaces of togetherness for them. Research that highlighted how dynamics of musical spaces were unique for providing moments of connection, interaction, bonding and expression (notably Kim et al., 2008, Rabinowitch et al. 2012 and Kirschner & Tomasello, 2010) echoed my own experiences with my brother. This therefore led to the springboard questions for the current thesis – what is it about musical spaces that create such a powerful shared experience that spans across perceptual boundaries, and in what ways is this important for autistic children and their families? For autistic children (like my brother) who are regularly excluded from research; those with behavioural difficulties, limited language or profound communication challenges, these needs were all the more acute, but the most understudied. From my own experience, I knew how important music was to my brother’s own identity, wellbeing and socialisation, but evidencing this was crucial to developing supports for families like mine to support their children in the future.

The project is situated within a wide research field that recognises the value of musical spaces as potentially alleviatory for autistic people, scaffolding expression often unavailable in normative environments (Ockelford, 2013). Historically, music has been frequently linked to autism, with numerous examples of exceptional musical talent and many people demonstrating remarkable capacities for learning and pitch recognition (Heaton, 2003; Ockelford, 2011). For autistic children in

particular, the dynamics of creative spaces provide opportunities to engage with others within a mutually understood, safe space. Others within therapeutic fields have further identified the value of music for autistic children to regulate, interact and develop (Geretsegger et al., 2014), supporting the growing recognition of the latent opportunities of arts approaches to promote developmental change across multiple domains for neurodiverse individuals (Goldstein et al., 2017).

Autism as a condition was first identified in Leo Kanner's landmark paper 'Autistic Disturbances of Affective Contact' (Kanner, 1943), where he studied eleven children who all displayed a similar collection of behaviours, notable of which were 'extreme autistic aloneness; obsessive desire for the preservation of sameness; delayed echolalia and hypersensitivity'. Since Kanner's first identification, both clinical and cultural understanding of autism as a neurodevelopmental condition have developed significantly, and currently it is estimated that autism affects 1 in 100 individuals in the UK (Happé & Frith, 2020). Understanding of the neurodevelopmental aspects of autism posits that it is traditionally onset in childhood and can qualitatively impair behaviours and the development of communication and reciprocal social interaction (APA, 2013). However, the varying experiences of autistic people have also led to an emphasis on the role of environment and appropriate supports as further factors in development (Astle & Fletcher-Watson, 2020). The complexity of autism as a condition and the variability of those who experience it is reflected in its definition as a 'spectrum' condition with inherent variabilities between different groups; from those who are overly verbal (hyperlexia) to the minimally communicative, while also encompassing those with additional intellectual, communication or attention deficit disorders. To reflect priorities across the autistic community, this thesis will use both 'autistic person/child' or identity first language, which has strong support in the autistic community, as well as person-first language or 'child with autism' which has also be shown to be preferred among many when communicating about autism (Fletcher-Watson & Happé, 2019).

The approach of the current project is based within a theoretical context that conceptualizes how musical spaces can be alleviatory and the known benefits that musical environments can have. Arts-in-health research is built on the significant amount of evidence in qualitative and epidemiological studies that have emphasised the use of music as a scaffolding device in everyday life, both to *smooth* our interactions with the external world and to regulate our own emotional well-being (Batt-Rawden et al., 2007; Ahmadi, 2011; Cuypers et al., 2012). Indeed, the mediatory capacities of music can be understood through the lens of musical entrainment, where the sonic space or “nested acoustic environment” can afford possibilities for emotion regulation and social coordination (Krueger, 2011, p. 1). Within this framework, shared musical spaces, from the imitative turn-taking of musical play to the reflexive improvisation music therapy, can be conceived as platforms upon which intentionality and understanding can be built using predictable, mutually understood symbolic and gestural communication. For autistic children accessing these spaces, positive behaviours that may be impeded in everyday contexts can be approached and scaffolded in an unthreatening space. This theoretical understanding of musical scaffolding further draws together two developmental, theoretical strands: (i) Vygotskian developmental ‘scaffolds’, where interaction with societal and environmental influences shape growth, particularly interactions between children and teachers (Vygotsky, 1980; Berk & Winsler, 1995) and (ii) Bronfenbrenner’s bioecological theory, which emphasises the importance of ecological research, and the person-context interrelatedness within human development (Bronfenbrenner, 1979, 2005; Tudge et al., 2009). The ‘context’ of the musical space can play a crucial role in shaping interaction and development, providing an accessible environment where behaviours may be modelled and experienced.

Both Bronfenbrenner and Vygotsky emphasise the importance of environment in shaping children’s development and the inclusion of these perspectives to make research ecological valid (Greene & Hogan, 2011d). As musical play is ubiquitous in early childhood and an important site for development, expression and creativity, it is highly relevant to autistic children’s own musical

development (Adachi et al., 2012; Barrett et al., 2012; Janzen & Thaut, 2018). Yet naturalistic observations of musical play remain rare within the evidence-based research into autism, which is primarily reliant on the therapy room, lab-based strange situations or mediated by highly trained therapists. This means far less is known about the enactment of musical behaviours within the everyday lives of autistic children, which are crucial both to understanding the role of music for development and to providing appropriate guidance for caregivers to support the potentially beneficial outcomes that therapeutic and arts-in-health approaches offer.

As psychological theories move away from the core-deficit hypothesis that identifies a single mechanistic impairment for the observed cognitive profile of autism (Astle & Fletcher-Watson, 2020), the approach to music and autism requires similar changes in modes of inquiry. As Janzen and Thaut (2018) have argued, the remit of autism and music research needs to be expanded to consider how music may act as a space of development and regulation. While the understanding of the developmental trajectories of musical ability for autism is still in its infancy, our knowledge of the perceptual and cognitive styles of autism, alongside evidence from caregivers and musical educators of those with autism, suggest that autistic children may be able to meet, or even exceed, music-developmental expectations with the right support (Ockelford, 2013, 2016). This in turn has implications for how musical programmes and access to music for autistic children and their families are framed in the future – as shared spaces to scaffold communication, play and regulation in everyday life. This can shed light on how children develop within this space and enable us to understand more clearly the mechanisms through which social and communicative development may be occurring. As with the model of intervention designs for autism in psychology and psychiatry, musical supports have been most often orientated around diagnostic criteria, with a focus on how music interventions can impact upon relevant behaviours, most notably social communication change (Geretsegger et al., 2014; Astle et al., 2021). Often, considerations of the role of music for supporting wider developmental and wellbeing goals are not considered, and such approaches

excludes the experiences of the participants themselves (particularly those who cannot express themselves verbally), as well as neglecting the dynamics of musical environments (Janzen & Thaut, 2018).

Addressing this lacuna, the project followed 25 families over the course of 12 months, including four home visits to each family, to explore the role of music in their everyday lives and assess the impact of a home-based musical programme on autistic children's musical abilities, musical play experiences and wider developmental changes. It further trialled a set of flashcard resources that detailed ideas and games, which were designed specifically to facilitate musical play and promote the wider development of autistic children. Using parental interviews, direct observation of children's musical play and the analysis of behavioural change, the impact of the resources and the wider changes observed during the musical programme are discussed in the course of this thesis. It will contextualise the observed musical play and musical development within wider behavioural changes. It will also further explore how music is used in everyday life to negotiate transitions, relationships and playful activities, and its perceived importance as a scaffold for development and well-being.

Therefore, my research questions are as follows:

(1) How do the musical abilities and engagement of young children on the autism spectrum develop over time?

1.1 What changes in musical skills and engagement were observed over the course of the project?

1.2 How do autistic children's musical development align with current music- developmental models?

1.3 What are the observed patterns of growth of autistic children's musical development?

- (2) What is the role of music in the daily lives of autistic children and their families?
- 2.1 For what purposes is music incorporated into everyday routines?*
 - 2.2 What is the impact of everyday music-making for supporting family and individual wellbeing?*
 - 2.3 How well can naturalistic programmes be incorporated into everyday routines?*
- (3) How can musical play promote the development of social competencies and impact wider developmental outcomes of young children with autism?
- 3.1 What is role of musical play in scaffolding social interaction for autistic children?*
 - 3.2 How does interactivity in musical play develop in autistic children?*
 - 3.3 Can musical play impact upon wider developmental goals for autistic children, and in what ways?*

This thesis comprises eight chapters. Following this introduction, Chapter 2 presents the background of autism, including current theoretical and cognitive models of the condition. It then reviews the literature in the field of music and autism including musical-behavioural interventions, music therapy approaches alongside current models of musical development and musical play in early childhood. Chapter 3 details the rationale, design and methods of the ecological, multi-dimensional mixed methods approach taken. Firstly, it outlines the theoretical background and relevance of ecological models for naturalistic, musical-intervention research, then examines these ecological principles for parent-led methodologies. It subsequently details the musical resources that were designed for the project and given to the parents to promote musical play, and the play procedures that were conducted at the home visits. This is followed by details of the mixed methods employed, firstly in the Pilot study, and then in the Main study, including descriptions of data collection and analysis of qualitative (interviews and diary entries) and quantitative (observational and behavioural measures) data. Chapter 4 presents the findings from the pilot project, which trialled the resources and the observational framework with a smaller group of families. It details the initial findings of the

effectiveness of the resources, the process of development and validation of the observational framework and the subsequent alterations to the design and resources that were made before the main study.

Chapter 5 is the first of the results chapters and presents the findings relating to the children's musical development, using both qualitative analysis of the parents' experiences of observations of musical change in their children and quantitative analysis of music-developmental change. Chapter 6 then presents the findings concerning the role of music in everyday life and the significance of musical play for the families. Qualitative findings from the thematic analysis are presented, followed by quantitative results from both musical play and wider developmental change are detailed in light of these findings. Chapter 7 discusses the results of the project in relation to the research questions and the results presented in Chapters 5 and 6, with consideration of how this links to pre-existing work in the field. It further examines the role of the resources developed during this project, and the implications of these for future approaches. The concluding chapter will summarise the findings of the project and considers both the limitations of the project and future research direction

2 Literature Review

2.1 Chapter Outline

This chapter will outline the theoretical and practical research backgrounds to music and autism research, and its relevance to the thesis research questions. To contextualise the previous approaches of music for autistic children, this chapter first outlines the behavioural profiles of autistic children, the current cognitive and developmental models in the field and how these have previously been incorporated to early intervention strategies (2.2: *Cognitive, Behavioural and Developmental Models*). It then expands upon the theoretical foundations for the study, including the role of musical environments for scaffolding interaction, play and understanding for both neurotypical and autistic children (2.3: *Musical Environments: scaffolds, play and regulation*). This provides the theoretical underpinning for the previous musical approaches concerning music and autism (2.4: *Autism and the Musical Environment*), including musical processing in autism and uses of music therapy for both autistic children and those with profound and multiple learning difficulties. Finally, current music-developmental models are also explored to inform how processes of change can be understood in both neurotypical and autistic children (2.5: *Musical Development*).

At the heart of this review are enquiries that attempt to understand the dynamics of musical environments for autistic people and their potential benefits for supporting development and wellbeing. From examining the impact of behavioural intervention programmes to substantiating perceptual models, these approaches are built upon observations that differences associated with autism appear to be less apparent in musical environments, leading to speculation that music-making may be an alleviatory space for interaction and expression. This has been the focus of many intervention programmes using music for autistic children, which have harnessed the interactive dynamics of musical spaces to highlight links between music and wider behavioural, particularly

social, change. Yet both the complexity of musical environments and the heterogeneity of the autistic phenotype mean that drawing causal links between musical and behaviour change remains a challenge. A particular lack of scrutiny on the musical environments themselves within this research has also limited understanding of processes of change during musical engagement.

2.2 Cognitive, Behavioural and Developmental Models

2.2.1 Behavioural Characteristics of Autism

In the current diagnostic criteria, the 5th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5: APA, 2013), autism is classed as one category, with diagnosis requiring atypical behaviours in both social-communication domains, and restrictive and repetitive behaviours.

A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history:

1. Deficits in social-emotional reciprocity.
2. Deficits in nonverbal communicative behaviours.
3. Deficits in developing, maintaining, and understanding relationships.

B. Restricted, repetitive patterns of behaviour, interests, or activities, as manifested by at least two of the following, currently or by history:

1. Stereotyped or repetitive motor movements.
2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behaviour.
3. Highly restricted, fixated interests that are abnormal in intensity or focus
4. Hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment.

(DSM 5)

In its current form, DSM-5 also includes a severity estimate, ranging along 'a continuum from mild to severe' (APA 2013). Across multiple diagnostic measures, the primary behavioural identifiers consist of difficulties in social interaction and communication (Baron-Cohen, 2004). While understanding of the neurobiological markers of autism are growing, the condition is still diagnosed on the basis of observed behaviours as highlighted above. In practice, every child with autism presents differently, and a complex constellation of language, sensory sensitivities and co-morbidities such as epilepsy are also a core part of autistic experiences (Leekam et al., 2007; Fletcher-Watson & Happé, 2019). These diagnoses are made from as young as eighteen months with the average age of diagnosis point of 42 months (Salomone et al., 2016), as communication and reciprocal behaviour fail to develop or develop atypically. Barriers pertaining to diagnosis remain, particularly for those with socio-economic disadvantage or those from ethnic minorities (Daniels & Mandell, 2014). Historically, boys have also been far more likely to receive a diagnosis than girls, at a ratio of around 5:1 (Fletcher-Watson & Happé, 2019). However, there is growing awareness of differences in the female profile of autism, which appears to manifest differently to the typical (male) definition, and thus it is likely that it has been historically significantly under-diagnosed. There is also significant heterogeneity in the language abilities of children diagnosed with autism. While it is estimated that between one third and one half are non-verbal, the proportion is much smaller among those who received very early intervention (Wetherby, 2006).

At a behavioural level, research has identified that social-communication differences in autistic children are observed in multiple domains. Notably, they demonstrate limited capacities for joint attention; the ability to coordinate their attention flexibly between people and objects. They can also be limited in their ability to use and understand symbols, which is essential in developing shared meanings and learning conventions, and contributes to the establishment of gestures, language, imitation and play (Wetherby, 2006). Other communication difficulties in autism also include initiating and responding to communication for reasons beyond joint attention, such as requesting

and protesting, establishing and maintaining friendships, understanding language pragmatics and semantics. These difficulties are further reflected in differences in communication observed in young, autistic children. In the early years, some have observed that autistic children communicate only to regulate the play and actions of others, not for social goals (Charman & Stone, 2006). Instead, their interactivity is premised on seeking to gain or prevent behaviours from others. Aside from social and communication difficulties, abnormalities in emotional regulation have also been observed (Samson et al., 2014), which can in some cases lead to tantrums, self-injurious behaviour and mood dysregulation (Lecavalier et al., 2006; Prizant & Laurent, 2011). The dynamics of play have also been highlighted as different in autistic children, with less spontaneity and pretend play being observed (Hobson et al., 2008), including social games such as 'peek-a-boo' with caregivers (Clifford & Dissanayake, 2008). Although the focus of much research has been placed on the social atypicality of autistic behaviours, the heterogeneity of the condition means that many present with an array of behavioural differences, which for those with the highest support needs can profoundly impact upon everyday life. This creates challenges for building appropriate supports and designing interventions, as each requires a highly individualised approach (Astle et al., 2021). What is also clear is that factors including the presence of additional intellectual disabilities and co-morbidities, as well as complex socioeconomic and environmental influences, all contribute to the severity, presentation and trajectories of autism for the individual. Particularly these factors additional impacts on everyday functioning, and how it will continue to impact upon their mental and social wellbeing in the future.

2.2.2 Cognitive Models

As research in the field continues to grow and the patterns of behaviours that fall under the umbrella of autism become more varied, a cognitive model that can explain all the underlying features of the condition remains elusive. Historically, psychological research has tended to focus on the core domains of autism, looking for cognitive mechanisms, underlying features and neurobiological markers that can explain the differences in social interaction, repetitive and

restrictive behaviours, and sensory experiences of autistic people, with research overwhelmingly focused on the social dimensions of the condition (Fletcher-Watson & Happé, 2019). This has been reflected in research and intervention approaches, which have used diagnostic criteria to target behavioural change (Astle et al., 2021). Historically, many of the theoretical attempts to characterise these deficits have sought to identify a single cognitive mechanism. One primary deficit model that seemingly provided this was 'Theory of Mind'. Its first proponents, Simon Baron-Cohen, Alan Leslie and Uta Frith proposed that the social interaction and communication difficulties observed in autism were due to problems 'mentalising', or understanding others states of being, intentions and beliefs (Baron-Cohen et al., 1985). They observed that 'Theory of Mind' (ToM) – the ability to attribute mental states to both oneself and others in order to understand our actions and behaviours – did not appear to be present in autistic children's behaviour, or in their pretend play. Theory of Mind is regarded as crucial for everyday interactions, cooperation and understanding with others, and the apparent failures in ToM tasks by autistic children led to the identification of this meta-representational (ToM) deficit as at the core of autism behavioural and social problems (Baron-Cohen, Leslie & Frith, 1985). What underlying deficit models (such as ToM) posit, is that these initial delays lead to further differences, which then continue to affect developmental trajectories. This is supported by observations of autistic children that have highlighted that while they do communicate, it is usually not for social goals (Charman et al., 1997), and others have pointed to the lack of pretend play (Wing, 1996) as evidence for the lack of meta-representational cognition (to understand and represent others thoughts and their subsequent actions).

While primary deficit models such as these have been useful for researchers to understand how patterns of behaviour could be linked by disruptions in underlying cognitive mechanisms, the continuum of differences in social behaviours in autistic people present a more complex picture. For

example, the false-belief tasks¹ that are the ‘gold standard’ for identifying ToM abilities have been identified are not an entirely reliable indicator, with some autistic people able to pass each time (Happé, 2015). As understanding that others can have different perspectives is a key part of neurodevelopment, the apparent early failures of this in children with autism have been used by some to identify cognitive explanations for difficulties in empathy and social understanding (Baron-Cohen et al., 1985). But the inconsistency of this measure would suggest that although delays may be present, some autistic people are able to develop strategies to work around their problems with ToM. Differing explanations, including that ToM is primarily a developmental delay that some may acquire through teaching or intervention, or that it is closely associated with IQ and intellectual disability, have further led to suggestions that autistic children’s difficulties in mentalising tasks may be explained by difficulties in more general processing (Iao & Leekam, 2014; Fletcher-Watson & Happé, 2019).

The heterogeneity of autism as a condition has further highlighted how one simple mechanism or deficit is unlikely. The growth of autism research at a developmental level has led to distancing from the monolith of Theory of Mind as a fixed indicator for social-cognitive theories of autism.

Researchers have also identified how other, more subtle differences in the way that autistic children interact with their environment may lead to the development of behaviours that characterise autism (Happé, 2015). Factors including lack of attentional bias towards a facial stimulus (Jones et al., 2008; Chawarska et al., 2012) and differences in eye tracking (Klin et al., 2002) have highlighted how small disruptions may lead to missed opportunities in social learning at crucial developmental stages,

¹ In false-belief tasks, such as the Sally-Anne task, children are asked to predict a character’s (Sally’s) actions. Sally leaves an object in one location (a basket), which is subsequently moved once Sally is out of the room (to a box). The children are then asked where Sally believes the object to be. This type of false belief task is used to measure whether the children recognize that Sally has different perspectives to their own. Typically, children over 4 are able to understand that Sally has different beliefs and perspectives, as she has not seen the object being moved and therefore point to the basket, whereas children under 3 point to the box. Successful completion of the Sally-Anne task indicates that the child can understand that others have unique beliefs that are different to their own – called ‘Theory of Mind’.

which thus lead to differentiated developmental outcomes, such as difficulties in joint attention, emotion recognition and ToM abilities, such as false-belief comprehension.

As the growing repertoire of approaches to developmental research in autism now emphasise, cognitive models are still inadequate in accounting for the vast differences and complexities of social cognition in autism (Happé, 2015). The stereotypical 'autism' of autistic aloneness that characterised the early years of research since Kanner's original paper has been overturned in favour of a more multidimensional account of autism. Diversifying research methodologies and involving key stakeholders, including autistic people themselves, have led to further insights in the field (Happé & Frith, 2020). As reports from observations, caregivers and autistic people have emphasised, those with autism can and do seek out social engagement and find it rewarding. However their approaches present differently from neurotypical behaviours and therefore historically have been characterised as antisocial (Kapp, 2020). This has been conceptualised as a 'double-empathy' problem, where the social differences can be explained as misunderstandings between two individuals with different social styles (Milton, 2012). As Crompton et al. (2020) found, communication between autistic people was highly effective, in comparison to exchanges between autistic people and their neurotypical peers, which suffered from clear disruptions in information transfer. Their results support similar studies that have also shown how neurotypical people struggle to recognise emotional expressions of autistic people (Sheppard et al., 2015).

The emerging research of this kind in the field indicates that the dimensions of social cognition in autism are far more complex than the deficit-driven narratives assume. Furthermore, the predominantly social-cognitive theories outlined above are inadequate in explaining some of the non-social features of autistic behaviour. In particular, they do not account for sensory and processing differences that are observed across the spectrum (Leekam et al., 2007). Domain-general interpretations, which consider wider attributes including attention and executive functions (such as

working memory, self-control and multitasking) may provide an insight into the underlying processes, and indicate that some of the early features of autism may not be entirely social-specific (Skripkauskaite et al., 2021). These information-processing models also offer the opportunity to account for both social and non-social differences at the perceptual level, taking into account how autistic people interpret and interact with their environment, and how this might in turn impact upon wider development and cognitive styles.

One of the most prominent theories of this kind is the weak central coherence theory (Frith & Happé, 1994). It postulates that autistic people have a preference for processing local or small level details, but that this is at the expense of the global whole or 'central coherence'. Frith suggests that a lack of central coherence is caused by a specific imbalance in integration of information at different levels, and this imbalance is the key characteristic of the difference in the autistic cognitive style (Frith, 1989). In neurotypical processing, detailed information tends to be drawn together to construct higher level meaning – the 'gestalt' (where the whole is perceived to be more than the sum of its parts). However, in autism central coherence is disturbed, thus resulting in the perceptual preference for local or low-level detail. Autistic abilities observed anecdotally, such as picking out tiny threads on a patterned carpet, noticing small changes in shelving arrangements, or perfect pitch abilities, have also been attributed to a weak central coherence (Frith & Happé, 1994), and highlight how local forms of processing that privilege detail can manifest in perception, taking precedent over global forms of processing that draw together the constituents of perceptual information to construct higher-level meaning. Much of Frith's original research suggested that central coherence theory can explain differences in autistic perception, identification, and comprehension, as autistic people do not always interpret individual words, objects or behaviours through a contextual lens (Happé & Frith, 2006).

Further research has identified that while weak coherence may be a distinct cognitive style, it does not necessarily represent a deficit, for when autistic individuals are alerted to the need to contextualise meanings, they are able to do so, indicating a preference for local processing, rather than an absence of global processing. One of the advantages of Frith's theory is that it is able to account for strengths as well as weakness in autistic development, such as strong pitch perception abilities and visual memory. This preference for local processing domains has been further expanded upon by Laurent Mottron's enhanced perceptual functioning model (Mottron et al., 2006). It details how a superiority in local processing may not necessarily be at the expense of global processing but may complement it.

What the theoretical models outlined above reflect is that understanding autism at the cognitive level remains varied, and none of the models fully account for the complexities of autism as a condition. Primary deficit models, such as ToM, are now regarded as too limited in their attempt to identify a single mechanistic feature of autism, although these accounts have been useful in drawing attention to how we understand others' perspectives. Cognitive difference models, such as weak central coherence, and enhanced perceptual functioning, demonstrate an attempt to interpret autism through a non-social lens, but again these accounts struggle to capture the huge diversity in autistic experiences. What is now emerging is that multidimensional accounts are needed that can account for both the strengths and weaknesses in autistic people, their everyday functioning and development. While some of these accounts offer competing interpretations, many of the theories need not be mutually exclusive, with each forming part of the description of a complex developmental fabric. For example, a perceptual cognitive style that biases local processing is compatible with a developmental model that identifies subtle disruptions in social behaviours such as eye tracking or joint attention, which lead to wider social difficulties. Few of the theories above are entirely mechanistic, highlighting how core-deficit hypotheses are becoming less relevant to the field than multi-dimensional, developmental constructs (Astle & Fletcher-Watson, 2020). As is now

recognised, the heterogeneity of the autism phenotype is also likely due to a number of factors including different genetic predispositions, parental characteristics, socio-economic status and access to early and specialised treatment (Fountain et al., 2012). Family studies have further indicated that there are multiple aetiologies along with multiple genetic predispositions (Fletcher-Watson & Happé, 2019). This has led some researchers to argue for a ‘fractionated triad’ which emphasises how various and separate psychological factors and genetic influences can impact on the behavioural presentation of autism (Happé & Ronald, 2008).

In line with the variety of presentations, cognitive styles and symptomatology, research is now increasingly looking to seek to understand more about how to support autistic people in a neurotypical world; both nurturing the differences in cognitive style while also alleviating the multiple and often profound difficulties that they experience in everyday interactions, and how to support and accommodate those differences in their personal and professional lives. This includes both developing strategies for autistic people to learn and cope with their condition and teaching those around them how to nurture and understand autism in order to allow autistic people to thrive (Lai & Szatmari, 2019). This has also been recognised in a general shift in the research and therapeutic priorities, from symptom reduction and normalisation to supporting and embracing autistic needs (Happé & Frith, 2020). Understanding the difficulties that those with autism experience in understanding and engaging with their environments can further help researchers, practitioners and caregivers to develop strategies to ease these environmental stressors, and support autistic child’s development to thrive and reach their potential (Fletcher-Watson, 2018; Leadbitter et al., 2021).

2.2.3 Developmental Trajectories

As the majority of those with autism are diagnosed in infancy, the role of early intervention has received a significant amount of attention, with some approaches targeting 'symptom reduction', and others having more specific outcomes such as increasing verbal communication or social responsiveness (Zwaigenbaum et al., 2015). Although early intervention has been identified as a way of potentially ameliorating some characteristics of autism, there is no 'cure'. Most children retain their diagnosis into adulthood but longitudinal research into ageing in autism, including developmental trajectories, is still limited (Howlin & Magiati, 2017). While some have noted that symptom severity tends to remain stable across the person's lifetime, other research has indicated that there is substantial diversity in developmental trajectories (Fountain et al., 2012).

Using data from a large Californian cohort of children with autism over a decade, from early childhood to adolescence, Fountain et al. (2012) identified six distinct communication, social and repetitive behaviour trajectories: high-functioning, bloomers, medium-high, medium, low-medium and low-functioning. Across the cohort, they found steady increases in communication in all the groups over time, with the most rapid increases observed up to the age of six. However, there was significant heterogeneity in these pathways, with those in the higher functioning groups at the start developing far more rapidly than those with lower functioning trajectories, whose progress was relatively flat, with the lowest group improving no more than 10% over the timeframe. One particular group, 'bloomers', was identified as having particularly high levels of development. Children in this category began with lower scores, compared to those on lower-functioning trajectories, but then improved steeply, in line with the higher functioning groups. The authors found that this group also differed in socioeconomic characteristics from the cohort as a whole, being more likely to have more educated, non-minority mothers and were mostly without intellectual disability. Overall, the trajectories and scoring in higher-functioning or lower-functioning domains were further dependent on factors including age at diagnosis, and parental and community resources. As the authors highlighted, although they were unable to identify specific mechanisms by

which socioeconomic factors directly impacted on developmental trajectories, the results suggest that there are complex environmental variables at play, including access to early intervention, quality of education and parental efficacy (Fountain et al., 2012). As others (Zwaigenbaum et al., 2015) have also indicated, early intervention that includes appropriate supports for both family and child, with strength-based approaches that capitalise on everyday activities, are most effective at promoting longer term development. Therefore, identifying appropriate strategies and supports for the youngest children, particularly those who are at socio-economic disadvantage, is essential for building positive future outcomes.

2.2.4 Early Intervention

The conclusion of much of the cognitive and developmental research into autism is that early intervention can be one of the most effective routes to help autistic children (Zwaigenbaum et al., 2015). This is perhaps unsurprising; it is strongly emphasised within both policy and research that access to quality early childhood education is one of the most significant factors in children's language, social and cognitive development and future attainment (Berlin et al., 1998; Sajaniemi et al., 2010). Investment in early years education and creating supportive environments for development and learning are regarded as one of the most effective ways to support children at a higher risk of compromised development (Sylva et al., 2004; Burger, 2010). Programmes that can aid these developmental pathways, by creating opportunities for play and learning with peers, have an important role in reducing the risk of social marginalisation and enhancing pathways for development. For autistic children, designs of early-intervention programmes have a more complex legacy, ranging from supporting verbal development and emotional regulation, to reducing adverse behaviours such as self-injurious behaviours. Many of these methods include elements of rote conditioning, which emphasises repetition and memorization of actions rather than understanding, to repress autistic behaviours and normalise communication and social interaction.

The goals of these early-intervention strategies have historically focused on specific behavioural modification goals, such as increasing eye contact, verbal communication, or targeting the 'core autism features of impaired reciprocal social communication and interaction' (defined as Early Intensive Behavioural Interventions [EIBI]), to more general community and family-based interventions (Zwaigenbaum et al., 2015). Prominent examples of early intensive behavioural interventions include Applied Behavioural Analysis (ABA) (Foxy, 2008), and the Early Start Denver Model (Dawson et al., 2010; Rogers et al., 2012), which have historically focused on the rote learning of behavioural autonomy through repetition and conditioning. Although the goals of ABA have somewhat shifted over the years, the principles of ABA have attracted criticism from autistic advocates, clinicians and researchers from both scientific and ethical perspectives. The design of EIBIs with their use of repetition, learned set behaviours through conditioning, and intensity with the goals of attempted elimination of autistic behaviours and interests have been questioned as fundamentally flawed in their assumptions that prerequisites such as eye contact, are required for more mature forms of social interaction to develop. The practices of ABA have also been called into question following the voiced experiences of autistic adults who underwent intervention in early childhood and who have described the practices as abusive. The initial evidence base of EIBIs have also been questioned, with researchers noting that it is too reliant on laboratory settings that lack generalisation (Zwaigenbaum et al., 2015). Despite this, ABA approaches continue to be used across research and clinical contexts; its legacy as an intervention with long research history which has shown effectiveness has meant that instead of abandoning ABA altogether, approaches using naturalistic approaches of ABA are now being used that are informed by the experiences of autistic people.

Many of the outcome measures of early interventions for autistic children have been criticised as overly focused on normalisation and the reduction of problematised behaviours, with less focus on

individual trajectories of growth (Fletcher-Watson & Happé, 2019). Outcomes of early intervention still primarily focus on the gains in social engagement, reciprocity and language, and their relationship to normative functioning. Yet some interventions are now shifting to recognise a more holistic approach. Amongst the youngest children the role of parents and families has always been noted as an important factor in success (Myers & Johnson, 2007). Other models have now emerged that combine some of the principles of ABA with knowledge of typical child development – for example the Early Start Denver Model. This approach uses relationship-based, developmental strategies to embed behavioural teaching within a structure that responds to the child through their play and own interests (Rogers et al., 2012). The ESDM is complemented by the parent mediated ESDM, which recognises the role that parents, and caregivers can play in generalising behavioural skills in everyday interactions. During P-ESDM training, parents are shown how to promote play with their children while also being sensitive to the developmental behaviours such as joint attention, non-verbal communication, and imitation. Results have indicated that parental implementation can be as effective as child intervention alone (Dawson et al., 2010; Estes et al., 2014). This importance of teaching strategies to parents to help nurture their child’s development and communication has led to further research that looks specifically at the role of communication-based, parental guidance interventions (Aldred et al., 2004). This found that individually tailored programmes that address the bidirectional adult-child communicative relationship and joint attention were effective. This lends further credence to the growing evidence that many of the social difficulties observed in autism may be due to a mutual misunderstanding, a ‘double empathy’ problem (Milton, 2012), rather than a deficit in social communication.

Naturalistic interventions, that place families at the heart of the approaches, alongside strategies that promote play, are now widely regarded as best practice (Zwaigenbaum et al., 2015).

Individualised approaches, with a focus on strength-based supports, have been further emphasised as elements that should be integrated into intervention strategies in order to support autistic

development in line with the principles of neurodiversity (Fletcher-Watson, 2018). Many of the principles of early intervention still apply, without the emphasis on potentially traumatic strategies that can lead to further negative impacts on wellbeing. Instead, early interventions that align with a neurodiversity framework have emphasised the importance of positive, natural development by focusing on wider range of environmental and individual factors. This includes fostering mutual communication, providing outlets for enjoyable interaction and creating strategies to reduce triggers and sensory difficulties (Leadbitter et al., 2021). What the evidence of early intervention, and particularly the success of parent delivered interventions (Aldred et al., 2004; Estes et al., 2014), highlights is that supporting parents to become highly sensitive to their children's communicative and reciprocal behaviours can be effective in promoting development. In particular, repairing and supporting synchronous, positive parent-child communicative relationships and recognising the importance of a child's environment can have a positive impact on their development (Sameroff, 2009; Leadbitter et al., 2021). While the majority of these principles have been applied in the context of behavioural interventions, they have equal applicability across multiple intervention and support programmes, including music.

2.3 Musical Environments – scaffolds for play, communication and regulation

As the above section has highlighted, supporting environmental strategies that can adapt to and understanding autistic children's differences in communication and their needs for emotional regulation and wellbeing are essential. The current cognitive and developmental models in the field outline the challenges that face autistic children and allow for an understanding for how early intervention strategies may be designed to support them; notably by nurturing safe spaces that recognise their individual needs and interests and that can nurture reciprocal communication and expression. This raises questions for what musical spaces may be able to offer; as an alleviatory, expressive and socially coordinated space.

The theoretical foundations for how music can foster these interactions are manifold. Musical spaces are woven with multiple, interconnected strands, each of which can potentially explain why they may be particularly suitable as a platform for interaction for autistic children. Firstly, they are spaces in which objects (instruments) can be shared in a social way that creates pleasurable joint interaction, unburdened by social scripts and the norms of everyday environments, and which scaffolds interpersonal, affective attunement (Krueger, 2014; Ockelford, 2016). Secondly, this environment creates an opportunity to develop an understanding of others' perspectives, build relationships and both enact and practise behaviours that underly social interactions, including imitation, turn-taking and synchronisation, which can help to scaffold development (Vygotsky, 1980; Molnar-Szakacs et al., 2012).

2.3.1 Musical Scaffolds – theoretical foundations and therapeutic uses

The ability of autistic individuals both to connect and interact with music on a level that appears to surpass their observed capacities in everyday environments is the implicit basis for the variety of clinical and therapeutic applications of music for this population. Music therapists often refer to the various capacities of music as a structured, communicative, social and emotional medium – crucial components for the therapeutic process (Allgood, 2005). These features are echoed by music psychologists and sociologists when considering more casual forms of music making in everyday life, both personal and collective. They emphasise the unique role of music as an environmental scaffold, upon which complex forms of affective attunement and emotional reactivity can be enacted, and its capacity to promote interactive and synchronised forms of engagement (Krueger, 2011). In the foreground of these theories is the notion that musical spaces can go beyond their presence as sonic objects and become cognitively embedded to aid the development of certain endogenous capacities. Music can become an environmental resource, and the sonic landscape can be exploited

to communicate and sustain emotional experiences (Krueger, 2014; Kersten, 2015). The spaces that music creates can facilitate forms of joint interaction that have the capacity to promote self-regulation, while collectively generating affective attunement, social intimacy and emotional understanding. At the heart of this is the principle that music is an 'aesthetic technology' (DeNora, 2000) which can be used as a tool to create opportunities to co-construct, share and mediate experiences for sense-making and understanding.

Within everyday life, this use of music as a cognitive extension can be observed in the ways that music is constantly employed to enhance communicative practices and deepen social intimacy (Krueger, 2011). This is evident in how we attend to and utilise music's various affordances for our own social, emotional and regulative needs. As Krueger argues, 'music can become part of an integrated brain–body–music system... [which can] provide resources and feedback that loop back onto us and, in so doing, enhance the functional complexity of various motor, attentional, and regulative capacities responsible for generating and sustaining emotional experience.' (Krueger, 2014, p. 4). For example, background music has been shown to assist students with various developmental and learning disabilities by helping them to regulate their emotions, enhance motor coordination, and organise the attention needed to sustain task focus (e.g. Cripe, 1986; Hallam & Price, 1998; Savan, 2016). This understanding of the shared cognitive spaces of musical experiences is clearly reflected in the core principles of music therapy – most notably in the affective attunement and shared sense-making that is co-constructed during the therapeutic process (Ansdell et al., 2010; Molnar-Szakacs et al., 2012).

Within theories of joint musical experience, the alignment of a state of togetherness is conceptualised as a form of intersubjectivity, whereby participants come to share similar affective and cognitive dynamics (Trevarthen & Aitken, 2001; Molnar-Szakacs et al., 2012; Rabinowitch et al., 2012). Here, intersubjectivity is most often defined as a sense of mutual understanding (Gillespie &

Cornish, 2010), interpersonal communication (Stern, 1985), or joint attention (Tomasello, 1988). Musical intersubjectivity is most often conceptualised through an embodied lens; as implicit and often automatic behavioural orientations towards others (Merleau-Ponty, 1945; Coelho & Figueiredo, 2003). In this state, a sharing of intentions, emotions and certain cognitive processes represents a deeper phase of interaction, where an individual's primary subjectivity is merged with the group (Rabinowitch et al., 2012). The factors of synchronisation and imitation that imbue these musical spaces further encourage a level of shared entrainment with the music and the participators (Rabinowitch & Meltzoff, 2017). It is within these platforms that emotional attunement and shared psychological states can be experienced.

Musical scaffolding and intersubjectivity can provide a wider theoretical understanding for much of the efficacy of music therapy as an emotional, regulatory tool. Furthermore, in the light of the apparent interest in and accessibility of music for autistic people, the potential of musical spaces that can facilitate a degree of communication and expression that is not always present in other environments is clear. As the cognitive accounts of autism highlight, autistic people can take longer to understand neurotypical social interaction cues. Musical environments provide a way to make these social worlds more understandable, by creating multi-sensory stimuli that can be presented as both highly structured but also flexibly responsive (Jaschke, 2014). Taken further beyond the structured and often limited environments of an interaction between a music therapist and a client (or patient), these principles of musical scaffolding are equally applicable to everyday interactions and are frequently enacted as such. If musical scaffolding is further interpreted through the lens of Vygotsky's own conception of scaffolding - that processes of development occur through our interactions with others - then musical spaces can be conceptualised as a powerful mediums of development in their own right (Vygotsky, 1967; Berk & Winsler, 1995). The role of music as forming part of these scaffolded interactions that may be developmentally significant for autistic children

and non-autistic children alike is further evident in the importance of music across early childhood, in play and in interactions with caregivers.

2.3.2 Musical Scaffolds in Early Childhood Play

The role of musical scaffolding can be observed in the affective communication between infants and caregivers. The gestural and vocal exchanges that characterise these interactions have been shown to follow clear musical contours, defined as a 'communicative musicality', which are an intrinsic part of parent-infant communications (Malloch & Trevarthen, 2009). These exchanges rely on the same principles of musical scaffolding, where music and music-like material enable the augmentation of affective and emotionally semantic meanings that go far beyond an infant's verbal level of understanding and comprehension. The regulatory capacities of lullabies are a clear example of this, and these musical exchanges facilitate intimate and rich attunement between caregivers and infants from the earliest months of life (Dissanayake, 2004; Barrett et al., 2012). The ubiquity of maternal singing to infants across cultures is further evidence of how musical intersubjectivities are enacted effortlessly and consistently.

The presence of musical scaffolding can be seen in the centrality of music forms a central part of a child's modes of interaction with the world, in their creative play, development and emotional regulation (Young, 2008a; Williams et al., 2015). The value of music in everyday life, both in early childhood and across the lifespan, provide a sociological and theoretical underpinning for many of the benefits that are observed in therapeutic practice and also present opportunities for how the strategies can be more readily woven into daily, ecological strategies. Music is ubiquitous in early childhood, as a medium for building understanding and promoting interaction, and is strongly linked to early developmental pathways. Research has highlighted the musical capacities of even the

youngest infants (Trehub & Nakata, 2001; Shenfield et al., 2003; Nakata & Trehub, 2004; Virtala & Partanen, 2018), and observational data has noted the prominence of music in children's everyday play (Voyajolu & Ockelford, 2016; Young, 2008a; Niland, 2009; Barrett, 2009). Large cohort studies have suggested that musical activities form an important part of the landscape of early childhood, both in creative exploration and as way to scaffold learning through counting and story-telling songs and games (Williams et al., 2015; Barrett et al., 2019).

As Voyajolu (2021) found, music was a core part of early childhood, with shared cultures between parents and children supporting musical development. As her observational study noted, musical play consists of a high degree of playfulness, multimodality, repetition and choice in which children were able to interact independently and creatively. Music has been observed as a point of aural coordination where, within a play-based setting, children can learn to share perspectives and develop communication skills (Campbell, 2002). Both education and early years' researchers have demonstrated how young children incorporate music into their early play experiences (Littleton, 1998; Campbell, 2002; de Vries, 2009) reinforced by the musical components of dyadic interactions between mother and child (Dissanayake, 2000; Malloch & Trevarthen, 2009).

As a vehicle for growth and development, the pervasiveness of musical characteristics in social play interactions is indicative of its communicative role, and the power of musical material to communicate and create 'conversations' that are free from external rules (Marsh & Young, 2015). Studies have further highlighted how the processes of imitation and shared affect are particularly enhanced through playful musical interactions, both in peer interactions through spontaneous, child-orientated contexts and with adults, acting as 'partners in play', scaffolding development and interaction (Young, 2008b; Koutsoupidou, 2020). Sustained programmes of intervention that target behaviours such as joint attention have indicated that improvements here can have wider

implications for social behaviours, offering evidence for the potential of directed musical interaction to facilitate social learning (Kasari et al., 2006).

2.4 Autism and the musical environment

As the sections above have highlighted, the dynamics of musical spaces have potential as an exploratory, non-threatening platform to foster both individualised and collective forms of emotional regulation, intersubjectivity, social learning and play, which are underpinned by theoretical conceptions of how music is experienced, used and learned. Applying these theoretical insights to the autism phenotype, it may be suggested that music could act as a safe space for interaction for this group.

Key studies in this area have provided further insight into the possibilities for music for autistic children and were particularly influential for the current study. This included those studied both the dynamics of musical environments (Kim et al., 2008; Kirschner & Tomasello, 2010) as well as their wider applications to caregiving environments (Thompson, 2012a,2012b). The evidence provided by Kirschner and Tomasello (2010), whose seminal study highlighted the role of music in promoting prosocial bonding between children and emphasised the social dynamics of musical spaces. This evidence, when linked to therapeutic approaches such as Kim et al. (2008)'s study, can provide further insight on the potential of musical environments for support and behavioural change, and provide a theoretical basis for these changes. As Kim et al. (2008) found, weekly music therapy sessions over twelve weeks for autistic children between the ages of 3 and 5 was shown to have significant impact on joint attention behaviours with therapists, with improvements in standardised measures for joint attention and eye contact duration. This was further strengthened by 16-week randomised control trial by Thompson (2012a), where improvements in social interaction for those

autistic children receiving music therapy intervention were observed. The strength of Kim et al.'s (2008) and Thompson's (2012a) findings both are the size of the cohorts (15 and 23 respectively), and their methodologies which employed observation alongside standardized measures. In Thompson (2012a) in particular, the focus of this study beyond children's individual behaviours and on parents' experiences and the caregiving environment also evidenced the importance of wider integration to promote the effectiveness of musical programs. Both the importance of the wider environment that is featured by Thompson (2012a) and the role of observation of musical play in Kim et al.'s (2008) study were key factors that influenced the current design. In particular, the current study aimed to combine Kim et al.'s (2008) rigorous approach to observing musical play, alongside Thompson's (2012a) integration of wider care networks to assess the dynamics and interaction between musical play, behavioural change and these uses in everyday life.

The fact that music is a medium which is consistently identified as a particular point of interest and motivation for autistic children also indicates its potential as a supportive environment (Ockelford, 2008, 2013; Lense & Camarata, 2020). As observational studies, combined with perceptual and neurological evidence, have further indicated, musical environments may be spaces in which autistic children can perceive and interact on their own terms (Heaton et al., 1999), raising the possibility that it can act as a platform for more equal play, communication and expression with others.

2.4.1 Autism and music perception

The connection between music and autism, as both an exceptional interest and in the capacity for prodigious skill, was recognised in some of the first accounts of autism by Kanner (1943).

Anecdotally, the relationship between autism and music is frequently referred to within the context of autistic savants, or those with extraordinary talent despite what appears to be profound disability. Across the wider autistic population, perceptual and cognitive differences related to

auditory processing have identified both strengths and weaknesses. Within the diagnostic criteria for autism, the restricted and repetitive behaviours section mentions over-sensitivity to sound, and adverse reactions to noise. Yet, heightened sensitivity to noise is just part of an increasingly complex picture when investigating the relationship between autism and auditory processing. Some studies (Heaton, 2003; Bonnel et al., 2010) have indicated that autistic individuals have higher rates of perfect pitch than in the neurotypical population, and enhanced perceptual functioning in relation to both local and global processing (Heaton, 2005). These empirical studies have often used the perceptual models of weak central coherence (WCC)² to inform their investigations and explain how autistic children's cognitive style might privilege certain forms of auditory processing.

Imaging studies have also indicated that autistic individuals process musical stimuli differently, indicating that frontotemporal connectivity is preserved during sung-word perception although disrupted during spoken-word perception (Sharda et al., 2015). This would indicate that there are different mechanisms by which singing, and speech are processed, in part due to the structural differences of music as a ritualised, tonal and predictable medium. Imaging has also shown that children with autism may be more effectively engaged by musical stimuli than speech (Lai et al., 2012). Furthermore, unlike observed difficulties in the perception of intention and tone of speech, those with autism can easily identify different valences of emotional musical stimuli (Heaton et al., 1999; Quintin et al., 2010; Gebauer et al., 2014; Brown, 2017). These empirical approaches present the picture that musical spaces may have the potential of enabling autistic children to interact well.

It has led to the conceptualisation that autistic children have an 'exceptional early cognitive

² Frith has suggested that a 'weak central coherence' is caused by a specific imbalance in integration of information at different levels, and this imbalance is the key characteristic of the difference in the autistic cognitive style (Frith 1989). In neurotypical processing, detailed information tends to be drawn together to construct higher level meaning or a central coherence. WCC posits that in autism, this is disturbed, thus resulting in the perceptual preference for local or low-level detail. Autistic abilities observed anecdotally, such as picking out tiny threads on a patterned carpet or noticing small changes in shelving arrangements have also been attributed to a weak central coherence (Frith & Happé 1994) and highlight how local forms of processing that privilege detail can manifest in perception, taking precedent over global forms of processing that draw together the constituent parts of the perceptual information to construct higher-level meanings. Further discussion of WCC can be found on pg. 23

environment' (Ockelford, 2013), in which the self-referential nature of music creates a tendency to over-interpret the sounds in the world around them as music.

What the cognitive and empirical research highlights is that music, or particular auditory and sung stimuli, may be privileged on account of certain cognitive styles in those with autism. As Ockelford (2013) has observed in his many interactions with autistic piano pupils, both conventionally structured musical pieces, and fluid improvisation, can build and foster musical conversations. These musical sounds may be imbued with semantic meanings, which creates unique ways of communicating, interacting, and relating. In Ockelford's experience of pupils across the autistic spectrum from savants to the most profoundly disabled children, this shared knowledge of musical material can create opportunities for playful, creative and meaningful interactions, the subtleties and expressive qualities of which go far beyond their capacities in verbal communication alone. The natural attraction of autistic people to musical forms of communication, interaction and self-expression is further evidence that musical modes of interaction can provide a meaningful and motivational platform. This has implications for supporting both developmental and well-being strategies for those with autism. Both these factors are reliant however on the unique capacity of music to offer an alleviating environment, to scaffold emotional and semantic meaning, and to host and coordinate mutual understanding.

2.4.2 Music Therapy for Autistic Children

The premise that musical spaces can offer a platform that creates pleasurable opportunities for social sharing and joint attention in an environment that is based on non-verbal, self-referential meaning support both the success of music therapeutic approaches, but also highlight its potential for developmentally orientated goals (Bergmann et al., 2015). Features such as strong cadences, opportunities for imitation and turn-taking and dynamic changes mean that musical environments

can scaffold dynamic forms of interaction with clearer, implicitly recognisable frameworks for communication (Corke, 2011; Bergmann, 2016). This evidence also corresponds to research in neurotypical children, which has shown that the social dimensions of musical play can improve prosocial behaviours and interpersonal relatedness (Kirschner & Tomasello, 2010; Rabinowitch et al., 2013; Rabinowitch & Meltzoff, 2017). Indeed, the use of music therapy as a psychosocial method for those with autism is well established; in a recent Cochrane review, outcomes ranging from improvement in executive function, social attention and verbal development, to sensory-motor skills and decreased stimming were found (Geretsegger et al., 2014). Systematic reviews exploring initiating behaviour, social-emotional reciprocity and social communication have further shown promising indications of music's effectiveness (Reschke-Hernández, 2011; Simpson & Keen, 2011; Geretsegger et al., 2014; DeVries et al., 2015; James et al., 2015; Hernandez-Ruiz, 2020; Mayer-Benarous et al., 2021). It is also echoed in wider research on music therapy with children with other disabilities has also further highlighted the importance of music in the everyday lives and routines of children with disabilities, in both educational and family settings, as a way to build relationships and regulate mood (Murphy & McFerran, 2017; Chou et al., 2019; Rushton & Kossyvaki, 2021), ignite playfulness (Corke, 2011; Rushton & Kossyvaki, 2020) and promote wellbeing (McFerran & Shoemark, 2013; Stensaeth, 2013).

For autistic children in particular, improvements in nonverbal skills, including gaze-related and gesture, have been shown to change in studies using a relational approach, where therapists attune to a child's emotional and musical expressions to create moments of synchronisation and shared experience (Gattino et al., 2011; Thompson, 2012b). Lim and Draper (2011) used a similar relational approach which was combined with the principles of ABA, to explore the impact of music on verbal communication on children between the ages of 2 and 5, with an increased verbal production observed in the group that received musical training in comparison to ABA speech training and no training conditions. In a neuroscientific study by Sharda et al. (2018), it was further found that

improvisational music sessions improved social communication and auditory-motor brain connectivity in 25 children between the ages of 6 and 12. This has also been replicated in smaller case studies, as both Finnegan and Star (2010) and Wimpory et al. (1995) found that social motivations and social responsiveness improved within musical settings that were integrated into everyday life. While intervention protocols may differ, many of these observed positive effects of music on joint attention, verbal development and social interaction have been observed and replicated within randomised control trial settings (Gattino et al., 2011; Kim et al., 2008; LaGasse, 2015; Thompson, 2012), which strengthens the quality of the evidence for this field.

The wealth of research on the significance of music as a platform for meaning-making, shared understanding and promoting wellbeing (Krueger, 2011; Ruud, 2010) suggest that benefits of music for autistic children go beyond the context of the therapy room. Systematically investigating these contexts is further complicated by multiple factors including the diversity of the autistic population and the natural flexibility of musical interaction and play, which means that controlling experimental factors within more ecological settings is particularly difficult. Some attempts have used more structured musical material, in the form of 'musical social stories', as a way to provide musical repetition within naturalistic environments. Social stories are a commonly used tool for learning and interaction for autistic children and adapted for individual needs to illustrate certain scenarios or problems where a child is having difficulty (Gray & Garand, 1993; Adams et al., 2004). In the current examples, these stories are put into song form to examine whether musical stimulus can increase their impact on behaviour change. For example, in Brownell's (2002) four case studies, musically-adapted, individualised social stories were successful in addressing participants' pre-determined target behaviours for which the songs were composed. Pasiali (2004) also observed behavioural changes using a similar design of prescriptive therapeutic songs to promote social skill acquisition and decrease restrictive behaviours in individualised contexts for three children between the ages of seven and nine within the home. In a more practical approach, a case study by Kern, Wakeford &

Aldridge (2007) showed that tailored songs had a positive impact on increasing independence during self-care tasks, including toilet-training, cleaning and hand-washing. Similar findings were reported by Osei (2009), who found that music for child learning had a positive impact on toilet training, verbal ability and controlling attention.

Looking further at the behavioural implications of this approach, the applied research is consistent with the notion that music can scaffold social exchanges, build understanding and teach behaviours. Stephen's (2008) study explored how musical social stories might be used to establish imitative actions and model behaviours between children and adult dyads. It was observed that within musical contexts, the social routines modelled led to increased reciprocal behaviours and spontaneous imitation. This has also been replicated within a wider context. An investigation by Kern, Wolery and Aldridge (2007) found that by orientating morning greeting routines around specially-designed greeting songs, the young autistic participants were increasingly independent in their transitions into nursery and in their initial interactions greeting peers. Kern and Aldridge's (2006) study had similar outcomes, where an embedded intervention of a music hut within a playground showed an increase in teacher-mediated and peer interactions for the participant children in the musical space.

As these studies within wider naturalistic environments have shown, embedding musical interventions can provide opportunities to support development, mediate behaviours and facilitate interactions between peers and adults. The distinction between these factors is often in practice more blurred, as the creation of a shared nonthreatening space means that developmental outcomes are intertwined with the capacity for greater interpersonal communication and interaction, which in turn can impact upon the presence of 'restrictive behaviours'. The time and labour intensity that is required for the implementation of these studies in everyday life mean they often suffer from small sample sizes. However, they provide a more in-depth perspective of how

processes of behaviour-change may occur, and they highlight the potentially wider contexts of music's role. In particular, it is possible to observe behavioural changes and outcomes that go beyond the pre-defined clinical measures. Naturalistic interventions, such as the ones highlighted above, demonstrate how environments can be mediated through music and provide opportunities for shared interaction and development, rather than simply reducing autistic behaviours alone. These also point to wider considerations for the role of environment and support networks, in particular the role of parents as mediators of musical programmes. Therefore, integrating the insights from naturalistic interventions alongside more rigorous methods of a behavioural measurement was a clear aim of the particular study design.

2.4.3 Parent-mediated music in everyday life

The divisions, variances and overlap between therapeutic, naturalistic and quasi-clinical approaches of the use of music for autistic children as highlighted above echo Fancourt's (2017) arts-in-health categories, in which she highlights a number of approaches that in different ways can create benefit from arts experiences. These range from arts activities in everyday life, which although not orientated around health outcomes have similar benefits of fostering social cohesion and building mental resilience, to more specific uses of arts within psychotherapy which may have more clinical orientated outcomes and that are delivered by trained specialists. In the current field, there is more complex overlap between these categories, particularly when considering the role of parents in music-making. While many of the therapeutic studies can be defined as having clinical outcomes, some of the strategies in these studies permeate approaches and uses of music in everyday life and in play, including the shaping of musical environments to share meaning, build empowerment and develop relationships (Ruud, 2010; Fancourt, 2017). The role of parents in musical interventions is a prime example of this, as the importance of caregivers as music mentors for their children and the inclusion of families in music therapy practices is widely acknowledged (Hernandez-Ruiz, 2020), with

the benefits exemplified in Thompson's (2012a, 2012b) influential work. Approaches range from an undefined 'parent inclusion as participants' with varying involvement and integration, to parents being trained to solely deliver highly structured programmes. This includes therapists training parents with songs and activities and then observing them within a structured setting.

Within contexts where family-centred approaches include parents as participants, the benefits to child-parent relationships have been reported alongside individual child gains (Thompson & McFerran, 2015; Thompson, 2012b; Nicholson et al., 2008; Williams et al., 2012). In particular, Thompson (2012b), found that after a 16-week programme of family-centred music sessions that took place in the family home, parents reported greater closeness in the relationships with their children and were also able to adapt the musical activities for more regular use in everyday life. Thompson's findings demonstrate the natural complexity of defining the parameters of a 'parent-mediated intervention'. While the study does not specify how parents were trained, or their exact involvement in the musical therapy sessions, the natural inclusion of parents into the programme meant that the applications of the musical activities were likely to have spilt over into everyday life beyond the therapy sessions. In a systematic review investigating parent-mediated music interventions, Hernandez-Ruiz (2020) highlights important distinctions between parent coaching and implementation of music programmes versus parental and family inclusion in the therapeutic process. While some programs include caregivers as *participants* within music-therapy (e.g. Di Renzo et al., 2015; Thompson, 2012b; Thompson et al., 2019), others specifically focus on the training of parents to mediate the musical interactions themselves (e.g. Nicholson et al., 2008; Yang, 2016)

Due to the nature of music therapy, the reporting of many of the procedures of these studies is limited. Some studies have made concerted attempts specifically to train parents, the most notable being the *Sing & Grow* programme (Nicholson et al., 2008; Williams et al., 2012) and *Musical Bonds*, (Yang, 2016). In *Sing & Grow*, parents were trained by professional musical therapists, and the

programme combines elements of both relationship-focused and behavioural parenting interventions, using traditional children's songs and specific compositions to aid developmental skills (Williams et al., 2012). Williams reports that each session includes 'greeting and farewell songs to encourage social responsiveness; familiar songs for engaging participation; action and movement songs to provide practice offline and gross motor skills and concept comprehension; instrumental play for promoting motor skills, following simple instructions, turn-taking and sharing; and quiet music to encourage physical touch, closeness and bonding between parent and child.' (Williams et al., 2012, p. 28) The principles of these interventions, and their delivery *by* parents under the instruction of a trained music therapist demonstrate how the essentially musical nature of many parent-child interactions can feed into the design of interventions (Malloch & Trevarthen, 2009). Yet in both Williams et al., (2012) and Nicholson et al., (2008), while CDs and song books are given to parents, there is no follow-up of the implementation and fidelity of these skills in everyday life. This means that despite attempts to implement the wider support networks of children's environments, the primary implementation of these factors was still within a specific, therapeutic context of an hour a week, with limited applicable evidence outside that. Moreover, although *Sing and Grow* was designed as an early intervention programme, only 15% of participants were reported as having an autism diagnosis, meaning it is not necessarily targeted at the particular needs of communication and behaviour in this population.

In comparison, *Musical Bonds* provides a wider applicability of a similarly structured programme, setting the training of parents at home and focusing the programme specifically on children with disabilities (Yang, 2016). The programme aimed to support parent's responsiveness to their child and facilitate dyadic interactions during musical play. Using musical games, singing, instrumental activities and relaxation techniques, Yang found improved parent-child interactions and highlighted the potential in this area for wider family and wellbeing goals (Yang, 2016). As Allgood (2005) also found, when integrating a music programme into homes and regular routines, some of the most

significant outcomes were in relation to parent confidence in engaging in musical relationships. It follows that as parents feel more comfortable in engaging in a musical relationship with their child, the quality of musical exchanges increases.

The smaller scale or case studies discussed above that detail a high intensity and focus on individual participants (e.g Wimpory et al., 1995; Kern & Aldridge, 2006; Finnigan & Starr, 2010) indicate the feasibility of parent coaching for simple, music-based activities and programmes and the importance of holistic strategies in effecting behaviour change. As highlighted above, the integration of parents as key partners in early intervention has clear precedent in behavioural programmes, including SCERTS³ (Prizant et al., 2003), ABA, and the Early Start Denver Model (Rogers et al., 2012), where separate parent training is required to ensure and maintain the intensity and regularity required. Hernandez-Ruiz (2020) found that parent roles, while varied, had positive outcomes across studies for parent-child relationships and behavioural change, despite the variation of approaches between parent-as-participant, parent-led and trained. This indicates that one of the primary components of the success of these approaches is the presence and involvement of parents and caregivers as part of the delivery. It also points to the wider significance of how embedding music within everyday life, as part of relationships, interactions and environments, is an important part for the success of musical intervention strategies.

2.5 Musical Development

As the discussion above has highlighted, music can provide a shared space for interaction, which can mediate mutually affective and intersubjective experiences. While these emotional and regulating dynamics of musical environments have long been utilised for musically therapeutic approaches,

³SCERTS is an acronym for social communication, emotional regulation, and transactional support, all features characteristic of early interventions for children with autism.

these approaches are difficult to categorise. As a place of behavioural development, many theoretical assumptions of music psychology and education, along with outcomes of music therapy, suggest that the medium of musical play is a fertile place for learning, social interaction and creative development (Littleton, 1998). Yet what is known about the dynamics of musical play and development is still primarily reliant on data from neurotypical children.

In light of the significance of musical play for development, understanding how autistic children can engage in musical play and the trajectories of neurodiverse musical development is essential. As highlighted above, while insights from music therapy show progress in relation to general behaviours including imitation and shared attention during intervention programmes, changes in musical abilities and skill are rarely reported. This means that relatively little is known about how autistic children develop musically. Within neurotypical models of musical development, key stages of musical competence tend to run in parallel to psychological development, so it would be expected that similar patterns would be reflected in autism. However, the heightened interest and higher competencies that autistic children have demonstrated with regard to musical processing (Heaton, 2005; Ockelford, 2013), show that musical processing and development may well be less entwined with general cognitive ability.

In neurotypical development, multiple models of musical development have been proposed that evaluate the development of the understanding and reproduction of musical material, which begin very early in life (Trehub & Nakata, 2001). Initially, there is an awareness of sound, primarily through sensory means, and unstructured babbling and crying. These vocalisations subsequently develop into interaction, with imitation between caregivers and infants (Papoušek & Papoušek, 1989). This babbling also begins to show features of musical contours, both rhythmically and melodically; as Papoušek notes these are 'variegated babbling ... short well-structured melodies in which familiar musical elements are creatively combined into new patterns with distinct rhythm and

accent' (Papoušek, 1996, p. 106). This subsequently develops into distinct melodic phrases, where motifs begin to be repeated, varied and juxtaposed (Hargreaves, 1986; Welch, 2012) creating 'potpourri' songs (Moog, 1968). It is from these fragmented iterations that more extended, clearer understanding of songs and structural features of music develop, leading to singing and playing in time and in tune. Multiple models have attempted to conceptualise this trajectory, including Gordon's (2007) 'concept of musicality', Swanwick and Tillman's (1986) 'Spiral Model' of musical development, and Hargreaves and Lamont's (2017) 'Phase model'. Hargreaves and Lamont propose a system of five progressive modes of musical growth: sensorimotor, (0-2), figural (2-5), schematic (5-8) rule systems (8-15) and professional (8-15). In this model, they emphasise how musical skill acquisition runs in parallel to psychological development, outlining key stages of musical competence, and how each level represents a distinct progression from the next in terms of understanding, perception and utilisation, moving from sensory and imitative play, towards assured and controlled mastery of musical material. Although many do not dwell on the microprocesses of early musical development, across these models there is a widespread acknowledgement that infants are born with an innate responsiveness to musical stimuli, which is nurtured through the musical qualities of the interactions with parents (Malloch & Trevarthen, 2009) and their individual explorations with the environment around them. Swanwick and Tillman are the most specific on this, using Piagetian principles of play to inform the earlier developmental modes, namely 'mastery'; involving sensory responses and controlling sound, 'imitation'; how children represent their environments through music, and 'imagination'; the creative contribution of music beyond that of simple imitation (Swanwick & Tillman, 1986). The fourth loop of the spiral, 'metacognition', is also relevant here, as it describes how children become aware of their own musical thinking. What the majority of these models have in common is that they follow similar developmental narratives from psychology: primarily that development is teleological and normalised to all children (Young, 2008b). Although many make reference to wider contextual factors that may influence these trajectories, these are not clearly or readily incorporated into the models.

Due to the spiky profiles that autistic children exhibit, existing musical-developmental models are unsatisfactory, considering both the atypical relationships with both their environments and other people, alongside the many that display an intense interest in music. The deep interests and abilities that some autistic children demonstrate suggest that musical development in this population is less tied to psychological development. The Sounds of Intent (Sol) model of musical development focuses specifically on the musical abilities of children and young people with disabilities (Welch et al., 2009; Vogiatzoglou et al., 2011; Ockelford et al., 2020). It recognises that, even among those with the most profound learning difficulties, many still possess the ability to respond and interact with music, which suggests some form of discrete cognitive processing. As Welch et al. (2009) found during these observations, the capacities for children with learning difficulties to process and reproduce certain forms of music mean that their musical capacities may be discrete, and do not completely align with normative musical developmental models. It was built from the evidence of hundreds of observations of children with profound and multiple learning difficulties interacting with music, as well as being informed by existing models of musical development alongside the premise of 'zygonic theory' which emphasises how musical perception is built on imitation and repetition (Ockelford, 2006). Zygonic theory posits that musical structure is cognitively processed when a musical element is perceived (consciously or non-consciously) to exist in imitation of another (Ockelford, 2012). Common among all music perception is that musical structure and expectation derive from imitation and repetition; both for patterns within groups of notes and between them (Ockelford, 2006). From this theory, the Sol framework emerged to model how, based on imitation and repetition, musical development even for those with the most profound needs can occur.

The Sol framework is based on six levels of musical development, which have a triad of domains at each level: Reactive, Proactive and Interactive. Reactive - 'R' (children's responses to sound and

music), Proactive – ‘P’ (children’s creation of sounds and music on their own) and Interactive – ‘I’ (children’s interactions with others through sound and music. The six levels progress from

- Level 1: ‘Confusion and chaos’, with a limited awareness of sound.
- Level 2: ‘Awareness and Intentionality’, where there is an emerging awareness of sound and its possibilities.
- Level 3: ‘Relationships, repetition and regularity’, at which a child has an awareness of the significant between sonic events,
- Level 4: ‘Sounds forming clusters’, at which perception recognises groups of sounds, and the relationships between them
- Level 5: ‘Deeper structural links’, where there is a recognition of whole pieces, and some awareness of the underlying structures that create them
- Level 6: ‘Mature artistic progression’, by which a child has an awareness of the cultural and emotional contexts of musical performances and compositions

(Summarised from Voyajolu & Ockelford, 2016).

The original Sounds of Intent framework was based on observations with children with special needs interacting with music and music practitioners. While it bears many of the hallmarks of the normative frameworks outlined above, with a clear emphasis on repetition and imitation and growing musical control, it is not tied to any age specified criteria. Instead, it was designed to be flexible enough to be able to cover abilities from the most profoundly disabled children to those with advanced musical abilities (Welch et al., 2009). A more recent iteration of the model for children in the early years ‘Sol-EY’ used the same principles of the Sounds of Intent model to further delineate the stages of development in the early years. Using the same tripartite design, the six levels were shortened to four of those most relevant to a child’s early years development: levels 2-5. Figure 1 illustrates the full Sol-EY framework, which is presented in a set of concentric circles, from Level 2, Reactive, Proactive and Interactive, to Level 5.

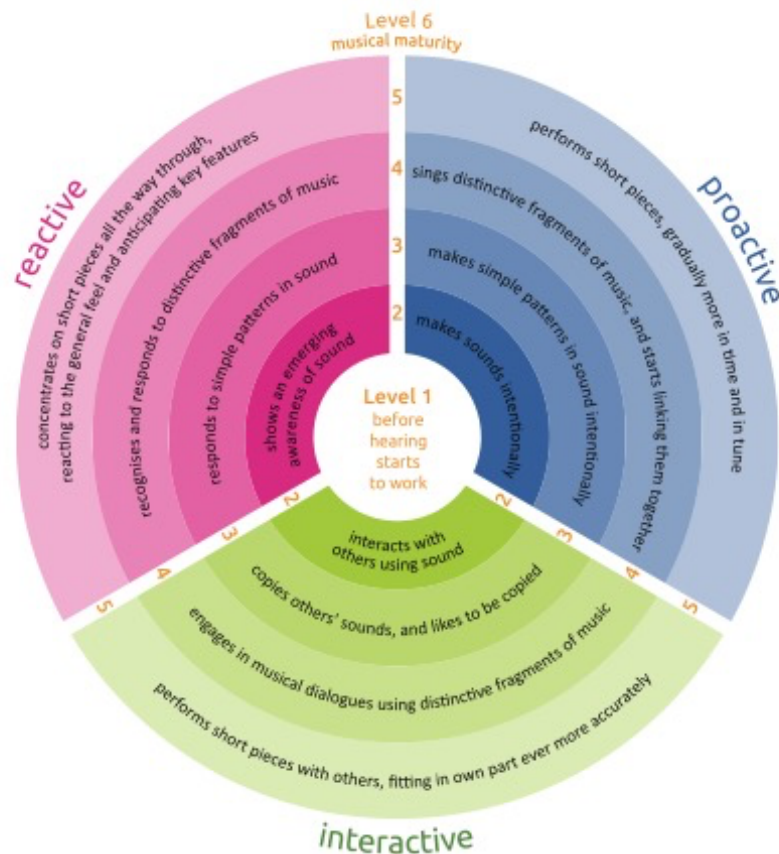


Figure 1 Sounds of Intent in the Early Years, Circular level framework (Voyajolu & Ockelford, 2016)

The Sol-EY framework differs from the original Sol framework in two noticeable ways. Firstly, it is applicable for *all* children, with the data collected in observations in a mainstream nursery setting. Secondly, many of the observations were taken during child-led play with peers as well as adults, meaning that it is relevant to independent and joint playful interactions as well as scaffolded interactions with practitioners. The fact that the original theoretical background for Sol-EY is rooted in an approach derived for children with special needs means that this framework may be equally applicable to children across the spectrum of neurodiversity. Although the authors make some predictions for age specificity for each level, it retains the same flexibility as the original Sol, in that it is not explicitly tied to general psychological development or age specified goals. Moreover, the model is explicitly practice based, with each level and its subsequent subdivisions (four 'elements' A,

B,C,D) providing more detail of musical abilities that can be categorised, observed and scored. Embedded within the model is the importance of interaction with others required for the development between each level. Voyajolu and Ockelford use Vygotskian principles, that 'we become ourselves through others' to examine how 'zones of proximal development' might operate (Voyajolu & Ockelford, 2016, p. 108). In line with teleological models, many have emphasised how the nexus of environmental factors and a child's 'musical doodlings' (Kartomi, 1991) are as much a result of their enculturation as they are of musical skill. Barrett et al. (2012) conceptualises these as 'spheres of influence', suggesting that there are seven 'emergent principles' that feed into a child's musical development. These include the 'aural and kinaesthetic interaction' with the adults and environmental culture around them, the social and cultural traditions within which the child grows up, and the active adult-infant interaction where mutual meaning-construction is enacted. The authors further emphasise that both repetition and variation are core features of a child's creative interests and development, through which the 'development of cultural knowledge and creative thought and activity are mutually constitutive' (Barrett et al., 2012, p. 310).

These approaches also resonate with Bronfenbrenner's ecological theory (Bronfenbrenner, 2005; Bronfenbrenner & Morris, 1998), which stresses the person-context relatedness in developmental trajectories, which are rarely as linear as developmental theory contends. For musical development, a child's interaction with the musical stimuli in their environments is a web of parents, peers and society, which will shape their ongoing preferences, development and abilities. Moreover, the amount of music that saturates everyday environments, from radio, TV, phones, tablets and smart-speakers, means that the richness and diversity of musical influences and instruction that young children can access is ever growing (Krause et al., 2015). Algorithmic driven auto-play on platforms such as Youtube Kids and TikTok give children the access and agency to be more exploratory as they form their musical preferences. The capacity to access any music instantly also has implications for changing modes of consumption and their developing relationship with music, both as a medium for

play and emotional regulation. Whereas once a parent might have sung a lullaby to send a child to sleep, a child can now choose the song they want and play it on repeat, constructing their own bedtime routines.

If, as has been observed in qualitative evidence from adults, music plays an important role in maintaining well-being in everyday life, in both passive and interactive forms by alleviating anxiety and stress as well as improving life satisfaction, these may be equally applicable for childhood music making. Furthermore, the purported benefits of music for learning and development for those in early childhood (Virtala & Partanen, 2018), would suggest that these growing forms of everyday music making raise new questions as to the role of music in the home. Home environments are now rich places of education and exposure to musical stimuli (Rideout et al., 2003; Carrington, 2004; Young, 2008a; DeVries, 2009), there is potentially a vast source of untapped musical potential in the uses of music in everyday life. This provides significant possibilities to empower and aid parents for whom music can be a unique point of engagement and communication, to provide a point of aural coordination between what children may be perceiving and what they can experience in their everyday environments. This is particularly important in the case of autistic children, for whom interactions with sonic landscapes form a key part of how they relate to their environment.

2.6 Chapter Summary

As the review above has shown, the potential uses of music with autistic children draws in numerous strands in the fields of musical development, psychology and therapy. Changes in the understanding of autism at a cognitive and developmental level have highlighted how intervention designs need to adapt to the needs and interests of autistic children themselves, taking into account their environments and supports. Music and musical play can offer insights here, as research with both

neurotypical and autistic children has shown, it can act as a space in communication, interaction and regulation can be effectively enacted and scaffolded.

The widespread use of music therapy in this population is indicative of the capacity of music as a space for emotional regulation. Its application in both structured and informal settings provides further evidence of the potential of music as a tool to encourage learning and development, both for strategic behavioural goals and to develop strategies for everyday life. The principles that underpin these therapeutic approaches are echoed by research in musical play and in everyday life, where widespread evidence acquired from primarily neurotypical children has highlighted the role of music as a medium for social interaction, learning and communication from their earliest years. Although the majority of the evidence of behavioural change regarding music and autistic children has been in the realm of music therapy, the principles of the role of music in everyday life that frequent discourses of arts-in-health and sociological fields are of equal relevance.

3 Methodology

3.1 Chapter Outline

This chapter outlines the methodology used during the project. First, it discusses the methodological considerations that were required for the project (3.2 - *Methodological Rationale*), including why the chosen mixed-methods, ecological approach using a parent-mediated intervention was most appropriate (3.3 - *Ecological Interventions: Designing Naturalistic Research*). The chapter is then split into two sections, the pilot study (3.4 - *Pilot Study: Methods*), and then the main study (3.5 *Main Study: Methods*). Within each the Pilot and Main study sections the following areas are covered; (i) methods (including data collection tools, measures and questionnaires), (ii) participants details (including participant demographics and differences between pilot and main study cohorts) (iii) materials and procedure (including details of the home based resources, their development, and parent guidance), and (iv) analytical approaches (including behavioural coding protocols, quantitative and qualitative methods, and the software that was used for each).

Across both the pilot and main studies, a holistic, ecological methodology was designed around three primary aims. Firstly, ecological principles were followed by embedding the intervention in everyday life. Secondly, ensuring that the methodology chosen empowered individuals and families as part of the research by developing the intervention to be adaptable to individual interests and needs and allowing participants to realise their own musical capacities, designing tasks around play and everyday routines. Finally, the methods of data collection used were experiential, and reflect the 'nested' nature of the programme and the experiences of the participants. To outline this in practice, Table 1 below details how each research question was answered using the corresponding methods and analytical approach.

Table 1 Research Questions, corresponding methods and analytical approach

Research Question		Methods	Analytical Approach	Measures
(Key: α - qualitative, β - quantitative, δ - piloted)				
1	How do the musical abilities and engagement of young children on the autism spectrum develop over time?	α : Semi structured Interview β : Observation: video coding (δ)	α : Thematic Analysis β : Repeated Measures ANOVA β : Latent Growth Models	Sounds of Intent in Early Years assessment (Voyajolu & Ockelford, 2016) Musical play observational coding
2	What is the role of music in the daily lives of autistic children and their families?	α : Semi structured Interview β : Questionnaire	α : Thematic Analysis β : Descriptive Statistics	Music in Everyday Life Scale (MEL) (Gottfried et al., 2018)
3	How can musical play promote the development of social competencies and impact wider developmental outcomes of young children with autism?	α : Semi structured Interview β : Pre & Post Questionnaire β : Observation: video coding	α : Thematic Analysis β : Repeated Measures ANOVA β : Latent Growth Models	β : Autism Behaviour Inventory (Bangerter et al., 2017) β : Social Responsiveness Scale (Constantino & Gruber, 2012) β : musical play coding scheme (δ)

3.2 Methodological Rationale

As the discussion in the previous chapter has highlighted, the role of music within the lives of autistic children is complex and multifaceted, drawing on interdisciplinary strands of developmental, psychological and sociological understanding of what music does: as a scaffold for development, a platform for interaction and as an agent for everyday regulation. Assessing these intertwined factors present a methodological challenge, it requires an approach that can both closely examine the dynamics of musical environments while also accounting for the web of contextual influences that impact individual trajectories. Therefore, empirical methods of monitoring behaviour change need to be blended with methodologies that situate both the research design and the data collection within the naturalistic, everyday contexts in which musical behaviours are regularly enacted.

The current project was designed using an ecological framework, which situates research with the environments, contexts, and systems of participants' everyday lives. Developmental psychology has a strong theoretical tradition of accounting for contextual factors, with influential theorists including Vygotsky and Bronfenbrenner emphasising the ongoing interactions of child, environment and wider cultural influences that play a role in development. Since the works of Vygotsky (1967, 1980) and Bronfenbrenner (1979), both of whom argued that the social worlds of children play a critical role in shaping development, criticisms of the positivist epistemological paradigms in developmental psychology have grown. While it is now widely recognised that models of child development cannot divorce children from the context within which they live, the field has struggled to shrug off its positivist position. Although research is now often undertaken in wider settings, quantitative approaches using standardised tests (often designed and validated from positivist perspectives) still dominate. Similar patterns exist in behavioural intervention research, where the 'gold-standard' of randomised control trials remains the dominant mode of inquiry; behaviours are observed within

the context of a laboratory setting to produce ‘evidence based’ interventions, while social and contextual factors remain widely neglected (Greene & Hogan, 2011c; Vandenbroeck et al., 2012). In the case of autism research, these approaches are further underpinned by core-deficit theories, which drive implicit assumptions that there is a single core mechanism that can be specifically targeted to alleviate the symptoms of the condition (Astle & Fletcher-Watson, 2020).

In both developmental and autism research, there is a growing acknowledgement of the value of contextualised, ecological approaches, which have been identified as a bridge between understanding psychological and sociological interpretations of development (Greene & Hogan, 2011a). The reframing of autism as a multidimensional condition has emphasised the problems with empirical behavioural interventions that solely target individual differences (Astle et al., 2021). More approaches now recognise that accounting for and adapting the environment and systems that an individual inhabits can be far more effective in promoting long-term change and acknowledging the rights and agency of individuals (Fletcher-Watson, 2018). Naturalistic interventions also place a greater emphasis on understanding behaviours within the everyday experiences of children, enriching the more data-driven outcomes of explanation, prediction and control that are dominant in evidence-based positivism.

It has also been observed that even the best-intentioned empirical work in the field faces further barriers, as ‘simply creating an inventory of evidence-based treatments [does] not result in their broad implementation in practice.’ (National Advisory Mental Health Council, 2006: 7). Instead, participatory and naturalistic models which involve collaboration with communities and caregivers can increase the implementation and maintenance of evidence-based approaches (Drahota et al., 2016). This approach also aligns with a growing shift in research in the field that looks away from attempts to ‘fix’ autistic behaviours, and instead recognise and support the diversity in neurocognitive styles (Kapp, 2020). As part of this, research that highlights the importance of

supporting strengths, special interests, and that focuses on the everyday quality of life of autistic people is becoming more prominent (Lai & Szatmari, 2019; Happé & Frith, 2020).

The current project sought to incorporate the principles of naturalistic intervention research into the realm of music and autism. The saturation of music in everyday life and its cultural and social significance highlights the clear need for an ecological approach, yet the majority of studies in music therapy still adopt empirical approaches that assess behaviour change before and after a structured intervention or programme (Geretsegger et al., 2014). As highlighted in the review in the previous chapter, although some attempts towards ecological validity have been made in the field, including bringing these approaches into the home (e.g. Yang, 2016), and more readily incorporating caregivers as part of the process (e.g. Thompson, 2012b), the assumptions of music as a controlled ‘treatment’ remains. This means the relationships between everyday musical play and the behaviours observed within therapeutic contexts are less often considered. As with behavioural interventions, the implementation of evidence-based musical approaches cannot succeed without the collaboration of a child’s support and social networks. Understanding how musical behaviours are enacted outside the context of the therapy room is crucial, particularly considering the high amount of music and music-based play that exists in a child’s daily environment. The efficacy of a once-a-week music therapy intervention is therefore limited unless micro- and macro-cultural systems within which the child interacts (including home and school environments) are considered. The natural propensity of musical play in early childhood accentuates this, and in the light of music-developmental models that emphasise the role of the environment (Hargreaves & Lamont, 2017; Voyajolu, 2021), approaches that incorporate these influences should be encouraged.

3.3 Ecological Interventions: Designing naturalistic research

3.3.1 The Relevance of Ecological Models for Intervention Research

The focus of the research questions on both the developmental processes of music and its impact on behavioural change requires the consideration of both developmental and behavioural intervention methodologies. While there is a natural intersection between the two approaches, often developmental researchers are more conscious of the richness and importance of contextual factors for processes of change, while behavioural interventionists are more aware on the methods of rapid skill-building through directed action (Schreibman et al., 2015). Although the integration of these domains to promote developmental behavioural change within generalisable settings has recently grown, the methodological approaches of each reveal different underlying assumptions as to how change is enacted and maintained, and the role of the child as either embedded or independent within their environment. As discussed more extensively in the previous chapter, the historic methodologies of behavioural interventions in autism have been widely criticised, with the focus on the fixing or normalisation of autism symptoms, potentially leading to trauma and masking of autistic individuals (Fletcher-Watson & Happé, 2019). Some of the criticisms of behavioural interventions also stem from their focus on the measurement of change or reduction in targeted behaviours that lack wider generalisation. The ‘evidence-based’ practices that interventions such as ABA adopt are predicated on a model of objective science, where subjects are controlled, and behaviours observed within closely monitored ‘laboratory’ settings (Baker, 1992). The result of this is a tendency to focus only on the quantitative aspects of change that can be empirically measured, and therefore failing to capture the richness of individual lives and the ecosystems of development that a child inhabits (Cairns et al., 1998). The use of randomised control trials which are regarded as the gold standard for proving treatment efficacy are limited in their ability to examine impact beyond the limited and often detached treatment outcomes (Frost et al., 2021). This reduces

understanding of the processes and mechanisms of change that can occur during these interventions.

Many approaches have now evolved into more community-based, naturalistic approaches with a focus on play, interpersonal relationships and strength-based approaches in daily routines, termed ‘Naturalistic Developmental Behavioural Interventions’ (NDBI’s) (Schreibman et al., 2015; Mottron, 2017). In parallel with this, there is also a concerted effort to design interventions that both acknowledge and respect the neurodiverse cognitive style of autistic children, while also encouraging development in areas that can support their needs for communication, interaction, and regulation (Fletcher-Watson, 2018). The growing use of NDBI’s demonstrate the convergence of developmental and behavioural science approaches, where their shared goals of supporting development and behaviour change are enacted in environments where the children are active participants and in which change can be maintained in the longer term. A further dimension in the case of autistic children is the heterogeneity of the condition, where the support needs of each individual are unique. In light of the importance of environmental supports for this population and to best serve the needs of the individual child, it is advantageous to work within the framework of an ecological, naturalistic context (Mottron, 2017).

Ecological approaches are built upon the theories that underpin naturalistic developmental research; that children grow up in a social world, that their development is attuned to numerous interlocking contextual networks, and that to understand the processes of change in a developing child, the importance of the physical and social contexts in which they develop are crucial.

Bronfenbrenner’s (1979, 1986, 2005) bioecological model of development provides a way to conceptualise how these networks act as ecosystems, emphasising the consistent interaction between contextual and individual development. In full, the theory identifies four concepts – Process, Person, Context, Time – and highlights in particular the interrelatedness of person and

context on a developmental trajectory. Bronfenbrenner also emphasises how ‘proximal processes’ represent the bridging of the gap between the developing child and their environment, and the importance of parent-child interactions as an essential proximal process for development. As Bronfenbrenner articulates, ‘Human development takes place through processes of progressively more complex reciprocal interaction between an active, evolving biopsychological human organism and the persons, object and symbols in its immediate external environment.’ (Bronfenbrenner & Morris, 1998, p. 996). The identification of environmental and contextual factors is therefore an important consideration for developmental and behavioural studies, requiring consideration of how both the persons, such as parents and caregivers, and the contexts, such as home environments, can be featured in its methodological approach. This is important both for the ecological efficacy of the research, and for its impact for change. As is further detailed in Bronfenbrenner’s developmental theory ‘To be effective, the interaction must occur on a fairly regular basis over extended periods of *time*.’ (Bronfenbrenner & Morris, 1998, p. 996). Naturalistic interventions can have a higher impact, particularly in social development, as they involve regular play and interaction between child, adult and peers (Morrier et al., 2009). They have been identified as ‘family friendly’ approaches, by which parents can implement strategies into natural environments, capitalising on teaching moments as they occur, and increasing the quantity and quality of learning experiences during activities such as bath time, visiting the park and transitions between daily routines (McGee & Daly, 2007; Schreibman et al., 2015).

For musical interventions, the case for an ecological approach seems apparent: a child’s musical world is intimately connected to their social and cultural environments. Yet in therapeutic programmes, the importance of parental engagement and opportunities to incorporate daily musical strategies are often overlooked. One of the core four elements in Bronfenbrenner’s ecological theory is the importance of time, and that to be an effective influence on learning and development, interactions must occur on a fairly regular basis over extended periods of time. This is a significant

factor in music-based research because in order to enact these types of studies, that are regularly implemented over longer periods of time, understanding and utilizing the wider uses of music as a daily resource are essential. The lack of longitudinal approaches to music interventions was identified in a most recent Cochrane review by Geretsegger et al. (2014), which reviewed the quality of the evidence for the impact of music therapy for children with autism. The authors concluded that although there is significant evidence that music therapy can be effective in helping children with autism for particular target areas, the review only accounts for short- and medium-term interventions (one week to seven months), and that longer term follow-up is needed. In particular, they highlight that it is 'important to specifically examine how long the effects of music therapy last'. The terminology referencing the 'effects' of music therapy highlights the differences between these approaches which conceptualise music as an isolated, deliverable treatment and the wider impacts of development and learning that ecological approaches can achieve. The reliance on short term studies for impactful results is emblematic of the difference between musical studies and other learning and behavioural studies, where there is greater recognition of the impact of longer-term repetition and contextual implementation (Zwaigenbaum et al., 2015). This is despite many of the aims of music therapy, particularly in the context of music and autism, are for outcomes that are long-term and developmental; for which a long term, developmental solution is needed.

3.3.2 Applying ecological principles: Parent-led methodologies

The growth of naturalistic interventions in developmental and behavioural research has been underpinned by the recognition of the importance of parental participation and engagement in the research and intervention process. As highlighted in the previous chapter, there are now well-established interventions that utilise a parent-led approach, such as the Parent- Early start Denver Model (Estes et al., 2014), Enhanced Milieu Teaching (Kaiser et al., 2000), Social ABCs (Brian et al., 2016) and Project IMPACT (Ingersoll & Wainer, 2013). For early intervention, caregiver involvement

is now considered best practice (Zwaigenbaum et al., 2015; Frost et al., 2021). Through the lens of an ecological framework, the integration of caregivers supports the importance of the proximal processes that Bronfenbrenner emphasised as crucial for developmental change. Their success is also further evidence of the importance of the context and time in providing meaningful behaviour change. The importance of time for specific interventions with autistic children has also been identified by the National Research Council, which has highlighted that 25 hours a week of engagement/intervention is necessary to truly affect behavioural change. As the NRC note, this is relevant if delivered directly by therapists alone. However, when strategies actively engaged parents and incorporated the intervention as part of daily routines, the number of hours requiring input from the therapist dropped significantly, while outcomes often remained much the same (Zwaigenbaum et al., 2015). However, this promise of caregiver-implemented interventions has not been seen consistently, with some mixed results suggested there more to learn about for whom and how they can work (McConachie & Diggle, 2007; Wetherby et al., 2018; Frost et al., 2021). The theoretical underpinning to NDBIs is that the context-dependent techniques are able to target the ‘active ingredients’ responsible for causing change, and thus cause cascading effects over time, such as on joint attention and imitation (Charman, 2003; Schreibman et al., 2015).

The advantages of these approaches are manifold; the importance of family involvement can also both increase empowerment and self-efficacy, be cost-effective and highly impactful, with parents able to ‘capitalise on teachable moments as they occur’ (Zwaigenbaum et al. 2015, p. 75). Ecological methodologies also ensure intervention approaches are adaptable and in the best interests of the child, with outcomes that have meaningful, everyday effects rather than being entirely theory driven. As Bernheimer & Keogh (1995, p. 427) note ‘Families do not develop their daily routines in response to developmental quotients or other test scores. They respond to the effects...on their everyday lives, and that child’s day-to-day wellbeing’. Pursuing an ecologically valid methodology therefore provides an opportunity to bridge the gap between theory and practice and ensure that

research can make a meaningful impact to the everyday lives of autistic people (Happé & Frith, 2020).

Music is an ideal medium to incorporate as a family-centred practice because it is social in nature, and it is easily shared throughout the various systems and contexts (Allgood, 2005). Research with families with children with disabilities has indicated that family music therapy can be beneficial in supporting well-being and create opportunities for interpersonal communication and relationship development between family members (Pasiali, 2012; Thompson, 2012b; Tegge love et al., 2019). Yet, while these benefits of caregiver inclusion are evident for well-being and relationship development are frequently espoused, the role of the caregivers within these settings is often not clearly defined (Hernandez-Ruiz, 2020). This was evident in a recent systematic review of parent-mediated music therapy for autistic children, where the settings for intervention varied from hospitals to community centres to childcare settings to therapist mediated play sessions in the home (Hernandez-Ruiz, 2020).

Many of the NDBIs in developmental and behavioural science are complex interventions with specific training and integration of caregiver roles and recognise that the proximity of caregivers to their children provide a methodological advantage to the consistent implementation of an intervention or programme. Although many music therapists acknowledge that it is part of their practice to support and empower parents to further utilise musical skills at home, there have been few attempts to integrate this systematically in the methodology of any music programme or intervention. Barriers include parent time and lack of confidence in using music. Further barriers to home and caregiver mediated methodologies are similar to those experienced in behavioural approaches. Often, interventions designed by professionals have observed that parents fail to implement or sustain them fully (Meyer & Bailey, 1993). Intervention strategies that require high levels of parental effort are liable to be difficult to maintain, with other factors including parent

workloads and the presence of siblings likely to have a further negative impact on implementation (Hernandez-Ruiz, 2020). As many strategies for NDBIs have identified, sensitive training to build parent confidence and empowerment, and ensuring the ease with which approaches can be implemented into daily routine, can mitigate some of these barriers (Schreibman et al. 2015).

In the current project, these challenges were partly addressed through the use of flashcards: resources that detailed easily accessible musical activities for both parents and as children to support implementation (see Section 3.4.5). A further benefit to this approach is that it ensured consistency of the programme across participants, while being adaptable enough to be incorporated into the daily lives of participants. In light of the well-being benefits that everyday musical engagement can have, the project design also incorporated the informal, individual manifestations of musical lives into its foundations. The home-based setting was an important element to this in order to engage and empower participants in their own, familiar spaces. Piloting this design was also essential to assess whether it was viable and a reliable method for both data collection and implementation. The methods for both the Pilot and the Main study followed the same models, as will be outlined separately below.

3.4 Pilot – Methods

The pilot project sought to trial the aspects of the intervention for the main study, including both design, procedure and analytical methods. Of particular interest was how the home music programme, that could be delivered in collaboration with parents and researcher-practitioners, was implemented in everyday life. It also investigated the ways in which the families initially engaged with the programme of resources, whether the methodological design of using an observational framework for musical play, was ecologically valid in the context of the autistic children's play. In this section, the design, methods, materials and procedure will be detailed. As the pilot project used the same qualitative and quantitative methods as the main study, greater reflection on the selection of qualitative and quantitative methods and the analytical procedure is considered in the main study methods section (3.5).

3.4.1 Design

During the pilot study each family was visited three times in the course of a 10–12-week period, and in between visits were encouraged to upload diary entries detailing their own home music making to the 'EthOS' app. During each visit, the researcher conducted musical play sessions with the participant children (which is outlined further in 3.4.3) consisting of introducing the instruments one by one, showing the participant how to use them functionally and then following the child's exploration of these instruments. At this visit, the parents also observed this first play session, during which the researcher modelled the play activities detailed in the resources (as detailed in 3.4.3). They were then directed by the researcher as to how to use the cards most appropriate to their child's abilities, such as 'they like the sound of the echo microphone, so try to make different sounds in that and see if they can copy you', or 'they like playing these first three notes on the keyboard, so try to make different patterns out of those, and then encourage them to start using

four or five notes'. These play sessions were repeated at the second and final visits and were recorded using a GoPro camera placed in the corner of the room. At the end of the pilot project, semi-structured interviews were conducted that explored the parents' experiences of the programme.

3.4.2 Validity

To date, the study of children's behaviour has utilised a diverse set of methodologies, ranging from unstructured, child-led interviews of their experiences to parents' retrospective reports. For understanding processes of change, research with children has primarily focused on age-related competencies, either through testing or parental report (Greene & Hogan, 2011d). Research of this kind is most often conducted in 'strange situations' such as university laboratories, and reflects positivist paradigms that these types of measures will uncover the true score of a child's developmental abilities (Bronfenbrenner & Morris, 1998). However, within the field there is a growing awareness of the need to collect ecological valid data and establish methods that can fully capture children's experiences in their everyday lives (Greene & Hogan, 2011a). Methodologies that are solely dependent on parent-reported data are of limited validity and reliability due a multitude of factors, including social desirability, parental expectations, psychological function and comprehension issues (Ash & Guyer, 1991; Melton, et al., 2014). This is often compounded in research with vulnerable or disabled populations. The over-dependence on parental reports has been criticised as a failure of the research community to develop methods that can communicate with and understand children's experiences, rather than simply being due to the limitations of the child (Melton et al., 2014). Therefore, many within child development research now recommend that a combination of multiple methods are used in order fully represent the behaviours, experiences and processes of change, a recommendation that was at the heart of the methodological design of this project (Melton et al., 2014).

For both the pilot and the main projects, to ensure the validity of the research at all stages of design, methods, collection and analysis, multiple considerations were made according to Cohen et al.'s (2017) suggestions for how to preserve and maintain validity and reliability in education research. To maximise the validity, the project used a mixed methods approach with both qualitative and quantitative forms of data collected. Using these methods, the data was triangulated from three different sources: semi-structured interviews, clinical behavioural measures, and observational behavioural coding. Validity was also maintained throughout data collection and analysis, with appropriate quantitative instruments selected for their wide acceptance within the field, and their strong psychometric qualities to assess behavioural change. The use of novel observational measures was built to further preserve validity and reduce reactivity. Inconspicuous cameras were used to reduce the possible reactions of the children to being filmed, and the validity of observational frameworks was confirmed using interrater reliability measures as well as being informed by existing theoretical and behavioural models.

3.4.3 Ethics

Ethical approval for both the pilot and the main projects was obtained through the University of Roehampton's Ethics Committee. During this application, both the University's and the British Psychological Society's ethics guidelines for research with vulnerable populations were adhered to. University safeguarding policies were also reviewed as well as the university's Lone Working Policy, as all the visits occurred in the family's homes. I held an enhanced DBS clearance for working with children and vulnerable populations.

As the children were aged under 10 and many had limited expressive verbal abilities, parents gave informed written consent for the participation of their child. Although the children could not always

verbally consent, if appropriate a script was developed with the parents to gain the assent of the child. A clear verbal explanation was always given to the children for my presence e.g. 'I am here to play some music with you. Is it ok if we play with some musical instruments together today?' The children were aware of the camera when filming, so there was no deception during sessions of musical play, but the camera was discreet enough to not distract the participants during the sessions. If the child turned the camera off multiple times (more than 3), that was respected, and filming was stopped. Throughout the play session, the child was monitored for signs of distress. If they repeatedly refused to play with the instruments, became distressed or withdrawn, the play session was stopped. In consultation with the parents and their children's needs, other adjustments were also made during the session, such as movement breaks. The fact that families could keep the resources provided for the study after its conclusion may have provided incentive for the participants, but no financial remuneration was provided.

For both the quantitative behavioural data collected, along with the videos uploaded by the parents in their diaries and collected at the home visits, anonymity was ensured throughout. Each participant was assigned a code, which is how they are referred to in this thesis and during data analysis. All video and audio data were stored on a password-protected hard drive and files' names were saved under the unique ID codes of the participants to retain confidentiality. For all videos and images used in publications and public-facing materials, children's faces and references to names were obscured. The paper and online questionnaires completed at the start and the end of the project were also labelled with the participant's code rather than their name to further preserve anonymity.

The upload of the videos and diary entries through the EthOS app and cloud platform also raised ethical concerns. As a well-established market and academic research tool, it had strict data storage policies that were also reviewed and gained approval from the university ethics committee. Each

parent’s access was protected by a password and username and was only viewable by the parent who uploaded the material and me. No parent was able to view uploads by other parents.

3.4.4 Methods and Analytical Procedure

At the beginning of the pilot study, parents completed a questionnaire that asked preliminary background questions about age, sex, their children’s previous musical experience and the child’s language abilities. Full details of this questionnaire can be found in Appendix 4. Qualitative interviews conducted, alongside quantitative observational measures of musical play. The interview questions were framed by three areas. Firstly, whether they found the cards helped them to engage musically with their child, and if so, how. Secondly, how the cards worked in everyday life and whether they had noticed any difference in their child’s musical engagement. Finally, whether there were any wider changes that they attributed to the greater use of music. Table 2 outlines each data collection tool, the areas each tool targeted, and the analytical procedures that were used for each part of the data. Preliminary data processed was done in Microsoft Excel, with statistical analysis conducted using R Studio.

Table 2 Data Collection Tools for Pilot Study

Data Collection Tools		Analytical Procedure	Software
Preliminary Questionnaire	Musical background, language and demographic details	n/a	Inputted using Microsoft Excel.
Videos of Musical Play	Observing musical play and changes in musical behaviours	Repeated Measures ANOVA	- Videos inputted using iMovie. Coded using Google Forms. ⁴ - Data inputted using Microsoft Excel - Statistical Analysis: R Studio (Version 2.1.5), package Psych (Revelle, 2021) used for analysis.
Semi structured Interview	Experiences of Resources	Thematic Analysis	Analysed using NVivo (Version 12.6.0)

⁴ More details on the coding procedure process and software can be found in Chapter 4, Section 4.4

3.4.5 Materials and procedure

i. Materials

Systematic guidance and accessible materials indicating how to support musical interaction in home-based environments is limited. While some activity learning cards have been produced by educational charities and magazines, the effectiveness of the materials that do exist has so far not been assessed. One project that sought to address this was the IMAGINE:Autism project (Ideas for Music and Games in the Early Years), which highlights an approach that moves away from more static models of music therapy and emphasises both the playful nature of musical engagement and how micro-practices of everyday music making can be beneficial (Lisboa et al., 2021). In particular, the resources that it details highlight how simple activities can be designed to encourage parents, and to promote confidence in their own musical abilities to engage with their child. As Lisboa et al. found, when parents were provided with appropriate resources and guidance, they were able to successfully support their children's musical development and play. Using this set of flashcards that detailed small, achievable activities of how to encourage musical play and that placed the majority of the 'intervention time' on the part of the parents with limited input from the music practitioners, the project observed development both in the children's musical skills and parent confidence.


The methodological design for the current study followed a similar framework as a home-based intervention, which encouraged the incorporation of musical play as part of everyday routine and interaction. The set of cards, discussed in Lisboa et al. (2021) was therefore used as a basis for the pilot resources, streamlining an original iteration of the cards from 48 to 24 (removing repetition and making the cards double-sided) and redesigning the cards to be printed in postcard form with clearer correspondence to the Sounds of Intent Levels, colour coded. Activities were also condensed to remove repetition, and formatting changed to put the 'hints for behaviours' in a different section on the back of the card. This set of 24 activity cards were provided to the parents, which detailed

different musical activities to encourage musical play and got progressively more complex as they went through. The cards, whose efficacy is evaluated in Lisboa et al. (2021) were designed around the Sol-EY Framework, meaning that the progression of the cards' complexity is orientated around the Sounds of Intent developmental milestones, corresponding to the Levels 2–5. At each level, three separate cards were included for the three different domains: Reactive (Listening and Responding), Proactive (Making Sounds and Music Myself), and Interactive (Making Sounds and Music with Others). This meant that at each level there were a variety of prompts which could be child-led, parent-led or a combination of the two.

The progressive developmental trajectory of the cards also allowed participants to take control of the pace of their own musical development, moving from 'Sounds Interesting' (Sounds of Intent-EY Level 2) to 'Copy me – Copy you' (Sounds of Intent-EY Level 3) to 'Bits of Pieces' (Sol-EY Level 4) to 'Whole songs in time and in tune' (Sol-EY Level 5). The cards were also designed to act as a springboard to more creative forms of engagement such as the users making up songs themselves, and they emphasised a mix of activities to structure routine, encourage joint play or to share a space of relaxation and interaction. At each level, the activities also provide an option for 'vocal' activities and 'applied' activities, where instruments were used. The cards were also designed to be visually attractive, with a colour scheme for each 'Reactive', 'Proactive' and 'Interactive' domain. The printed cards were only postcard sized and were held together with a metal split ring in order to be easily transportable, less likely get lost and easy to flick through. Figures 3–6 feature examples of the double-sided cards in each domain. A full visual account of the cards is also in Appendix 3 along with detailed breakdown of the individual activities and relevant descriptors that were detailed on each card.

Reactive Level 2 Listening and Responding

Show me the sounds that everyday things and musical instruments can make



Card 2

Figure 2 Example Reactive Card at Sol-EY Level 2

Reactive Level 2 Listening and Responding

- **Shaking** containers with things that rattle and instruments like maracas
- **Banging** things together: wooden spoons on pots and pans, drums, tambourines and claves
- **Rubbing** a brush on a tray or playing a guiro

Remember that I may be particularly sensitive to certain sounds which I may find exciting or distressing - or both.


Be sensitive to my reactions and give me plenty of time to get used to new experiences. There's no rush!

I may prefer to explore new things for myself (proactively)

Card 2

Proactive Level 3 Making sounds and music myself

Encourage me to make patterns on sounds makers and musical instruments



Card 10

Figure 3 Example Proactive Card at Sol-EY Level 3

Proactive Level 3 Making sounds and music myself

- Encourage me to transfer my interest in making patterns in sound by giving me musical instruments to tap instead
- Give me a keyboard to play with too (or a keyboard app!)
- Help me understand the pattern of the black notes or white notes by labelling the keys with colours or letter or both
- Try to move me from just making sounds with everyday object to musical instruments
- Let me see how fun it is to play with you!


Some autistic children (like me) may not need much encouragement to make patterns in sounds by tapping everyday objects like glasses and cups

This is because I find the sounds they make are fascinating - perhaps more important to me that the usual function of the objects

Card 10

Interactive Level 4 Making sounds and music with others

Play 'call and response' games with me using your voice



Card 17

Figure 4 Example Interactive card at Sol-EY Level 4

Interactive Level 4 Making sounds and music with others

- When I sing short patterns of sounds, copy what I do
- Encourage me to do the same
- Play 'call and response games' - you could use some of the communication songs, like 'What's your name?...My name is Jack'
- Play the game with other people in a small circle - one person could be the leader for others to follow, or you could play 'pass the pattern' from one person to another

At first, I may just copy what you do, so you could model the interaction with others

Card 17

The cards provided flexible strategies that were built on developmental goals but could also be easily adapted, providing the parents with ideas that are not overly prescriptive but rooted in musical developmental models. This encouraged parents to both adopt and respond to their own child's interests and become aware of their own musical agency and confidence. During the initial visit and play session a preliminary assessment of the Sol-EY level at which the child was engaging with the instruments was made and the appropriate corresponding levels on the card were recommended to the parents as a starting point. At this play session, I also modelled some of the activities on the cards. Their pre-existing musical routines were also discussed and used as a foundation on which to build, in order to highlight to the families what strategies they might already be using, and how to develop these further using the activities detailed in the cards. For example, using songs they already know to structure routines, or showing how the instruments could be used within the context of those songs to encourage imitation, by copying a particular melody, rhythm or attempting to tap along. The musical instruments provided were given to the families to keep in their homes, which was an important element as it provided them with flexible opportunities to develop musical routines and skills. Unlike a set programme of therapy or intervention that is conducted over a dictated period of time and context (such as an hour a week in a community location), this approach ensured that the interaction is driven by the child's interests, on their own terms and enables the parents to capitalise on particular moments. Once the instruments and cards had been introduced, the parents could begin to implement the strategies. For example, exploring the sound-making potential of everyday objects such as crisp packets, or singing short everyday phrases such as 'hello', 'goodbye' appropriate points or 'what do you want?' at mealtimes.



Figure 5 Example set of instruments provided to the families

With the use of and easy access to the instruments, the parents were able to integrate them as part of their everyday play or introduce music at critical points such as at periods of stress or meltdown as a way to regulate a child’s emotions. The role of parents was vital to slowly implementing and responding at the most appropriate points for their child’s development as developing routines and skills are dynamic processes and therefore require consistent, long-term implementation (Zwaigenbaum et al., 2015).

ii. Procedure

As a researcher, I was able to work collaboratively with the parents using the cards, which further facilitated the ability to map out a developmental path with targeted goals, while also corresponding and accounting for their own musical experiences. One of the advantages of this approach is that it both allowed a high level of adaptability for each family, while also ensuring that there was consistency across the participants in terms of the types of activities that were being undertaken. This meant that although a common framework underpinned the intervention programme and design across the participants, the experiences of the participants meant that they feel in control and empowered in their own musical journeys, and that it was suitable to be adapted for their

specific contexts and needs. Given the heterogeneity of the condition, this meant that the highly complex needs of each child and their families could be addressed.

At the first visit the families were provided with a set of handheld musical instruments, including maracas, castanets, sleigh bells, and tambourine along with a small 44-note Casio keyboard, as can be seen in Figure 6, and the flashcard resources outlined above. At the first and each subsequent visit, a musical play session was conducted with the child, with the parents first observing and then participating. These musical play sessions were recorded using a small, portable camera in the corner of the room. Activities from the cards were modelled with the children during the play session, that whilst being led by the children, followed a flexible structure that aimed to include imitation, singing, creative and constructive play as part of the session, although this was not prescriptive. Home visits lasted between 45 minutes and an hour and a half, and a flexible approach was taken to respond to the child's particular interests and needs. A preliminary itinerary for the home visits can be seen in Figure 6.

Informal feedback sessions with the parents were also conducted at each visit, discussing the progress and experiences with the



Figure 6 Example visit structure

programme, and advice was given on how to further facilitate and develop musical play according to the child's level of engagement and ability by directing them to the next cards that their children could use, and identifying the child's own interests.

An example series of the activities that were covered in the play session, and their broad functions in terms of supporting different types of play, are outlined below in Table 3.

Table 3 Example Joint Play Schedule

Role	Task	Function
Exploratory	Musical instruments laid out, encouraged to explore sound-making potential of each instrument Song - "Hello song"	<i>To introduce instruments and to prime children in knowledge of what is going to happen.</i>
Joint Play Musical Agency	Nursery Rhyme of participant's choice, with instruments being used as accompaniment	<i>Enables child to be aware of own musical agency and encourages child to realise capacity of instruments to supplement/enhance their own music making.</i>
Joint Play Musical Skill Development	"Sound and Silence", game.	<i>Highlights child's own control of musical instruments and introduce element of fun. Encourages turn-taking between partners.</i>
Imitation Musical Skill Development	"Can you copy me?"	<i>First introduction of musical skills and musical motifs of each instrument, with attempts to help children recognise the capacity of their own instruments to reproduce the motifs.</i>
Joint Play Musical Agency	Nursery Rhyme of participants choice, with instruments being used as accompaniment or as part of <i>the song</i> .	<i>Use of structured songs to teach turn taking and patterns and demonstrate incorporation of instruments. Potential to show ability to replicate melodies on instruments</i>
Verbal Development Music in Everyday Life	"Goodbye" Song	<i>Signposts the end of the session, highlighting to parent's use of music in everyday life and potential avenues for verbal development.</i>

3.4.6 Participants

Seven families of children aged between 4 and 9 years ($M = 6.9$), with a diagnosis of Autism Spectrum Disorder were recruited for the pilot project. Within the participant cohort, there were five boys and two girls. Two were non-verbal, three had emerging language, and two were fully verbal. One participant also had sensorineural hearing loss, which was treated with the use of a cochlear implant. Participants were recruited via local support networks and charities, as well as through social media, with two recruited from a Twitter advert, one through word of mouth, and the other four from a local National Autistic Society support group. All participants lived in Greater London. The parents all gave informed written consent and children's assent was assessed by an ongoing process of monitoring well-being of the child and stopping if there were any signs of distress. None of the pilot participants took part in the main study.

Table 4 Pilot Participant Details

Participant ID	Age	Sex	Language	Previous Musical Experience
Participant A	7	M	Single words	None
Participant B	7	M	Simple Sentences	Occasional music therapy
Participant C	8.1	F	Simple Sentences	Ongoing music therapy
Participant D	3.8	M	No Language	None
Participant E	9.1	F	Full sentences (<i>selectively mute</i>)	None
Participant F	6.4	M	Simple Sentences	None
Participant G	3.9	M	Simple Sentences	None

Details of data collection methods and questionnaires can be seen in Appendix 4.

3.5 Main Study – Methods

3.5.1 Design

The main study used the same within-subjects, home-based design as the pilot. Over a period of 12 months parents acted as the primary deliverers of a flexible programme that was designed to encourage the integration of music more readily into everyday life. Over the year, each of the 25 families based within Greater London were visited at home four times, during which a variety of qualitative and quantitative data was collected. Musical play sessions lasting roughly half an hour with the children were also conducted at each visit and filmed using a small, portable camera placed in the corner of the room. To support and maintain musical play between the visits, 24 activity cards (outlined above in section 3.4.5 and based on the Sol-EY stages of development) were given to the families, who were encouraged to implement the activities on the cards between the visits. These activities became progressively more complex, and parents were encouraged to implement the activities both through musical play as well as in daily routines. Although originally five evenly spaced visits were planned, the lockdown caused by the coronavirus pandemic during the spring and summer of 2020 meant that one visit was cancelled, widening the gap between the third and fourth visits to six months. A timeline of the visits is shown below.

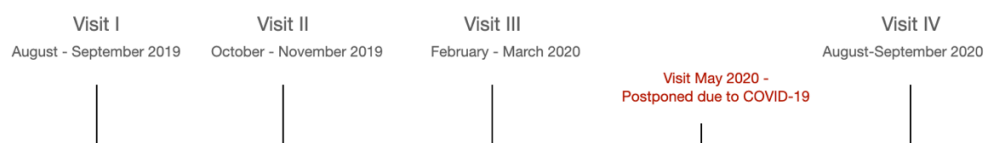


Figure 7 Timeline of Visits

To reflect the complex and integrated nature of musical experiences that were a core part of the research design, the project adopted a mixed methods approach to data collection, triangulating three separate modes of collection:

1. Qualitative data, in the form of parent interviews and diary entries about their child's musical behaviours and engagement, to understand how music is used in everyday life and the nature of their child's interaction with music.
2. Direct, empirical observation of children's musical play to capture mechanisms of change and provide a deeper understanding of how interactive behaviours are scaffolding during play and of how these may be tied to development.
3. Quantitative behavioural measures, including standardised quantitative, behavioural checklists in order to monitor wider changes in behaviour over time, and enable comparisons within the cohort. Details of data collection questionnaires can be found in Appendix 5.

For clarity, the research questions, methods, analytical approach and measures are repeated below in Table 5, which also further details the number of visits at which the various methods were employed. Further granularity on the methods used at each visit can be observed in Table 6.

Table 5 Research questions, methods and measures

Research Question		Methods	Analytical Approach	Measures
		(Key: α - qualitative, β - quantitative, ¹ denotes at which visit methods were employed)		
1	How do the musical abilities and engagement of young children on the autism spectrum develop over time?	α : Semi structured Interview ⁴ β : Observation: video coding ^{1,2,3,4}	α : Thematic Analysis β : Repeated Measures ANOVA β : Latent Growth Models	Sounds of Intent in the Early years (Voyajolu & Ockelford, 2016) Musical play observational coding
2	What is the role of music in the daily lives of autistic children and their families?	α : Semi structured Interview ⁴ β : Questionnaire ⁴	α : Thematic Analysis β : Descriptive Statistics	Music in Everyday Life Scale (MEL) (Gottfried et al., 2018)
3	How can musical play promote the development of social competencies and impact wider developmental outcomes of young children with autism?	α : Semi structured Interview ⁴ β : Pre & Post Questionnaire ^{1,4} β : Observation: video coding ^{1,2,3,4}	α : Thematic Analysis β : Repeated Measures ANOVA β : Latent Growth Models	β : Autism Behaviour Inventory (Bangerter et al., 2017) β : Social Responsiveness Scale (Constantino & Gruber, 2012) β : musical play coding scheme
All data processing was done using Microsoft Excel and Microsoft Word. Qualitative analysis was undertaken using NVivo (Version 12.6.0). Statistical analysis was undertaken R v3.6.1 (R Core Team, 2021) using packages <i>Psych</i> (v2.1.9, Revelle, 2021), <i>RStatix</i> (v. 0.7.0; Kassambra, 2021) and <i>Lavaan</i> (v. 0.9.0; Rosseel, 2012).				

3.5.2 Methods and Analysis

The research adopted a multidimensional strategy that employed mixed methods to address all aspects of the research questions, ranging from the richness and depth of individual families' experiences to the expressions and enactment of children's behaviours, and to the impact of the

programme on generalised behaviours. The multiple methods outlined below, including qualitative interviews and thematic analysis alongside quantitative behavioural and observational measures, emphasise the integrated nature of the data. The lived reality and social context of the research further required a contextualisation of the quantitative findings with the richness that qualitative accounts can provide. As Mason (2006) has recommended, ‘qualitative thinking’ can be a valuable starting point for mixed methods research of this kind. It can help inform the mainstream methods for observing and quantifying changes in social behaviours for autism where validated measures tend to focus on identifying and measuring the amount of deficit. Although statistical methods can quantify and track change in specific pre-identified behaviours, they are limited in their ability to capture the richness and agency of individual lives. Interpreting these scores in light of the accounts and experiences of the families can enrich these findings and offer insights into the wider beneficial impact of these changes.

3.5.2.1 Data Collection Tools

At the first and final visits, the parents completed questionnaires that detailed musical experiences and interests, demographic details and language ability as well as two clinical behaviour measures, the Social Responsiveness Scale (Constantino & Gruber, 2012) and the Autism Behaviour Inventory (Bangerter et al., 2017). Copies of the questionnaires given to the parents can be found in Appendix 5. Semi-Structured interviews were conducted at the final visit to explore the parents’ experiences of the project, to reflect on any changes they had observed in their children’s musical behaviours, and to understand the perceived value and dynamics of musical play and the role of music in the lives of their children and their families.

Methods used across the project enabled the capturing of parent experiences and perceptions of the value of musical play through in-depth interviews, systematic measurement of behavioural

change (to investigate potential transfer effects from music to wider behaviours), and the ability to assess the children’s responses to the musical spaces directly through observation. Table 6 outlines the methods and measures of data collection, and the analytic methods used for each.

Table 6 Detailed breakdown of data collection tools and measures by timepoint

		Visit I	Visit II	Visit III	Visit IV		
Data Collection Tool	Measure					Analytic Method	Research Question
Observation of Musical Play	Sounds of Intent-EY	✓	✓	✓	✓	Latent Growth Models	RQ1
	Interactive dimensions of musical play	✓	✓	✓	✓	Latent Growth Models, Repeated Measures ANOVA	RQ1, RQ3
Questionnaire	Previous musical experience & interest	✓			✓	Covariate for LGM’s	RQ1
	Social Responsiveness Scale	✓			✓	Repeated Measures ANOVA	RQ3
	Autism Behaviour Inventory	✓			✓	Repeated Measures ANOVA	RQ3
	Music in Everyday Life Scale				✓	Descriptive analysis Covariate for LGM’s	RQ2
Qualitative	Semi-structured interviews				✓	Thematic Analysis	RQ1,2,3
	Diary Entries	✓	✓	✓	✓		

Each data collection tool and analysis provided a unique perspective on the experiences of the participants and the changes in behaviour that were observed during the programme. For each research question, at least three different methods of data collection were used so that findings could be triangulated, with qualitative experiences enriching and contextualising the quantitative

results. The theoretical underpinnings for each of these methodological and data collection tools will be outlined below, including the validity for both new and existing quantitative and observational scales.

3.5.2.2 Qualitative Data: Semi-Structured Interviews and Diary Entries

Due to the closeness that the parents had with the research process as the primary implementers of the musical programme, as well as their expected intimate knowledge of their children's changing behaviours and experiences with music, understanding their perspectives were essential in the process of data collection and analysis. The importance of the adaptability of the programme, and the perceived value and experiences of the shared musical spaces that were detailed in the research questions are multifaceted issues that can only be addressed a multi-dimensional research strategy that included both qualitative and quantitative approaches. The use of a semi-structured interviews allowed for a contextualisation of music's behavioural and regulating impact and provided a richer account of the uses of music in everyday life for the participant families, that would fail to be reflected by quantitative methods alone. The centrality of daily routines and experiences of the families to the research required qualitative approaches which could reflect this depth. The use of semi-structured interviews enabled this to be captured, and the individual experiences of each family to be compared across and within the participant cohort. Within psychology and education this methodology is well-established as a means of gaining rich, in-depth perspectives of participants experiences (Braun & Clarke, 2006). By exploring the value of music as a shared space of engagement, it was possible to reflect on the beneficial impacts to families that may not be accounted for in the quantitative measures, and that therefore go undetected. As Mason (2006) has emphasised, the use of qualitative approaches within a mixed-methods paradigm can be a particularly valuable starting point for exploring research questions related to social experiences and lived realities, enabling 'qualitatively driven' analysis.

The interviews were conducted in person at the end of the programme at the final home visit and lasted between 30-45 minutes. Open-ended questions addressed the parents and children's overall experience with programme, particularly with regard to the changes they had observed in their children's engagement and musical behaviours, and their perceptions of both their own and their child's experiences during musical play. Questions about music in everyday life were also asked, including the specific uses of music for the families in wider environments, and the importance of music for their children. Interviews were audio recorded, subject to the participants consent, and then transcribed. Diary entries were also completed across the course of the programme by the parents in between the visits who uploaded multi-media including text and video detailing their progress in musical activities and changes uses of music. The only guidance given to the participants for their diary updates was to detail their progress and experiences of music making. Reminders were sent out to continue uploading diary entries twice between each visit. Due to the variability of the video material uploaded by the parents, only text and audio material detailed by the parents was subject to analysis.

The interviews and diary entries were analysed using thematic analysis, using the procedures detailed by Braun and Clarke for thematic analysis in psychology (Braun & Clarke, 2006, 2014). This analytic method was selected due its relative freedom from theoretical assumptions, while still providing a rich and complex account of the data, with a clear and rigorous procedure. Braun and Clarke identify six phases that comprise the process of thematic analysis, whilst also emphasising that it is both reflexive and recursive, requiring movement back and forth as led by the data throughout the analysis (Anzul et al., 2003; Braun & Clarke, 2006, 2014). These six phases are:

1. Familiarisation with the data
2. Generating initial codes
3. Searching for themes

4. Reviewing themes
5. Defining and naming themes
6. Producing the report.

(As detailed in Braun & Clarke, 2006, p. 89)

Some of the advantages of this type of thematic analysis is that it can detail the similarities and differences across a data set and is particularly appropriate when working within participatory research where the participants act as quasi co-researchers within the project. Its bottom-up, inductive approach also enables participants' experiences to be reflected in detail. Within the context of this project, the process of analysis begun with diary entries being added to the beginning of the final interview transcripts, then all 25 transcripts read through several times for familiarity. Although some of the participants had English as a second language, sessions were transcribed verbatim so in some cases linguistic idiosyncrasies remain. Initial codes were first generated for all transcripts, which were then sense-checked and reviewed across participants. These were subsequently collated into emergent themes and then grouped into wider themes which reflected the parent's experiences of musical engagement with their children, the perceived changes they observed across the programme, and the importance of music for their children.

3.5.2.3 Quantitative methods: Observation of Musical Play

As emphasised above, the experiences of the participants themselves were a core component of the research questions, but one that was particularly inaccessible due to the verbal and intellectual limitations of the participants. One of the most effective ways to collect ecological data is to observe children in naturalistic situations, where their agency is made clear by their actions and interactions with the environment (Greene & Hogan, 2011b). The capacity to observe non-verbal cues and behaviours within the context of the task is particularly advantageous for autistic children, where

capacity for verbal communication is often limited. Observation also provided the opportunity to get as close to ‘real life’ scenarios as possible, with the ability to identify the mechanisms of play and its everyday manifestations. Observational methods have grown in popularity as they place more emphasis on the environment whilst also having a capacity to directly measure behaviours and interactions. Behavioural observation in particular has the advantage that it can both identify and test theories of behaviour, whilst retaining high levels of ecological validity (Heyman et al., 2014). In light of the current research questions, where behavioural outcomes related to social interaction and development are of central importance, observation during musical play provided the most appropriate way to capture and measure both behavioural and musical occurrences, and also to identify the processes of change in these behaviours over time.

To analyse behavioural changes within musical play settings, two different areas were the focus of the observation. One section of behavioural coding analysed musical-interactive behaviours and was closely linked to expected social communication behaviours exhibited in childhood play – ‘Measuring Musical-Interactive Play’. The other analysed changes in musical ability and engagement, measured by the Sounds of Intent-EY framework to track the development of musical competencies over time.

i. Measuring Musical-Interactive Play

An effective observational scheme for this research was needed that could reflect the active role of the child as musical actors within their environment. In particular, it needed to identify behaviours that may occur during musical play that have relevance to wider social development (RQ3), but that also develop within musical spaces (RQ1). This can shed light on the mechanisms that may produce transfer affects from musical play to wider social-behavioural change. Therefore, a coding scheme to analyse the dynamics of the participants musical play was developed specifically for the research questions, adapted from two pre-existing autism-relevant observation frameworks: MUSAD (Music

Based Autism Diagnostic Schedule) (Bergmann et al., 2019) and the ESCS (Early Social Communication Scales) (Mundy et al., 2003). The procedures involved in the development of this framework, its piloting and validation are detailed in depth in Chapter 4. In both its initial development with pilot videos and during data analysis of the videos from the main participant cohort, the scheme was validated by independent raters, with Intraclass correlation coefficient (ICC) of over .85 for each domain, which indicate a very good reliability. Through an iterative process of development, which engaged existing, relevant observational frameworks alongside grounded analysis of pilot videos of autistic musical play, five categories of relevant social and musical behaviours were identified: Reactions to Directing Attention (Joint Attention), Responses to Playing Together (Responding to Social Interaction), Reciprocity in Musical Interaction (Initiating Social Interaction), and Imagination and Creativity in Musical Play. These mutually exclusive categories were coded on a 1–4-point scale (1= severe impairment/no exhibition of target behaviours, 2 = moderate impairment/occasional exhibition of target behaviours, 3 = mild impairment/frequent exhibition of target behaviours, 4 = no impairment/consistent exhibition of target behaviours).⁵

This targeted framework enabled the tracking of interactive behaviours across multiple domains of musical play over time. Its alignment with the social interaction observational frameworks and the areas of common difficulty of social interaction identified in DSM-5 further allowed the possibility to examine the capacities of musical environments as potentially alleviatory spaces for interaction. Alongside music-developmental observation, as will be outlined below, it also enabled the relationships between musical ability and interactivity in musical play to be assessed.

⁵In depth descriptors of each of the four points, including example behaviours and scenarios, alongside the compilation of relevant categories for play with this population in a naturalistic setting are detailed in Chapter 4.

ii. Sounds of Intent

To monitor changes in musical ability (RQ1) participants performance in the Sounds of Intent in the Early Years framework was observed and scored alongside the musical play behaviours. As outlined in the previous chapter, the Sounds of Intent in the Early Years (Sol-EY) framework was developed to monitor and identify musical behaviours in musical play across all children in the early years. In its original model, Sounds of Intent was developed for those with profound and multiple learning difficulties, meaning that it is not tied to explicitly psychological, developmental, or cognitive goals. The Sol-EY is built on a similar premise and provides a way to capture children’s development over time and their capacities to interact with the instruments and musical stimuli separately from their cognitive and verbal skills and development. Unlike the behavioural categories above, it specifically focuses on musical cognition, as well as changing modes of musical interaction, ‘Reactive’, ‘Proactive’ and ‘Interactive’. The Sol-EY is made up of 4 levels of the Sol framework (Levels 2–5) with its descriptors adjusted to be more relevant to early years play. Table 7 details the descriptors within each level and domain.

Table 7 Sounds of Intent-EY Descriptors

Level	Mode	Descriptor
2	Reactive	Shows an Emerging Awareness of Sound
	Proactive	Makes Sounds Intentionally
	Interactive	Interacts with Others Using Sounds
3	Reactive	Responds to Simple Patterns in Sound
	Proactive	Makes simple patterns in sound intentionally
	Interactive	Copies Others’ Sound and Likes to be Copied
4	Reactive	Recognises and responds to distinctive chunks of music
	Proactive	Sings or plays distinctive chunks of music, and starts linking to them together
	Interactive	Engages in musical dialogues using distinctive chunks of music

5	Reactive	Concentrates on short pieces all the way through, reacting to the general feel and anticipating key features
	Proactive	Performs short pieces of music, gradually more in time and in tune
	Interactive	Performs short pieces with others, fitting in own part ever more accurately

For scoring the Sol-EY, the mutually exclusive domains of Reactive, Proactive, and Interactive were coded separately from the levels. Each level was then scored against three levels, from ‘Emerging to Achieving to Excelling’. This scoring system was trialled extensively in Voyajolu (2021) to assess the within level changes in musical play in the early years. The explicit scoring of the framework is detailed below in Table 8.

Table 8 Sounds of Intent-EY Scoring

Level	Emerging	Achieving	Excelling
1	1	2	3
2	4	5	6
3	7	8	9
4	10	11	12
5	13	14	15

Combined, the novel musical play observation scheme and the Sol-EY framework provided a suite of comprehensive tools for which the dynamics of musical play, and their processes of change over time, could be monitored. The output of discrete scores from each category enabled the changes in behaviours to be understood more concretely in terms of their real-life manifestations in musical play. Unlike many quantitative and observational measures associated with this demographic, both these rating scales focused on levels of ability, chronicling what the children were able to do, and how these skills and abilities increased over time, rather than scoring their levels of disability and deficit.

The video observations were collected at every home visit using a GoPro Hero 3,⁶ which was placed in the corner of the room for the entire course of the home visit to reduce its potential impact on children. Each of the four play videos collected for each participant at each visit was processed using iMovie to identify the relevant musically active sections of play during the visit and then subject to coding. As the length of the play sessions ranged from 9 to 39 minutes across the participants; to ensure data consistency ten randomly selected minutes were coded for each participant for every visit. The mean of the ten coded minutes at each visit were then calculated for each participant, so that each participant was assigned a score in the five interactive play categories for each of the four visits. Further detail on the development of the coding framework and its validity are detailed in Chapter 4.

3.5.2.4 Quantitative Behavioural Measures

To enrich and support the qualitative experiences of the parents reflecting on the changing behaviours of their children and provide a link between the observational change in musical behaviours against wider behaviours, clinical measures that were able to track changes in autistic traits sensitively, that were also collected at the beginning and the end of the project. To date, there have been a wide range of quantitative and observational tools to measure the core symptoms for autistic individuals that have been used in intervention research to monitor change. However, many of these scales, such as the Vineland Adaptive Behaviour Scale (Sparrow et al., 2005) and the Autism Behaviour Checklist (Cassidy, 2013) have primarily been designed to measure static core symptoms, and are often time-consuming and have less sensitivity to change over time (Anagnostou et al.,

⁶GoPro cameras are well-established in sports and adventure filming as a camera that can provide high image quality while being easily portable and very small/discreet (can fit into a pocket). Its wide-angle lens meant that it could capture images from the across entire room when placed in the corner, unlike the fixed perspective of a normal camera, meaning no musical play was out of shot even if the children moved around the room. It was particularly appropriate for the current population as they are designed to be resilient and therefore wouldn't break when dropped or thrown.

2015). Two previously validated scales were identified that had been either designed specifically for, or been widely used within, research to monitor changes in core autism behaviours and wider associated difficulties. These were the Social Responsiveness Scale, second edition (SRS-2) (Constantino et al., 2003; Constantino & Gruber, 2012) and the Autism Behaviour Inventory (ABI) (Bangerter et al., 2017, 2020). They were used to track the above-mentioned changes. Both are parent-reported, quantitative behavioural questionnaires that use rating scales cover a range of relevant areas for autistic children. The SRS-2 was chosen as it is a widely established scale used by physicians and researchers to assess autistic traits, provide recommendations for an autism diagnosis and has previously been used in several intervention research studies. The ABI is a more recent scale that was developed to address the gap of clinical scales that can sensitively reflect wider behaviour change, rather than just traits, in a number of areas that includes social communication but also cover wider behaviours including mood and anxiety, challenging behaviours and self-regulation.

i. Social Responsiveness Scale 2 – Revised (Constantino & Gruber, 2012)

The Social Responsiveness Scale was first developed Constantino to provide a quantitative measure of autistic traits with an instrument that can be completed by parents or teachers in 15–20 minutes. It is a 65-item rating scale, that measures deficits in social behaviours that are most associated with the diagnostic criteria for autism as detailed in DSM 5, giving it a high clinical relevance. Each item is scored on a 4-point Likert scale, ranging from 1 = *not true*, 2 = *sometimes true*, 3 = *often true*, and 4 = *almost always true*. As well as an overall raw score and T-Score, which serves as an index for the severity of social deficits for the autistic individual, subscale scores are produced for Social Awareness, Social Cognition, Social Communication, Social Motivation, and Restricted Interests and Repetitive Behaviours.

The SRS-2 has been used in a wide range of behaviour-genetic, epidemiological and intervention studies, and has demonstrated good psychometric, test-retest reliability and cross-cultural properties, with long term stability and equitability across age groups. In a comparison between parents in the UK and the US, acceptable reliability and validity and a single factor structure were identified (Wigham et al., 2012). One of the advantages of the SRS is that the T-scores also align with an assessment of symptom severity: within normal limits, Mild, Moderate and Severe. This provides a way to group participants and compare symptom severities across the cohort, which is particularly useful for a population that is known to be heterogenous. It has also been validated and compared against other diagnostic instruments for autism, including the Autism Diagnostic Interview-Revised (ADI-R), the industry standard diagnostic measure. More recently, concurrent validity has also been shown between the SRS and the Childhood Autism Rating Scale (CARS) (Schopler et al., 2010). One of the strengths of the SRS is its stability over time, and its use for autistic individuals across the lifespan. However, it has a specified behaviour recall period of six months, meaning it has some limitations in research that is investigating shorter-term change. It may also be insensitive to reflecting more subtle, or area-specific, change that research seeks to address. The high validity of the SRS, and its recognition across psychological, educational and clinical fields means that as a measure for the current research it provided a reliable insight into behaviour change in clinically relevant areas of autism. The timespan of 12 months between recall periods meant that it could be used as a pre- and post- measure. However, the focus on social communication meant that other behavioural and emotional changes that research has indicated that musical interventions may target, such as anxiety, self-regulation and well-being, were less accounted for, requiring an additional measure that was wider reaching.

ii. Autism Behaviour Inventory (Bangerter et al., 2017)

The Autism Behaviour Inventory was developed by Bangerter et al., (2017, 2020) to respond to the lack of psychometric instruments that can reliably and sensitively reflect change in intervention research for autism. It is a 62-item checklist that is suitable to be answered by caregivers of autistic individuals from age 3 through to adulthood. Each item is scored on a 4-point frequency Likert scale, ranging from 1 = *Never*, 2 = *Sometimes*, 3 = *Often*, to 4 = *Very Often*. Scores are produced for 6 different sub-scales: Core Symptoms; Social Communication; Restrictive and Repetitive Behaviours; Self-Regulation; Mood and Anxiety; Challenging Behaviour. These subscales address some of the gaps that other checklists in the field do not account for, measuring behaviours that often co-exist and impact quality of life for autistic children, including obsessive/compulsive attributes, aggression, self-injury, mood swings, hyperactivity and concentration issues, anxiety, and sleep disorders (Anagnostou et al. 2015). Its social communication subscale has high correlations with the SRS and the ABI-R, with its additional subscale scores showing high correlations with the CASI-4R Anxiety Scale Score and the Abberant Behaviour Checklist (Bangerter et al. 2019). It was not developed as a diagnostic tool, and instead was designed to specifically focus on behaviours that may be targets for change in autism. The 1-week time period for reporting particularly enhances its capacity to reflect change more sensitively than diagnostic scales. Due to the breadth of the behaviours measured in the ABI, and its heightened sensitivity to change, it was selected as a particularly appropriate measure for the current research, as it could identify changes in both core and associated behaviours associated with autism.

iii. Music in Everyday Life Questionnaire

To capture the wider dimensions of music in everyday life, parents were asked in the final questionnaire about the regularity, dimensions and quality of musical play in everyday life. The

questions were derived from the Music in Everyday Life Scale (Gottfried et al., 2018), which was designed specifically for families with autistic children, and includes both using music for activities in areas of joint interaction and play, but also through everyday life and routine activities (Gottfried et al., 2018). The component questions with the MEL survey are further illustrative of the range of behaviours and context in which casual music use is used to scaffold everyday life, including ‘calming down’, ‘understanding daily routines’, and ‘transitioning smoothly between activities (Gottfried et al., 2018, p. 140).

3.5.3 Materials and procedure

The materials given to the participants were the same set of instruments and keyboard as outlined for the pilot study (see section 3.4.5). This includes a 24 activity cards which detailed different musical activities to encourage musical play and got progressively more complex as they went through. The progression of the cards’ complexity is based on Sounds of Intent developmental milestones, corresponding to the Levels 2–5. At each level, three separate cards were included for the three different domains: Reactive (Listening and Responding), Proactive (Making Sounds and Music Myself), and Interactive (Making Sounds and Music with Others). The progressive developmental trajectory of the cards also allowed participants to take control of the pace of their own musical development, moving from ‘Sounds Interesting’ (Sounds of Intent-EY Level 2) to ‘Copy me – Copy you’ (Sounds of Intent-EY Level 3) to ‘Bits of Pieces’ (Sol-EY Level 4) to ‘Whole songs in time and in tune’ (Sol-EY Level 5). Building on the findings of the pilot study, an addition set of ‘pathways’ were included that gave the parents more guidance on how to move through the cards based on their child interests and abilities. More details on the adaptations and changes to the cards can be found in Chapter 4, section 4.5.1.

The same procedure from the pilot in regard to visit protocols and play schedules were also followed; starting with initial introductions to parent and child where consent and assent is

obtained, then an initial play session and exploring of instruments, introduction to resources (see Section 3.4.5). The length of visit was the same as the pilot study (roughly between 45 minutes to an hour). The final visit also included a semi-structured interview to explore parents' experiences of the project and their perceived changes.

3.5.4 Participants

The behavioural and demographic characteristics of the participants that took part in the research are presented below. None of the pilot participants took part in the main study. Thirty-two participant families were enrolled at the start of the project. Over the course of the year, seven participant families withdrew from the project, or did not complete the final visits due to lack of child interest ($n=2$), wider medical problems ($n=2$), moving abroad ($n=1$) or became uncontactable ($n=2$). This left twenty-five participant families that completed at least three of the home visits, and all the pre- and post- behavioural measures. Participant families were recruited using local networks and email mailing lists of charities that supported autistic families. All the participant families were resident in London or Greater London, and all participant children had received a clinical diagnosis of autism spectrum disorder, along with an associated Intellectual or Communicative disability. For data collection, the primary caregivers completing the questionnaires were all mothers ($n = 24$) apart from one father ($n = 1$). Table 9 details the demographics of the participant cohort.

Table 9 Participant Characteristics, *N*= 25

	<i>n</i>	%
Age at Start (in months)	Mean	<i>SD</i>
	5.8	1.6
Categories	<i>n</i>	%
Under 5	9	36
5-8 years old	14	56
8-9 years old	2	0.08
Gender		
Male	23	92
Female	2	8
Social Responsiveness Score (baseline)		
Medium	2	8
Severe	23	92
Verbal Ability		
No Language	4	16
Signs/Single Words	10	40
Simple Sentences	7	28
Full Sentences	4	16

As is typical with participant cohorts of autistic children with high support needs, the behavioural profiles of the children were heterogenous. However, the majority were rated within the severe range (as defined by a >76T score) on the Social Responsiveness Scale, indicating profound deficiencies in reciprocal social behaviour that are clinically significant and leading to severe interference with everyday social interactions. The sample was male dominated. The majority (84%) of the sample showed delays in expressive language, with very few able to communicate in full sentences (as measured by questionnaire, detailed in Appendix 5). The average age was 5.8, with 60% having at least one sibling.

Table 10 Sociodemographic, economic characteristics of Participant Families, N=25

	<i>n</i>	%
Ethnicity		
White Background	4	16
Mixed ethnic backgrounds	7	28
Asian ethnic backgrounds	5	20
Black ethnic backgrounds	4	16
Any other ethnic background	5	20
Household Income		
Under £15,000	3	12
£16,00-£29,999	7	28
£30,000-£49,999	1	4
£50,000-£74,999	5	20
£75,000-£99,999	4	16
£100,000-£150,000	3	12
Over £150,000	2	8
Relationship Status		
Married	21	84
Single Parent Family	4	16
Caregiver Education		
Secondary qualification (e.g., high school diploma)	5	20
Tertiary / higher/ further qualification (e.g., bachelor's degree)	16	48
Advanced qualification (e.g., masters, PhD, DMA, DMus degree)	4	16
Family Musical Experience		
Parent plays an instrument	4	16
None	21	84

The sociodemographic and economic characteristics of the cohort were diverse, with 84% from minority backgrounds, and 40% earning less the median London annual income (£30,700). At least 64% ($n = 20$) had completed tertiary education or higher, with most having no prior musical experience and only 4 (16%) played a musical instrument. Overall, the participant cohort was representative and reflective of the diversity of families living in London and showed a good representation of different ethnicities and income brackets. The lack of musical experience amongst the families provided a valuable insight into the suitability of the resources for untrained parents.

3.6 Methodology Summary

The methodological approaches that have been outlined above highlight the deeply embedded mixed methodologies that the project utilised in order to capture the richness of the musical lives of the participants. Qualitative and diary entries were able to emphasise the changing ways in which music was integrated into everyday life, and the significance of these behaviours for the families. Quantitative measures of behaviour change were able to situate these findings alongside evidence of development for the individuals. Observational measures provide further insight into these changes, as the details of changing behaviours within the musical environments are able to be tracked. While being led by the parents' experiences, the triangulation of these measures ensured the validity of findings was maintained.

4 Pilot: Resources and Observational Frameworks

4.1 Chapter Outline

This chapter presents the results of the pilot project, which trialled the programme of home-based music making with a small group of families. First, the qualitative results pertaining to the parent's experiences of the resources are detailed, including the parents perceived changes in their children's musical behaviours as a result (Section 4.3). Then, the process of developing and validating an observational framework is presented (Section 4.4). This also details the initial changes observed through this framework as part of the project (Section 4.4.5). Finally, the findings of the pilot project are interpreted in light of their implications for the main study, and the adjustments that were made as part of these findings are presented (Section 4.5).

4.2 Pilot Design and Rationale

This pilot aimed to assess the efficacy of the music programme that could be delivered in collaboration with parents and researcher-practitioners in a home environment for the families. It also investigated the ways in which the families initially engaged with the programme of resources, whether the methodological design of using an observational framework for musical play, was ecologically valid in the context of the autistic children's play. The objectives were therefore to explore how families engaged with the set of musical resources (outlined in Chapter 3) and how successful the intervention was in promoting engagement and development in musical behaviours. The research questions for this pilot study were different from the aims of the thesis, with their exploratory design framing the data collection.

- a. How did the parents engage with and commit to the research design?
- b. How did the parents become empowered to use music more readily in everyday life?

- c. What were the changes observed in children's musical behaviours and engagement over this pilot project?

As detailed more fully in Chapter 3, this first pilot part employed an exploratory design. Recognising the diverse nature of individuals' and families' experiences, it also used a mixed-methods approach, with qualitative interviews conducted, alongside observational measures of musical play taken. The behavioural measures detailed for the main study part of the project were not included here, due to the short timeframe of the data collection. At the end of the pilot project, semi-structured interviews were conducted that explored the parents' experiences of the programme. The interview questions were framed by three areas. Firstly, whether they found the cards helped them to engage musically with their child, and if so, how. Secondly, how the cards worked in everyday life and whether they had noticed any difference in their child's musical engagement. Finally, whether there were any wider changes that they attributed to the greater use of music. Interviews were audio recorded and transcribed verbatim, meaning language idiosyncrasies remain. Videos of the children's musical play with the researcher were also taken. These videos were then used to pilot an observational framework to measure the changes in musical play behaviours between visits. Firstly, the qualitative outcomes from the parents will be considered, including their feedback on the resources, the success of implementing the design into daily routines, and the validity of the diary entries.

4.3 Qualitative Results: Resources and perceived musical changes

Based upon the qualitative analysis of the interviews and diary entries from the text data, the feedback that emerged from the parents regarding their uses of resources, and the perceived impact they had on changing musical behaviour, will be presented below. Thematic analysis (using the process outlined in Chapter 3, detailed by Braun & Clarke, 2006) was conducted on the qualitative data. These accounts provide an initial picture of how the resources stimulated changes in the family's musical behaviours and the particular areas of significance. It was evident over the course of

the project that the different needs and behaviours of each individual child meant that parents' perceptions of the potential outcomes for their children were quite varied. For example, some parents had aims that were quite specific, such as developing communication and musical skills, and worked through the cards one by one systematically. Others were more flexible in in the form and methods which they used, and reflected that the changes were more generalised, such as in an increased interest in music. The feedback on the cards was overwhelmingly positive; however, more structured guidance on working through the cards was reflected as an area for potential improvement. Table 11 details the themes and sub-themes that emerged from the parents' accounts.

Table 11 Themes and Sub-Themes of parent's experiences of the musical resources

Themes	Sub-Themes
1 Parent Empowerment	1.1 Increased Confidence
	1.2 Musical Flexibility
	1.3 Mood Regulation
2 Musical Engagement	2.1 Environmental awareness
	2.2 Skill Development
	2.4 Self-Regulated attention
3 Behavioural Change	3.1 Social Engagement
	3.2 Verbal Development

4.3.1 Parental Empowerment

i. Increased Confidence

Parents reflected how the resources allowed them to gain confidence in their own capacities to engage musically with their children. Additionally, they provided further contextual evidence of how they began to utilise music more widely in everyday life. Participants described how the activities on the cards made them more aware of the simple strategies that they could apply in less structured settings to engage their child, which subsequently encouraged their child's development; as one noted, 'Without them I wouldn't have known what to do with the instruments' (Parent, Participant F):

It generated ideas for me that I might not have initially thought of... But the other ones were very good. They gave me ideas. They gave me the inspiration. And it was something that we were able to just carry on throughout the day... With the cards it was just like little, little things but it was like 'oh yeah I can do that'. (Parent, Participant E)

Yeah, they were especially helpful for in the beginning, because I didn't really know where to start.... I think for me, the cards it made me feel like I can start anywhere. And I think that was freeing for some people they gave really concrete examples of ways to do things....it seems to me that we are now doing it in a more practised way rather than just singing...or maybe I've just been more aware that it's a tool now rather than this thing that we do. (Parent, Participant C)

As well as supporting the parents in providing guidance on what activities to do with the instruments, the programme also helped in validating their own skills and abilities to musically engage. As the comment 'I've just been more aware that it's a tool now' highlights, the response

reflects the empowerment of the parents, and demonstrates the foundations that the cards provided for wider engagement. From the quotations above, it is apparent that the specific ideas that the resources gave the parents courage to use music more readily, and the positive interactions they received from their children further encouraged this. The developmental design of the cards following the Sol levels proved to work well, as it encouraged fluidity and versatility on behalf of the parents. The accounts detail how their activities allowed them focus on basic musical skills such as imitation and pattern making, whilst also incorporating more complex forms of engagement such as singing and tapping along to complete pieces of music. The parental responses also highlighted the relative ease with which they began to use the cards more readily in day-to-day life.

ii. Musical Flexibility

The theme of requiring musical flexibility also supports the methodological design, as all parents emphasised the variability of engagement, with the child's willingness to take part a key factor. The design of empowering the parents to deliver the intervention themselves accounts for this, as it recognises that the engagement with the researcher can be variable and not necessarily reflective of the child's musical abilities.

Granted, it often has to be on her terms. So even more so than it was today. Obviously with us. It's a lot of like, 'No, no' just not doing it if you kept it. (Parent, Participant C)

We had to skip some of them and then just find ones that she would do. And they tended to be quite similar ones that she wanted to do. Or that she would respond to all. (Parent, Participant F)

He is very stubborn, it all depends on how he wants to do...His main problem is that he doesn't want to follow.... he does it by himself. (Parent, Participant G)

The importance of responding to these challenges with flexibility was reflected in the parents' approaches to the musical tasks. Through the comments and captions that the participants uploaded, the parents became more flexible in their own approaches to the music and in responding to the child's own interests. As this account below details:

...was struggling to engage and I could not do a formal sit down with the instruments. Instead, I put on some music that I knew she likes (VERY catchy alphabet songs from 'abc mouse') and after her initially telling me to 'turn it off', she settled into a listening calm. I then would pause the music to see if she would notice or engage. Within seconds she would say 'press play mate'! We did this for a good 20 minutes with her warming up and making occasional eye contact with me. She started reacting to the music with her body at first and then occasionally would sing a phrase or two. I started singing the occasional phrase as well and eventually we were singing together! (Parent, Participant C)

This account demonstrates how parents utilised the cards with a great deal of versatility. In this musical snapshot, the parent has progressed the interaction from reactive to proactive engagement, eventually arriving at interactivity. Within this exchange, activities from three different cards in different domains are mentioned, and it highlights how the skills and ideas detailed in the resources led to a knowledge of how to use music with more freedom. The initial statement 'x was struggling to engage' encapsulates one of the primary challenges of the project visits; everything has to be led by the interests of the child, and it was not uncommon for the children to simply not engage. This non-compliance highlights a problem for systematic data collection, particularly at the researcher visits.

iii. Mood Regulation

Common among the parents' reports was the utilization of the music to create a calmer environment, or to redirect attention from anxiety-inducing situations. As further demonstrated below:

If you go and tell him to go and pick up something but do it in a, you know, musical fun singing way. And he'll do it without crying or getting upset.... definitely, we do sing a lot more, even if it's just a silly thing we just make up little songs to go along with things, and I do find that he responds to it a bit more positively. (Parent, Participant E)

This also represented an encouraging pattern of the parents beginning to develop their own uses for the card and starting to use music more flexibly for their specific needs. This use of music more widely also began to be reflected in the children's own behaviours. As a parent noted 'All the day he walks and he whistles Sometimes he comes to the room, sits down by the player, and then all he does is listen to the music.' (Parent, Participant G) This is an encouraging indication of how music became a way to regulate emotional mood.

4.3.2 Greater Musical Engagement

Leading on from the growing empowerment of the parents in utilising the resources was the impact of these activities on the musical behaviours of their children. All reported that this was most clearly seen in greater musical engagement, with parents reflecting that their children appeared to have more environmental awareness of musical stimulus and their child's ability to express within these spaces had also grown (Environmental Awareness). Others also reported that they had seen changes in their skill levels with which they were engaging with music (Skill Development). The children's capacity to control their musical engagement, both in terms of focus and type of expression had also changed, with longer and more mature dialogues emerging (Self-Regulation).

i. Environmental Awareness

During the interviews all participant parents reported an increase in musical interest, and a developing attendance to musical stimulus, both during musical interaction but also in everyday life. They reflected on how they became more aware of music in their environments, and it was significant how many described how the children would actively seek out and develop their own musical interests independently.

I think she I think she has become more interested in music I'm not sure if it's because of this but that song that you know the one I kept talking about. She's been singing a lot lately and I've not really noticed her having particular relation really singing a song before? (Parent, Participant F)

So yeah, he enjoys it, he likes music, a lot more than before, (repeats) a lot more than before. He never used to really respond before, never. Whereas now he will happily sing along. He will even do the actions. When we have done it here and been like do 'twinkle twinkle (mimes)' he will do the actions and he is quite happy to do it whereas previously he wouldn't. He wouldn't. You wouldn't get nothing at all. (Parent, Participant E)

The change in musical interests on the part of the children was clear across the twelve weeks. Some parents described it as a process of unlocking, as the children began to realise the enjoyment and interaction they could receive from the music. Common among the accounts were the descriptions of seeking out the musical stimulus, and a growing recognition of their own capacities to engage in music.

He finds this Just Dance thing on YouTube 'Johnny Johnny', and he copies, and he dances with the music. He wanted his grandparents (who are visiting) to be there and to watch him

- non-stop he seems to do this...also when we came home and sat with him with instrumental music, probably since then he started to believe that music is also something which is my study...he started playing the recorded tracks on the piano. We just left it there, and he himself did it a couple of days with intervals. He listened to each and every one. Then after this he picked up singing confidently with the track. Then, he started following Postman Pat and other things with the track. He did it by himself, he knows, we didn't show him how to play the tracks one after another. I think he followed it, and then he practiced it to himself. (Parent, Participant G)

She'll say 'No, no, no, don't do that 'if I start a song, she'll listen to that and be like 'no, don't sing that' and make it up and be like 'We're getting dressed with this song instead' (Parent, Participant C)

This taking control and directing their own musical engagement and narrative can be interpreted as a process of empowering themselves to regulate and engage with the music themselves. From this perspective the provision of the musical instruments and activities provided the children and families with a distinct outlet for empowered expression, creativity and skill development.

ii. Skill Development

The changes in the children's musical behaviours were also reflected in the reports of development of skill, and how they improved their own musical abilities through the musical activities.

In three months, it has significantly developed. He's listening, listening like as Dad says, he copies the same music, the proper tunes, and singing that and tries to focus on the words he

started playing the recorded tracks on the piano. We just left it there, and he himself did it a couple of days with intervals. He listened to each and every one. (Parent, Participant G)

Most significant were the reactions of the children themselves to the musical instruments and tasks as they began to take ownership of their own musical engagement and development.

iii. Self-Regulated Attention

Among the qualitative data were frequent references to changes in a variety of executive functioning, including attention, emotional control and goal-directed motivation. These were grouped together and defined as self-regulation, referring to an individual's ability to control and modulate their attention, arousal and cognitive state, and which is regularly linked to outcomes in social, emotional and cognitive domains (Beeghly et al., 2016). Across the cohort, there was also a reported improvement in self-regulatory abilities, regarding the ability of the children to control their own behaviour, adjust and modulate their emotions and to focus their attention. For the participants it was reported that their ability to engage in musical activities for a prolonged period of time significantly improved. As the families observed, as the visits progressed the musical space captured their attention for a longer time, and this contrasted with their behaviour during other activities, which was characterised by frequent distractions and inability to stay focused on one activity.

I thought this was really good today! It was for such a long time that she stayed with it...And didn't really until the very end pick up her kids (her dolls). So I think we've seen a bit more of that as well. (Parent, Participant C)

But I guess it's something that we need to do like it. There aren't many times when I get her to sit down and do something in a particular way. So, I guess it was good practice. (Parent, Participant F)

His concentration and interactive, the way he can become interactive, it has changed...We noticed that since the last four months his focus is much better, his ability to follow instructions has phenomenally improved and progressed. His patience, his patience is so much more... like it was an impossible task for him to be in one place for five minutes, even six months ago. But now we can study for two hours. Other evening, we started from six to eight. And like today, he is here for nearly an hour. His patience and his acceptance also, like sometimes I try to break his routine so that he can accept and deal with it. (Parent, Participant G)

The use of music as a medium through which self-regulatory behaviours could be improved, as illustrated above, was also reflected in another domain; to regulate mood. The proactive interests that the children themselves demonstrated can also be linked to the theme of child empowerment as discussed above, as it highlights the actions of the children themselves in seeking out and developing their own musical interests for their social and emotional needs.

4.3.3 Behavioural Change

i. Social Engagement

A consistent observation across the data concerned the changes in behaviour seen in the children, particularly in the way they were becoming interactive, or proactively seeking out others. Parents regarded the musical activities as a pathway for opening up or unlocking their child's expressiveness,

which in turn had a wider impact on their interactive behaviour. Music's regulatory function had the impact of redirecting attention:

Sometimes he can be grumpy or his ears hurting but when he hears or plays the piano, he totally changes...also he talk more, he's more interactive, I think that's the main point...it makes him talk more. (Parent, Participant B)

Furthermore, it was apparent that by using musical play as a mechanism for joint attention, it was able to promote shared moments of interaction. This in turn was reported to have wider impacts, in that the behaviours practiced began to have external applications in everyday behaviours aside from music:

I think there's been a lot more to joint attention and things, even if they're small, short moments...But she's definitely engaging with it more and tolerating you in the same space with it, And although she still wants to direct you what to do. But that's still including you, isn't it? Yeah, even if it's not like totally co-operative, she's letting you in as opposed to like, I think when you first brought it, it was like, 'Nobody's touching this, but me! (Parent, Participant C)

But I do find that he does enjoy singing. So, when we do sing him humpty dumpty he does sing along and engage with us. I mean my eldest son, he does little singy-songs that he makes up with him, or he'll mimic a song that he hears, and then he will do the same.

(Parent, Participant E)

So, I think [through the music] he has developed something which he does want to share with you...so then after this [the researchers visit] is when he started concentrating into

music, it can happen because was one to one attention, because he is seeking attention always. (Parent, Participant G)

From the feedback we are getting back from the nursery, he is now doing more, he's getting involved. Whereas before he would run away, he now goes and grabs a drum and participates. It's participating in his own terms and on the side, but still participating, which is promising. (Parent, Participant E)

It was clear from the participants that the musical engagement provided the families with a platform upon which they were able to engage with their children, and that they felt through this musical space other behaviours were able to develop. All reflected that the music allowed an opening up and by letting people into shared space there was a pleasure in the joint attention, and this was reflected in the progression from solo to joint musical play. For the families, music was a place of a kind of social interaction, but a kind that is more prescribed so offers a clear structure for interaction. Through these structured spaces, their children were able to learn and engage in behaviours that had wider applications in day-to-day life.

ii. Verbal Development

In the parents' accounts of the observed changes in the child's behaviours, it was apparent that the musical activities scaffolded verbal interaction that subsequently impacted upon their everyday speech:

Through the singing whereby he is saying a few more words...think most definitely the most positive is that we've had a few words, I think that it was definitely the most positive thing we've had over the past couple of weeks. (Parent, Participant E)

As they reflected, singing and engaging with music acted as a scaffold to further development:

Any vocal thing he is very interested. But I think if we keep doing it, keep doing it in the future, it may help to make him more interactive. (Parent, Participant G)

4.3.4 Resources: Diary Entries

There were differing styles of videos, with some uploading short snap shots of 20–40 seconds, with others filming longer, five-minute segments of a more structured and targeted play. Examples of the types of videos uploaded included excerpts of child playing with the provided xylophone and following a colour coded score to play ‘Twinkle, Twinkle Little Star’, vocal exchanges between the parents and children using echo microphones and using percussion instruments to copy patterns from each other. The videos also showed how the families began to use music more readily in everyday life, as they were taken in a variety of contexts: in addition to being in the home, there were examples on public transport and in public spaces including parks and restaurants. This reflects the applicability of the resources for using music in wider contexts and is indicative of the abilities of previously musically untrained parents to carry out the ideas on the cards effectively once instructed to do so by the researcher.

4.3.5 Qualitative Results: Pilot Summary

Overall, it was clear from the parental feedback that there was a notable change in the children’s musical engagement, and this in turn had a wider impact on other behavioural domains, such as verbal or social development, as perceived by the parents. The results outlined above are evidence that both the resources provided to the families, and the naturalistic methodological design of this pilot may be helpful promoting musical engagement and development in autistic children. The

variety of behavioural change that was reported is also significant as it highlights the wide-reaching impacts that music making can have. However, it also presents challenges as to how to systematically measure and detect improvement in such a diverse set of behaviours. It mirrors continued debates throughout the discipline of how to present and analyse the effects of musical engagement, as the manifold benefits can be difficult to isolate to a specific cause and effect narrative. Each individual family of the small cohort presented here had entirely different narratives and experiences, and although the analysis above produced some common themes, substantiating those with quantitative data is challenging. Ensuring that qualitative findings can be corroborated against quantitative data, collected through the psychometric behavioural measures and observational coding, will ensure that the findings are triangulated across these three areas and therefore validity preserved, whilst also maintaining the richness of the individual narratives of musical engagement.

4.4 Developing an Observational Framework

To understand more closely the changing behaviours within musical play, a framework to observe, code and track changes over time during musical play with autistic children was developed. It emerged through an iterative process of consulting existing frameworks of social and musical play for autistic children and analysis of pilot video data which were considered in light of the specific research questions for this project. The framework was trialled and validated with video data collected during the pilot, with the final framework re-validated before being used to analyse the over 800 minutes of musical play collected during the main study.

As advised by numerous protocols on developing and modifying observational frameworks (Bakeman & Gottman, 1997; Heyman et al., 2014; Chorney et al., 2015), the process of identifying and developing a behavioural coding scheme should be led by the research questions and involve an iterative process of adjustment during its development. It should both be framed by existing theoretical considerations, and additionally reflect the measurement and analytic plans of the proposed research interests. As Bakeman and Gottman emphasise, it is a complex process which is deeply embedded in the aims of each individual research project.

We sometimes hear people ask: 'Do you have a coding scheme I can borrow?' This seems to us a little like wearing someone else's underwear. [Using] a coding scheme is very much a theoretical act, one that should begin in the privacy of one's own study, and the coding scheme itself represents a hypothesis, even if it is rarely treated as such. (Bakeman and Gottman (1997, p. 15)

As Bakeman and Gottman encapsulate above, a coding scheme serves the unique needs of a particular project and its research questions, and therefore the act of developing a framework is an

essential part of the research process. For the current project, considerations included the need to find a flexible system that could capture the micro-interactions of social communication that are exhibited during musical play but was also responsive to the often fleeting and chaotic interaction styles of autistic children. As the behaviours of interest were a combination of social and musical modes of interaction, it also required a framework that could integrate these simultaneously. In order to develop and validate the coding scheme outlined below, a multi-dimensional, iterative approach was taken. As will be detailed in depth below, relevant behaviours of interest were developed alongside the observational codes of two frameworks; Music-based Scale for Autism Diagnostics (MUSAD), (Bergmann et al., 2015) and the Early Social Communication Scales (ESCS) (Mundy et al., 2003). These initial categories were then modified to fit the context of the research in dialogue with grounded analysis of the data, and also adapted to correspond to a rating system for strengths-based approach that would track development in behaviours through naturalistic observation of children's play over time. The framework was first piloted with 20 videos (511 minutes) and validated by two independent raters. It was further refined based on the results of the pilot to five distinct categories, that provided the most relevant and mutually exclusive categories for the characteristics of musical play for autistic children.

4.4.1 Background

Coding systems can include nominal codes or rating scales, and range in granularity from micro-ratings of every ten seconds to wider scores across whole play sessions or grouped by events. In developmental childhood research, observational frameworks of play often rely on strict protocols of play procedures or 'eliciting situations' (Mundy et al., 2003), where particular toys or games are presented to the child by a researcher, and their reactions and engagement monitored on a frequency or scored basis. The goal of these is primarily to give a diagnostic outcome. For example, the Autism Diagnostic Observation Schedule (ADOS), and the Early Social Communication Scales

(ESCS) have been developed specifically in order to give a comprehensive, clinical measure of a child's social or communication abilities and assess children on the diagnostic pathway for autism and associated social communication delays. These frameworks can provide a valuable starting point for observational codes, as their established use as a diagnostic tool means that each of the developed categories will possess a high level of validity. However, they are often based on highly structured play protocols, which are less effective analysing free play, as diagnostic measures are designed to determine areas of deficit or difficulty, rather than areas of strength. Due to the often-highly self-directed nature of autistic behaviour, it was assessed that an observational framework needed to be flexible, so it could recognise specific behaviours but was not reliant on particular prompts by a partner, as the child would not always reliably respond to these prompts and was much more likely to engage when encouraged on their own terms. A further consideration was how to account for the multitude of musical and gestural signals that form a core part of expressive interaction during music. A framework that was too structured would not reliably or accurately reflect the nature of interactivity within musical play, particularly within naturalistic settings.

Flexible observational coding systems are less established in music-educational research, in particular those that account for neurodiverse modes of interaction. In line with the research aims, the coding scheme was required to have a high level of granularity that captured the intensity and level of micro-social behaviours within musical play, rather than produce a clinical behavioural measure. Models such as the Cambridgeshire Independent Learning in the Foundation Stage (C.Ind.Le) coding scheme (Whitebread et al., 2009), provided an example for this type of flexibility, where child behaviours are rated on a four point scale by minute in naturalistic play settings. Important in Whitebread et al.'s model was the observation of non-verbal cues and assessing spontaneous occurrences of behaviours within unstructured play, rather than structured, elicited responses as common in the diagnostic models. Their design therefore provided a framework for how to analyse behaviours that were not reliant on strict protocols. Whitebread et al. also detail

how the C.Ind.Le scheme was developed through a blend of a priori categories of behaviour deriving from previous research literature and new categories emerging from a 'grounded' analysis of the data, which provided a model for the development process of the current framework (Whitebread et al., 2009).

The behavioural categories for the current framework first emerged from the categories of two observational scales, the MUSAD (Music-based Scale for Autism Diagnostics in adults with intellectual developmental disabilities) and the ESCS (Early Social Communication Scales). These were selected as they were validated diagnostic measures that encompassed the extent of social and gestural behaviours that are of interest in social developmental research, as well as incorporating play-based behaviours relevant to musical interaction. While both are tied to structured play protocols, the categories were also broad enough to be applicable and likely to be observable in free play.

i. MUSAD (Music-based Scale for Autism Diagnostics)

The MUSAD scale was developed by Bergmann et al., (2015, 2019) in order to address the lack of psychometrically valid assessment procedures for musical interaction for individuals with Autism Spectrum Conditions. It can be considered as a musical equivalent to the ADOS (Autism Diagnostic Observation Schedule), which uses structured play-based prompts in order to provoke diagnostically relevant behaviours which are coded on a 4-point Likert scale, from 0 = no impairment, 1 = slightly impaired, 2 = clearly impaired and 3 = substantially impaired. MUSAD was identified as particularly relevant for the current study as the validated categories were produced with the social and interactive domains that are relevant both to autistic symptomatology and within a setting of musical play

To code MUSAD, the play protocol⁷ is videotaped and subject to coding in 47 different categories that are grouped into three sections; (1) Social Interaction, (2) Stereotyped, Restricted and Repetitive behaviours and (3) Motor Skills. In light of the research questions of the current project, the twenty categories from (1) Social Interaction were the only ones selected as relevant for coding. Each individual category was trialled for coding with a set of preliminary videos of musical play with autistic children in order to establish their relevance and efficacy within the context of naturalistic musical play. It was initially observed that during naturalistic play some of the categories within MUSAD did not occur regularly and were therefore difficult to code, and other were unsuitable for younger children's play. A high degree of overlap was also observed throughout the coding, so the categories selected represent those that encompassed the majority of behaviours, whilst remaining distinct from each other. A final list of ten categories identified as most relevant for naturalistic play were identified: Eye Contact, Reactions to Directing Attention, Communicative Gestures, Facial Expression, Joy in Playing Together, Play Gestures to Regulate Musical Interaction, Making Social Contact and Reciprocity in Musical Interaction, Interpersonal Movement Synchronisation, Imagination and Creativity in Musical Play.⁸

ii. Early Social Communication Scales (ESCS)

In order to link to social communication scales that were based on non-musical contexts, the Early Social Communication Scale (ESCS) were also used (Mundy et al., 2003). The ESCS is a structured observation measure to provide analysis of individual differences in nonverbal communication skills and differs from MUSAD in that although it is social communication based, it is designed to be used

⁷ The play protocol follows a set structure that has been designed to elicit particular social and musical responses: Free-play - *warm-up phase*; Piano/xylophone – *joint attention*; Drumming - *musical dialogue*; *Break*; Guitar (optional) - *singing a song*; Ocean Drum; *contact via instrument*; Symbolic instruments - *pretend play*; Music selection- *asking for help*; Balloon game – *reciprocity*; Dancing together -*bodily synchronization*; Table - *ending and final discussion*.

⁸ The categories removed were as follows: Bodily alignment in interaction, Reaction to surprising events, Integration of the investigator into the play, Asking for Help, Emotional reaction to the offer of physical contact, Frequency of socially directed speech or vocalizations, Initiating, ending and sustaining verbal/nonverbal contact Functionalizing the body of another person, Pointing. Other categories were also removed as there was an observed overlap between those and identified relevant categories including: Reactions to contact offers (overlap with reactions to directing attention), Reactive social smile (overlap with facial expressions).

both with typically developing children and with those with developmental delays, so it is not autism specific. This means the categories identified have a wider relevance to detail change and improvement in social interaction, rather than only identifying areas of deficit or difficulty. Its coding scheme is structured into three categories: Joint Attention, Behavioural Requests and Social Interaction. Each category is further subdivided into 'Initiating' (e.g., Initiating Behavioural Requests) and 'Responding' e.g. (Responding to Social Interaction), in which various codes are placed, e.g. Eye contact, Point, Appeal, Tease. While there is overlap between codes, Mundy et al., (2013) clearly define and differentiate these behavioural categories as mutually exclusive. Joint Attention is identified as a behaviour where the function is to share attention with the partner, or monitor their attention, with an emphasis on sharing experiences e.g., show. Behavioural Requests differ from Joint Attention by the fact that these serve a function that is eliciting or instrumental, rather than simply social sharing e.g., Reach. Social interaction is further delineated as behaviours that occur in order to initiate or maintain a turn taking or interactive game with a partner e.g., tease.

The classifications of behaviours detailed in the ESCS are all indicative of non-verbal early social-communication behaviours and therefore highly relevant to the current projects area of interest. To incorporate the ESCS into the framework, the ESCS categories were first 'translated' into musically related contexts, to make them more applicable to the musical play settings. These categories were then matched to the selected categories from the MUSAD. On comparison, there was a substantial amount of overlap between the MUSAD and ESCS categories, with many of the ESCS codes (Point, Appeal, Show) embedded within the MUSAD behavioural descriptors. As the specificity of the ESCS codes is high due to the strict play protocols that it is designed to analyse, it was deemed that the overarching behavioural themes that underpin these codes, e.g. initiating and responding to joint attention, behavioural requests and social interaction, were most applicable to the setting of free play rather than to tallying individual coded behaviours, such as points, as these would not appear consistently across participants without specific prompting. To incorporate these whilst preserving

the descriptors set out in the MUSAD, the categories were therefore enriched by aligning each with the equivalent ESCS categories within their descriptors.

iii. Alignments with DSM 5 criteria

To further identify how musical spaces might act as alleviating, the coding categories were also compared against the criteria for autism diagnosis from the Diagnostic Statistical Manual of Disorders 5th Edition (DSM 5) for autism spectrum disorders. This enabled the categories to also reflect which areas of deficit or difficulty they were linked to, and therefore the significance of improvement in these areas. Of particular focus was Section A in DSM 5 which identifies symptom criteria as 'Persistent deficits in social communication and social interaction across multiple contexts.' These manifest in three traits: deficits in social-emotional reciprocity; deficits in nonverbal communication behaviours (e.g., gestures); and deficits in the development, maintenance and comprehension of relationships. In the coding framework, each category was considered against the criteria in Section A, and the relevant descriptors were included as additional detail alongside those of the ESCS.

4.4.2 Scoring

The complete initial framework therefore represented a sub-set of MUSAD categories, that had been aligned with the ESCS framework and the DSM 5 criteria. Due to the difference in cohort (MUSAD was originally developed for young adults) and ecological setting, it was also necessary to adjust slightly the scoring methods. While the categories and their score levels outlined above retained their phrasing at both category and score-level, the numeric values of the scoring were changed to reflect ability rather than deficit. In the original MUSAD the coding was from 0 = no manifestation, 1 = mild manifestation, 2 = moderate manifestation, 3 = severe manifestation. In its

current iteration, this was inverted, so that 1= severe/no exhibition of target behaviours, 2 = moderate/occasional exhibition of target behaviours, 3 = mild/frequent exhibition of target behaviours, 4 = consistent exhibition of target behaviours. To be more sensitive to behavioural change and capture micro granularity, the protocol was also adjusted to be scored in one-minute intervals whilst watching back the video data and then the mean for each visit taken as an indicative score, rather than providing a collated score at the end of the interaction.

Detailed below is the initial framework that was developed from the process outlined above. In order to preserve the validity of the scale, the terminology and rating descriptors within the categories has been preserved from MUSAD (with some slight alterations due to translation idiosyncrasies). The category descriptions, the example behaviours (italicised) and associated codes from the ESCS and DSM-5 are new additions.

i. Eye Contact

This category monitored the frequency and control of explicit eye contact with the partner during musical play and activities. During each coding segment of one minute, behaviours where the child looks at and/or subsequently engages in eye contact with the partner during musical play were coded, using the following 1–4 scale:

- 1 No eye contact or eye contact is actively avoided (E.g., *Child avoids eye contact by turning head or by looking away.*)
- 2 Eye contact is not controlled, is rigid or fleeting (*Child makes eye contact only by chance. Child engages in eye contact for unusually long periods of time - staring.*)
- 3 Eye contact is controlled but is less flexible. It is not used consistently in interaction i.e., only during some periods active music-making (*Child only makes eye contact occasionally with their partner while manipulating/touching an instrument, or engaging in a vocal dialogue*)

- 4 Controlled eye contact that is interactive in quality. Gaze corresponds to the reciprocity in joint interaction and is appropriate. *(Child makes eye contact with partner after tester has offered a musical turn, or during a pause between next one, child seeks out eye contact to share pleasure/excitement)*

The corresponding frameworks were MUSAD categories 101, 102 (Eye contact), ESCS codes:

Initiating Joint Attention and Responding to Social Interaction. Category also aligns with DSM-5 diagnostic criteria A.2 Abnormalities in Eye Contact.

ii. Reactions to Directing Attention

This category monitored how the child responds to the play partners attempts to direct or share musical attention. During each coding segment, behaviours which showed the child's acceptance, engagement or rejection of partners attempts to show or direct attention towards of musical instruments was coded on a 1–4 scale.

- 1 No reaction to investigator or contact offer is specifically fended off *(Child turns away or leaves situation. Child does not respond to musical prompts and continues with their own activity)*
- 2 Reactions with eye gaze only in combination with a clear and directed musical gestures after repeated attempts (delayed). *(After a delay, child turns head or eyes gaze moves sufficiently to indicate they are looking at the instrument or object the partner is playing with/making sound on.)*
- 3 Following of eye gaze and clear reaction to partner playing, particularly if aligned with child's interests/musical exploration *(Child looks towards partner without being prompted and*

makes a physical reaction such as moving over/turning body to indicate their awareness of partner's involvement in musical play.)

- 4 Flexible reactions independent of the situational context (*Immediate following of directed eye gaze towards the musical instrument, makes gestural attempts to share partners attention*)

The corresponding categories were MUSAD - 119, 114 (Reactions to directing attention). The associated ESCS codes were Responding to Behavioural Requests. This category also aligns with DSM-5, A.2. abnormalities in understanding and use of nonverbal communication.

iii. Communicative Musical Gestures

This category monitors how the child recognises their partner as a social being, and whether social sharing of musical stimulus is initiated. It assesses the child's expression as a form of non-verbal communication in which visible bodily actions communicate particular messages, either in place of speech or together with and in parallel to words, during musical play. Gestures include movement of the hands, face, or other parts of the body. During each coding segment, behaviours were assessed on a 1-4 scale.

- 1 No gestures in social communication.
- 2 Fleeting gestures with reduced repertoire (*Child indicates Yes/No with head shake or nod. Child points to instrument that they desire with an extended index finger.*)
- 3 Clear gestures but only in restricted contexts – especially when asking for or rejecting somethings (*Child pushes, throws or hands an instrument to partner in order to request repetition or to get rid of the instrument. Makes vocal utterances directed at partner.*)

- 4 Consistent and differentiated gestures – including descriptive or symbolic gestures and eye contact (*Child raises instrument towards partners face or makes a vocal utterance while still looking at the tester. Maintains or repeatedly alternate gaze while producing sounds on instrument.*)

This category corresponded to MUSAD – (206a, b Communicative gestures). It incorporated the following behaviours from the ESCS: *Initiating Behavioural Request*.

iv. Reactive Facial Expressions

Assessed here was the child's expressive facial reactions to the changing contexts and affective states during musical play. It includes the modulation or change in facial expressions in response to partners attempts to change in music or direct positive affect (such as smile) and was coded on a 1-4 scale:

- 1 No modulation of facial expression in contact with the other, with no reaction to the smile of the partner. (*Facial expression of child appears rigid, is unmodulated or mask – like.*)
- 2 Facial expression only changes with higher affective tension (*Child's face only alters when they are either expressing rejection or happiness*)
- 3 Fleeting reactive smile to partner, but is slightly delayed, smiles back but with restricted character (*Child responds to caregivers smile or positive affect, but hesitantly and delayed, Facial expressions reflect state of music, smile is not fully formed*)
- 4 Flexible and coordinated facial expression across all situations (*Child smiles back immediately, smile is clearly shaped*)

This category corresponds to the MUSAD categories 105 and 107 (105,107 Facial Expression) and aligns with *DSM 5 - A.2 lack of facial expression or gestures, A.1. deficits in socio-emotional reciprocity.*

v. Responses to Playing Together

This category monitors the child's state of interaction and interests during joint musical play. It assesses how the child shows recognition and positive affect during joint exploration and musical play through physical and gestural behaviours and was coded on a 1–4 scale:

- 1 No emotional involvement at all and engagement in joint musical play (*Physical contact actively rejected, turns away from attempts for synchronization.*)
- 2 Short/fleeting acceptance of synchronised moments or joint musical play with positive affect demonstrated (*Signs of tension at offers of physical contact. Child briefly engages in joint tapping or rhythms but is easily distracted/moves onto something else. turns face to look at partner/acknowledges partners presence. Passive tolerance of physical contact.*)
- 3 Extended joint musical play is tolerated and occasionally sought after. Expressions of joy are frequent and synchronised with partner. (*Positive affect during offers of physical contact (smiling/laughing). Both engages in joint activities such as tapping or singing together, vocalizations such as 'no, play with me' Child recognises joint play such as coordinated tapping or sounds.*)
- 4 Musical play is both initiated and flexibly responsive. Joy is spontaneously shared during joint play. (*Physical contact is initiated as well as accepted. Joint activities such as singing together and tapping rhythms, playing melodies/accompaniment are adjusted to changes in speed and dynamics. Child turns to smile and laugh with partner.*)

This category corresponds to MUSAD - 118 (Joy in playing together), with the phrasing adapted to be more neutral and less leading.

vi. Gestures to Regulate Musical Play

This category assesses how a child interacts in a playful manner with the musical stimulus presented to them. It monitors how the child plays with musical instruments in an appropriate and exploratory manner. This includes whether they show recognition of partners' play, and how they integrate and copy partners' actions in their own play. Coding was carried out using the following 1–4 scale:

- 1 There are no clear and directed play movements. Instruments are rather touched by chance or used in a non-functional way. (*Childs makes no attempts to engage with instruments, or actively avoids them.*)
- 2 Play movements have no gestural character and are not directed to the partner. (*Child fleetingly touches/picks up instruments, but quickly gets distracted and makes no reaction to sounds produced.*)
- 3 Play gestures are present although restricted and repetitive. (*Child bangs up and down keyboard or makes sounds with instruments but makes no attempt to explore further. Ignores partners attempts to engage. Repeats the same thing over and over again.*)
- 4 Play gestures are flexible and coordinated with partner. (*Child engages with musical material such as continuing a song, or joining in with a melody, attempts to show partner what they are doing. Makes attempts at more imaginative play.*)

This category corresponds to the MUSAD framework 120, Play gestures to regulate musical interaction, and also aligns with ESCS codes Responding to Social Interaction and Response to Invitation.

vii. Making Social Contact

This category assesses how the child recognises their partner as a social being, and whether social sharing of musical stimulus is initiated. This includes how the child engages in musical and gestural/communicative dialogs with the partner. In particular, whether music and song are used as a way to communicate, and how the child combines this with gestural features such as eye contact and physical orientation. Coding was carried out using the following 1–4 scale:

- 1 No active seeking of support or contact with the partner
- 2 Using the partner as a means to fill own desires – functionalising the body of another (*Child takes partners hand and leads it to the instrument*)
- 3 Contact primarily occurs through joint attention to the instrument, and interpersonal contact is less pronounced. (*Child engages with partner through copying or continuing only during active musical play, and primarily on their terms such as partner coping what they do, and then copying back. May ask for help but this is without expression or eye contact/orientation to partner, and this may be prompted i.e., ‘do you want some help?’*)
- 4 Seeking of interpersonal help/contact with the partner occurs independently and without prompting. *Child directs an unprompted joint attention behaviour towards the caregiver e.g., ‘look what I can do’, or ‘can you help me?’. Requests are accompanied by eye contact and bodily orientation*

The corresponding MUSAD category is 113 - Making social contact and it incorporated the following behaviours from the ESCS: Initiating Behavioural Request.

viii. Reciprocity in Musical Interaction

This category monitored the levels at which the child interacted in joint interplay with the musical stimulus. This included how the child responded musically and flexibly to partners' attempts to incorporate them into musical joint play, copying melodies, affect and developing particular motifs.

Coding was carried out using the following 1–4 scale:

- 1 Instruments are not used at all or absence of joint play. No reactions to clear motifs, breaks and verbal encouragement for interplay
- 2 Turn Taking requires verbal/gestural prompting. Limited response to musical motifs. Resistance to synchronisation. *(Child engages in turn taking when guided by hand/partner shows first 'now your turn' and plays melody/signs)*
- 3 Reciprocal play develops through musical prompting (motifs and breaks), but the reaction tends to be imitative. *(After partner plays motif, child returns with utterance based on similar material. Child tolerates joint/synchronised play (following a common beat)*
- 4 The interplay flows naturally and leads to a common shape. *(There is reciprocal adoption and development of motifs, shared affect and synchronization during joint play)*

Category corresponds to MUSAD 111, Reciprocity in musical interaction and aligns with ESCS codes Initiating Social Interaction.

4.4.3 Analysis

This section will outline the procedure for how the videos were prepared for and subsequently coded. All participants were coded as individuals, with the play partner kept consistent in the form of the researcher throughout the visits. The observation period lasted for the duration of the musical play session where the participant was musically active and engaged. Observations were recorded using a GoPro Hero 3+ camera, which reduced reactivity as it is small and highly portable, so was

discreet enough that the children were not overly aware that they are being filmed. The scale of the coding framework meant that a simple questionnaire style procedure was implemented in order to code the videos using a Google Form that was populated with the framework and completed at every minute. Each participant was coded according to their participant code, retaining their anonymity, and these anonymous answers were then automatically fed into an excel spreadsheet. At every minute, each category was coded on the scales in the framework (1-4) using the descriptors and examples outlined above. An additional code of 0 was used if the category was entirely not applicable, for example if the participants face is not in view, or there is no joint play, or no opportunity for play during the time frame where selected behaviour could have been exhibited.

Eye Contact

Monitoring the frequency and control of explicit eye contact with partner during musical interaction. 0 is Non-Observable - Eyes/Face not in picture. 1 - No eye contact or eye contact is actively avoided. 2 - Eye contact is not controlled, is rigid or fleeting. 3 - Eye contact is controlled but is less flexible. It is not used consistently in interaction i.e. only during some periods active music-making 4 - Controlled eye contact that is interactive in quality. Gaze corresponds to the reciprocity in joint interaction and is appropriate

0 1 2 3 4

Reactions to Directing Attention towards Music

Monitoring how child responds to partners attempts to direct or share musical attention 0 is Non-Observable - Eyes/Face not in picture or no attempts to share attention. 1 - No reaction to investigator or contact offer is specifically fended off. 2 - Reactions with eye gaze only in combination with a clear and directed musical gestures after repeated attempts (delayed). 3 -Following of eye gaze and clear reaction to partner a, particularly if aligned with child's interests/musical exploration. 4 - Flexible reactions independent of the situational musical context

0 1 2 3 4

Figure 8 Screenshot of example coding section of Google Form

i. Interrater Reliability

The coding procedure above was trialled on 511 minutes of musical play collected from the pilot phase of the research project. This comprised of seven participants, each with three separate visits. All the data was first coded by the primary researcher. Inter-rater reliability was assessed for both the entire, collated dataset and separately for each domain. In total, 20 videos, totalling 511

minutes, were coded across the 7 participants by the primary rater. A second rater was trained in the coding protocol and then coded 5% of the data (a randomly selected 27-minute video). This rater was a professorial expert in their field with significant experience of observation in autistic arts-based play. Firstly, to assess the framework's reliability, and ensure its replicability, interrater reliability was assessed using Cohen's kappa, one of the most commonly used statistics to test interrater reliability in healthcare and clinical research (Cohen, 1960). McHugh's suggested interpretations for Cohen's kappa statistic are used, where she emphasises any kappa below 0.60 indicates inadequate agreement among the raters, .61-.79 as *Moderate*, 0.80-0.90 as *Strong*, and above +.90 as almost perfect (McHugh, 2012).

Table 12 Interrater Reliability by Category

<i>Category</i>	<i>kappa</i>	<i>Reliability</i>	<i>% Missing values (coded 0)</i>
<i>Eye Contact</i>	.80	Strong	30%
<i>Reactions to Directing Attention</i>	.87	Strong	2.1%
<i>Communicative Musical Gestures</i>	.89	Strong	19.6%
<i>Reactive Facial Expressions</i>	.69	Moderate	39.9%
<i>Responses to Playing Together</i>	.86	Strong	11.6%
<i>Gestures to Regulate Musical Play</i>	.18	None	3.3%
<i>Making Social Contact</i>	.68	Moderate	9.6%
<i>Reciprocity in Musical Interaction</i>	.83	Strong	14.9%

4.4.4 Adjustments

i. Coding Framework

After further inspection of the interrater coding the following changes were made to the framework: Two categories that had both high proportions of missing values, 'Eye Contact' and 'Reactive Facial Expressions', were removed. The category 'Communicative Musical Gestures' had a high proportion of missing data, so this was also removed. Further analysis of the coding framework highlighted how some of the more specific categories were incorporated within the descriptors of others. For

example, the category 'Responses to Playing Together' states in the descriptors 'turns face to look at partner/acknowledges partners presence,' was moved to 'Child turns to smile and laugh with partner', which incorporates the behaviours detailed in the Reactive Facial Expressions category. Of the remaining five categories, three showed overlaps with each other: Responses to Playing Together, Gestures to Regulate Musical Play and Reciprocity in Musical Interaction. Gestures to Regulate Musical Play had poor interrater agreement. However, the theoretical dimensions to the category, namely that it provided an insight into the types of play that was occurring, was an important factor in retaining it as part of the framework. Therefore, further analysis of the original MUSAD framework was conducted to identify a more appropriate category for this area. Selected was '206c Imagination and creativity in musical play', which showed similar descriptors, but were more targeted towards creative play behaviours (*italics additions/adjustments to make it age appropriate*). The following 1-4 scale was used for coding:

- 1 Instruments are not used for generating sounds, are only played fleetingly or used for sensory needs.
- 2 The kind of play is inflexible, *repetitive* or solely imitative, e.g., only following the investigator's lead.
- 3 There is variability in musical expression, which may also result in unusual ways of generating sounds like scratching strings or knocking objects, *with proactive turn-taking and expression*.
- 4 The methods of playing are creative *and appropriate*, with rhythmic or melodic motifs are developed and varied.

Although there was also potential for Responses to Playing Together and Reciprocity in Musical Interaction to be condensed into one category, it was assessed that as one category was reactive, and the other initiative, these were likely to be correlated, it was important to preserve these distinct domains. Therefore, the final coding framework features five categories that were deemed

to be the most relevant and reflective of the behaviours exhibited during musical play for autistic children, and those most sensitive to developmental change and improvement.

ii. Coding Procedure

A number of problems emerged that from coding the pilot videos led to an adjustment of the coding procedure going forward. Due to the flexible and unpredictable nature of naturalistic musical play and the regular non-compliance of the participants, the coding data produced was highly heterogeneous, with large amounts of variance in 'codeable' time between visits and between participants. Therefore, from each session of musical play, the 'musically active' sections were established (musically active segments are defined as when either/both the child and the partner are touching and playing musical instruments or singing). Another problem was that there were a number of missing values which required a high amount of cleaning to arrive at data that was suitable for statistical analysis. In the process of analysing the first visits, therefore, data had to go through a two-stage cleaning process in order to analyse it in long form (not delineated by participant). Firstly, missing values were taken out of the data. Then, for each participant, five randomly coded minutes at each visit were selected. This meant that each variable had an equally matched sample size, from which comparative statistical analysis could be conducted. This highlighted the problem that the procedure of video analysis is extremely time consuming and produces a large amount of data – much of which is saturated with missing data. A new protocol was thus developed for the main study coding and analysis, where for each participant video, a maximum of 10 minutes of fully coded play from the video (excluding missing data) was used, regardless of the length of the play session, which ranged from 10 to 39 minutes. From the 25 participants across 4 visits, this produced 855 minutes of codable data, accounting for the missing visits from some participants over the course of the study.

4.4.5 Final Framework

Out of an initial framework of eight categories, five were selected as the most relevant, reliable and valid for the types of musical play exhibited by autistic children, and subsequently coded against the data collected. These four categories were: Joint Play, Responsiveness, Reciprocity and Imagination and Creativity in Musical Play. The framework is also aligned with standard frameworks of social play in the early years, covering Joint Attention, Behavioural Requests and Social Interaction, as outlined in the ESCS. To further review the efficacy of the final categories selected, and their sensitivity to detect change over time, repeated measures analysis was run on the categories for the pilot data, which included:

Joint Play: Responses to Playing Together: Intraclass correlations coefficients indicated a good reliability within this domain ($k = 0.87$). This category had a relatively low amount of un-coded data, with only 11.6% coded as non-applicable. A repeated measures ANOVA was conducted to evaluate the changes in joint play during musical play over time. It was observed that the joint play score was statistically significantly different between time points $F(2,10) = 19.33, p < .001$. Post-hoc analyses with a Bonferroni adjustment subsequently revealed that pairwise differences between the time points were statistically significant between the final two time points ($p = .0028$), and between the first and final visits. This gave a strong indication that this category was reflecting the behavioural changes and development across the course of the programme.

Responsiveness: Reactions to Directing Attention: Intraclass correlation coefficients indicated a good to excellent reliability within this category, $k = 0.89$. It also had a high level of successful coding attempts, with only 2.1% coded as Not Applicable. A repeated measures ANOVA was performed to evaluate the change in responsiveness during musical play over time. It was observed that the score was statistically significantly different between time points $F(2,10) = 10.91, p = 0.0003$). However,

post-hoc analyses with a Bonferroni adjustment revealed that pairwise differences between the time points were only statistically significant between the final two time points ($p = .003$). Overall, these indicate that this behavioural category was a reliable indicator and sensitive to these behaviours during musical play and reflected the developmental changes over time.

Reciprocity in Musical Interaction: Intraclass correlation coefficients indicated a good reliability within this domain ($k = .88$). The percentage of data that was coded as not applicable was 14.9%. A repeated measures ANOVA was conducted to evaluate the changes in the Reciprocity in Musical Interaction over time. It was observed that the reciprocity score was statistically significantly different between time points $F(2,10) = 5.9, p = .02$, Post-hoc analyses with a Bonferroni adjustment subsequently revealed that pairwise differences between the time points were statistically significant between the first and final visits ($p = 0.04$). This showed adequate evidence that this was a reliable and sensitive domain to be included in the observational framework for musical play. While it showed strong positive correlations with joint play in particular, as discussed above, the differences in the directionality of the categories (reactive or proactive), meant that both were retained.

An additional category of *Imagination and Creativity in Musical Play* was added to reflect changes in the modes and engagement within specific aspects of musical play. From the coding of the data collected in the main study, intraclass correlation coefficients indicated a good reliability within this domain, ($k = .82$).

Each final category was revalidated with a random 20% sample of the participants ($n = 5$). Each domain showed good reliability; Responsiveness ($k=.86$), Joint Play ($k=1.00$), Reciprocity ($k=.83$) and Imagination ($k =.82$). This pilot video data enabled the evaluation of this observational coding system and explored whether it could be an effective framework for the analysis of musical play and

demonstrated that it was a sensitive measure to reflect developmental changes in musical play. Of the categories highlighted as most sensitive in detecting change, although not all showed significant differences between every time point, all showed significant differences with at least one other.

Table 13 below outlines the final framework as a result of this process of development and evaluation. For the coding procedure outlined below, each behaviour was coded on a scale of 1–4 for every minute of video. When coding, a judgement is made on the most common/consistent style of behaviour that you see during that minute. If there is no opportunity to code the behaviour, for example the child's head is turned, out of view, code 0.

Table 13 Final Framework of Musical Interactive Behaviours

Category Name	Description of behaviour	Examples
Responsiveness: Reactions to Directing Attention <i>Monitoring how child responds to partners attempts to direct or share musical attention</i> Corresponding Frameworks: <i>MUSAD - 119, 114 ESCS – Responding to Joint Attention DSM 5 – A.2. abnormalities in understanding and use of nonverbal communication</i>	Child's acceptance, engagement or rejection of partners attempts to show or direct attention towards of musical instruments.	
	1 No reaction to investigator or contact offer is specifically fended off	<i>Child turns away or leaves situation Child does not respond to musical prompts and continues with their own activity.</i>
	2 Reactions with eye gaze only in combination with a clear and directed musical gestures after repeated attempts (delayed).	<i>After a delay, child turns head or eyes gaze moves sufficiently to indicate they are looking at the instrument or object the partner is playing with/making sound on.</i>
	3 Following of eye gaze and clear reaction to partner playing, particularly if aligned with child's interests/musical exploration.	<i>Child looks towards partner without being prompted and makes a physical reaction such as moving over/turning body to indicate their awareness of partner's involvement in musical play. Immediate following of directed eye gaze towards the musical instrument, makes gestural responses to sharing of attention</i>
	4 Flexible reactions independent of the situational context	
Joint Play: Responses to Playing Together <i>Monitoring child's state of interaction and interest during joint musical play</i> Corresponding Frameworks: <i>MUSAD - 118 – adapted to appear more</i>	Child gives recognition and positive affect during joint exploration and musical play through physical and gestural behaviours	
	1 No emotional involvement at all and engagement in joint musical play.	<i>Physical contact actively rejected, turns away from attempts for synchronization Signs of tension at offers of physical contact. Child briefly engages in joint tapping or rhythms but is easily distracted/moves onto something else. turns face to look at</i>
	2 Short/fleeting acceptance of synchronised moments or joint musical play with positive affect demonstrated	

*neutral
DSM 5 – A1.
Deficits in social
emotional
reciprocity.*

3 Extended joint musical play is tolerated and occasionally sought after. Expressions of joy are frequent and synchronised with partner.

4 Musical play is both initiated and flexibly responsive. Joy is spontaneously shared during joint play.

*partner/acknowledges
partners presence. Passive
tolerance of physical contact.*

*Positive affect during offers
of physical contact
(smiling/laughing). Both
engages in joint activities
such as tapping or singing
together. Child recognises
joint play such as
coordinated tapping or
sounds.
Joint activities such as
singing together and tapping
rhythms, playing
melodies/accompaniment
are adjusted to changes in
speed and dynamics. Child
turns to smile and laugh with
partner. Physical contact is
initiated as well as accepted.*

**Reciprocity in
Musical
Interaction**

*Monitoring the
levels to which
child interacts in
joint interplay
with the musical
stimulus*

*Corresponding
Frameworks:
MUSAD -111
ESCS - Initiating
Social Interaction
DSM 5 A.2 deficits
in social
emotional
reciprocity esp.
reducing sharing
interests,
emotions or
affects*

Child responds musically and flexibly to partners attempts to musical joint play, sharing melodies, affect and interests.

1 Instruments are not used at all or absence of joint play. No reactions to clear motifs, breaks and verbal encouragement for interplay

2 Turn Taking requires verbal/gestural prompting. No adequate response to musical motifs. Resistance to synchronization.

3 Reciprocal play develops through musical prompting (motifs and breaks), but the reaction tends to be imitative.

*Child engages in turn taking
when guided by
hand/partner shows first
'now your turn' and plays
melody/signs.*

*After partner plays motif,
child returns with utterance
based on similar material.
Child tolerates
joint/synchronised play
(following a common beat)*

4 The interplay flows naturally and leads to a common shape.

There is reciprocal adoption and development of motifs, shared affect and synchronization during joint play.

Imagination and creativity in musical play

Monitoring the ability to which the child can engage in a flexible and creative manner with the musical stimulus

Corresponding Frameworks: MUSAD – 206c

DSM 5 – A.3 Deficits in developing, maintaining and understanding relationships, esp. difficulties in sharing imaginative play.

Child responds in appropriate and creative ways to the musical play, and follows partners lead to develop and be flexible in their play.

1 Instruments are not used for generating sounds, are only played fleetingly or used for sensory needs.

Child stims on the instruments, flickering them in front of their eyes, banging against the floor, listening intently whilst rocking.

2 The kind of play is inflexible, *repetitive* or solely imitative, e.g., only following the investigator’s lead.

Child bangs up and down on the keyboard, repeats the same note over and over again makes limited imitative patterns

3 There is variability in musical expression, which may also result in unusual ways of generating sounds like scratching strings or knocking objects, *with proactive turn-taking and expression*

Child imitates longer patterns, changes the sounds on the keyboard or purposely changes timbre of voice

4 The methods of playing are creative *and appropriate*, with rhythmic or melodic motifs are developed and varied.

Child engages in turn taking, varies the musical material they are playing, plays songs in their entirety

4.5 Summary of Challenges and Changes emerging from the Pilot

Several important findings emerged from this pilot of the project design and analytical methods. Firstly, the responses from the parents to the resources and to the changes in the observational measures indicate that musical play can have positive developmental impacts on autistic children. The progress of the children highlights that the resources designed are reliable prompts for promoting this engagement, and that the naturalistic design encouraged the children's own musical engagement and subsequent empowerment to use music as a self-regulatory tool. The positive behavioural changes that were reported and seen in the observational quantitative analysis of the children's musical play demonstrate that the methodological design of incorporating caregivers as part deliverers of the intervention can be successful and support these changes. It was particularly significant how parents with little or no musical training could positively impact their child's musical engagement and development. The positive responses of the children themselves also highlight the potential benefits of this naturalistic approach, in that by allowing the children access to develop and engage with the resources on their own terms and in their own time, a more exploratory, collaborative form of musical engagement is encouraged.

The parents showed commitment to the research design, with the diary entries and interviews highlighting their engagement with the project. The feedback from the parents was positive with regard to the card resources and enabled them to have more confidence in their own abilities to engage musically with their child. The resources appeared to be successful in promoting various forms of musical engagement and were effective in guiding the parents in how music can be woven more readily into day-to-day life, scaffolding tasks and changing behaviours. Some parents suggested that although the flexible nature of the cards worked well, they would have liked more guidance as to which ones to use based on particular skill areas. Therefore, further cards were added that detailed particular pathways for areas of development. This included pathways for singing,

verbal development, joint play, core musical skills, building a melody and promoting creativity. For example, a pathway entitled 'Sing that Song', was designed to encouraging singing instructs to start with Card 3: Encourage me to make sounds with my voice, then moving on to Card 9 and following specific cards using vocal and singing activities. The pathway 'Play along with me' focuses on joint play, starting at Card 6: Play with me making everyday sounds, inside and outside, and musical instruments then Card 8: Tap into my love of pattern then Card 12: Copy the sounds I make with everyday objects and instruments and encourage me to copy what you do. Figures 8 and 9 show these double-sided cards for a vocal and instrumental pathway.



Figure 10 Play along with me! Pathways to encourage playing music with others

The pilot also identified a number of challenges in the methodological design. The GoPro camera proved to be a source of distraction for some of the children, particularly the red recording light. Black tape was placed over the blinking red recording light to further avoid distraction. As the visits frequently went over an hour, an additional problem was that it produced a significant amount of video data of which much was obscured or unusable. This presented a challenge as to how the footage could be collated into a codable format, and what was the safest, securest and easiest way to store the data. This is particularly key as during the longitudinal main study, the data was going to be at least three times greater. The solution to creating a codeable data set of videos was to select

the 'Musically Active' sections of the observation videos and edit them in iMovie, combining them as discrete files (with originals also being kept). These 'Musically Active' edited videos could then be coded every minute. This approach still raised some problems with regard to the quality of the data collected during the visits. Due to the behavioural and compliance issues of the population in the study it was frequently a challenge to get participant children to engage for long periods of time in the musical tasks initiated by the researcher/practitioner and there was a high variance in children's engagement between visits.

Challenges also emerged in the quality of the data and some of the children's willingness to engage in musical play. Parents reported how it was often on the child's own terms, and this was not always regular or consistent. The longitudinal design with regular and remote opportunities for engagement provides a potential solution to some of these problems as there are multiple opportunities for data collection. Reassuring parents that child non-compliance is to be expected was important in order to reduce anxiety and encouraging parents to be led by the child, and to take opportunities for playful engagement when they can, rather than as a prescriptive task, provided a way to alleviate this.

Maintaining engagement with participants was an additional issue. Although the responses of the participants during the pilot demonstrated that a remote model of engagement can be a successful method of implementing the programme, it was a concern that over a longitudinal study of a year, engagement could wane more significantly and that steps would need to be taken to address this.

From the feedback and experience of the pilot, this was addressed in a number of ways. Firstly, greater utilisation of the remote possibilities of communication, providing more two-way engagement between the participants' diary entries and the researcher, gave the parents with more tangible guidance and promoted further involvement. Finally, to further maintain engagement, the visits were spaced at different times throughout the year; at 2 months, 6 months, 8 months⁹ and a final visit at 12 months, giving periods of more intense support and two periods of relative freedom

⁹ Although planned, this visit was subsequently cancelled due to the coronavirus pandemic.

from the researcher. This allowed the families to receive more regular support in how to use the resources at the very beginning, then gave them space to begin to establish the activities in daily life with more flexibility. The second set of closely spaced visits were designed to reignite engagement that might have waned, before a further period of space and exploration for the parents.

Overall, this pilot project demonstrated that the methodological design of embedding the intervention within the family home and combining research visits and input with parent engagement was able to sufficiently engage parents and encourage them to use the card prompts to use music in everyday life. The benefits to this approach, including maintaining a naturalistic environment, meant the data was ecological valid, and the adaptations of the home visits responded to the needs of the children and worked around the challenges of variable occasions of engagement and mood.

5 Results I: Musical Development

5.1 Chapter Outline

This chapter outlines the results pertaining to the participants musical development over the course of the main study. Firstly, the qualitative findings from the semi-structured interviews with the parents regarding their children's changing musical behaviours and interests are presented (Section 5.2), including how these insights correspond to the Sounds of Intent in Early Years framework (Section 5.2.3). Then, quantitative results from the observations of musical play are presented, demonstrating changes in musical behaviours between time points (Section 5.3.1) and patterns of growth over time (Section 5.3.2). As a mixed methods approach was adopted, results regarding musical development were observed through qualitative interviews, conducted with the parents at the end of the project explored the impact of the programme, as well as through quantitative data, in the form observational measures which were used to track changing musical behaviours using the Sounds of Intent in Early Years framework.

As the data was mixed methods this enabled the qualitative contextualised evidence reported by the parents to be corroborated against observational measures of musical development. The perceived changes reported by the parents provided an important first step to explore how the developmental framework used for analysis, the 'Sounds of Intent in the Early Years' (EY), was relevant to the parental reports of the behaviours and changes that were observed in autistic children's interactions with music. Parental accounts also enabled these behaviours to be contextualised within play, and the progression and patterns of change specific to this population to be tracked. Once its applicability was established, the quantitative measures taken using the Sounds of Intent-EY framework were used to assess changes over time, and to gain a picture of the inter and intraindividual change considering other contextual and environmental factors.

5.2 Qualitative Results: Musical-Developmental Change

Qualitative analysis was conducted from both the parental feedback through closing interviews and the updates that the parents had reported between visits in their remote diaries. At the final visit, parents were asked to reflect on how they had been using the resources and their general use of music in day-to-day life. They were also asked whether across the course of the project, they had noticed any changes in their child's engagement with music. This section will focus on the musical changes observed by the parents over the course of the project, in particular focusing on (i) the child's developing musical competencies and (ii) heightened interests displayed by the children.

The qualitative data were analysed using thematic analysis using procedures set out in Braun & Clarke, (2006), as detailed in full in Chapter 3. Each interview was subject to an iterative analytical process, based upon a two-stage coding procedure which comprised first order coding, where initial codes were generated, and second order coding, where codes were collated into potential themes. These themes were then inputted into a thematic map, from which larger thematic categories were drawn (Braun & Clarke, 2006).

Parents' perceived changes were grouped in two main themes. These related both to the observable changes in the ways that the children were able to engage with music vocally, aurally and instrumentally (Developing Musical Competencies, Theme 1), but also changes in the ways of using music (Heightened Musical Awareness, Theme 2). Within these themes, further subthemes clarified the more specific changes that the families observed in the musical behaviours of the children and contextualised their growing awareness of music in their environments and daily lives. Table 14 summarises the themes and sub-themes for the overarching category of musical development.

Table 14 Themes, Sub themes and descriptors

Theme (Musical Development)	Sub-Theme	Definition
1 Developing Musical Competencies	1.1 Vocal Development	<i>Parents perception of changes in regard to wider vocal development, including both musical and non-musical expression.</i>
	1.2 Aural Engagement	<i>Processes by which children appeared to engage and learn, particularly by ear.</i>
	1.3 Pattern Recognition	<i>Abilities and interests of children towards patterns in music, including keyboard melodies and repetitive rhythms</i>
2 Heightened Musical Awareness	2.1 Increased Recognition	<i>The growing awareness of children of music in their everyday environments, including how to use music for better effect for their own wants and needs.</i>
	2.2 Attentional Engagement	<i>Changing modes of engagement with music, including higher quality and longer attention to musical stimulus.</i>

5.2.1 Theme 1 - Developing Musical Competencies

Parents observed changes both in their children's abilities and skills to interact with music over the course of the project, and in the differing ways in which these skills came about. Within the theme 'Developing Musical Competencies', parents referred most prominently to the changes in Vocal Development (sub-theme 1.1) ($n = 14$). These ranged from increased babbling and vocalisations to greater control to singing in tune along to melodies, which were frequently reported in correlation

with greater verbal articulation and expressive freedom. Alongside developments in their children's vocal capacities, parents ($n = 16$) became more aware of their children's Aural Recognition (sub-theme 1.2) noticing changes in how their children learned and processed music in their environment, and how these internal processes subsequently impacted upon their child's skills and changing abilities. Thirdly, within the context of the instruments, parents ($n = 18$) reported changes in Pattern Learning and Recognition (sub-theme 1.3) referring to how the children developed in the complexity of the patterns they were creating on the instruments and how some began to reproduce more complex portions of music by recognising patterns on the keyboard. Table 15 details these sub-themes alongside indicative quotations for each.

Table 15 Sub-themes for Theme 1 - Developing Musical Competencies

Theme 1 – Developing Musical Competencies	
1.1 Vocal Development	He has really become...I don't know what the correct wording is, the school says 'vocal' but it's...he's making a lot, a lot of sounds...he really likes 'Hey Duggee' and when it goes 'Duggee' he starts you know vocalise, and a lot of that is to music'
1.2 Aural Engagement	He didn't always join in the singing in the choir, but then in the car he afterwards he would sing the song, so he's listening and learning the songs, he's just not singing in there
1.3 Pattern Recognition	'I think he has changed, he picks up stuff very quickly, he's very visual so that type of thing, when I tell him to look and see the patterns, he won't forget them'

i. Vocal Development

The most prominent change that the parents observed over the course of the study was a change in the frequency and expressivity with which their children were vocalizing. At the earliest stages of development, this was the first time they had begun to hear their children vocalise, as they observed them begin to hum along to music or whistle certain melodies. This grew, moving from unstructured babbling to sounding out and comprehensive engagement with particular songs and music. While this was perceived as a bridge to development in wider communication and verbalisation, it was also reflected that these musical babblings and singing were distinct, and in some ways more complex and advanced than their child's verbal abilities. Overall, it was clear that many ($n = 14$) associated music with an opportunity for their children to vocalise and engage in vocal expression. These musical-vocal expressions provided an opportunity for their children to develop and express themselves beyond normal modes of communication. As was reflected in the accounts, critical moments of vocal development were observed through music. One mother reported how her previously non-verbal son had started to express himself more through sound.

He has really become...I don't know what the correct wording is, the school says 'vocal' but it's...he's making a lot, a lot of sounds... just yesterday he was watching something on YouTube of letters and comics and stuff and he was starting to sound out along to the music....he really likes 'Hey Duggee' and when it goes 'Duggee' he starts you know vocalise, and a lot of that is to music. (Parent, Participant 7)

As the child begins to vocalise, he is demonstrating his ability to make sounds more confidently in different settings and express himself through sound. The association with the cartoon and the motif for 'Hey Duggee' demonstrates the ability to link particular sounds with people. This ability to follow melodies, and make non-verbal musical sounds was reported as a significant step; 'So if there's

something playing on the telly, I see him although it's out of tune, going - it's not matching but he's like got it, humming. That I think, has been very successful.' (Parent, Participant 7).

These vocal developments showed progression from initial forms of humming into unstructured musical verbalisation. 'Now like, you know, he's singing, but not that words that you can understand. It's a lot more just the melody, he's doing a lot more 'abalalabah',' (Parent, Participant 4). These proactive verbalisations represent a common stage of verbal development but were here tied to the responses to the music and musical materials that the children were hearing and experiencing, suggesting that the music is scaffolding these expressions. For those children that were predominantly non-verbal, it was particularly significant for the parents to observe them responding vocally to something in their environment.

The opportunities of music to promote verbal expression were also observed in the next step in developmental trajectories, in the ability to sing along fully to sounds. For example, those children that at the start of the study were commonly interacting with music through unstructured verbalisations as encapsulated in the quotation above, were now able to fully articulate and sing along. As one mother recounted, 'But positively I'm surprised that he actually can now sing in this way for the nursery rhymes, the 'Wind the Bobbin Up' just then, you can actually make out some words out of it,' (Parent, Participant 17). For this child, their musical capacities had progressed from the babbling reported by other parents, to being able to sing whole songs, with the emerging capacity for them being in time and in tune.

The changes in children's vocal development also had implications for how they engaged with music. It was noted that their new abilities meant that their vocal engagement with music became more sophisticated:

He has been singing along when music is playing, whereas before it was either-or. Either he was listening to music, or he was singing it, but now he is singing along with it, which is nice, so he is definitely growing in that sense. (Parent, Participant 14)

This shows a change from reactive and proactive forms of engagement to more interactivity with the music, where the child is able to maintain and share a part with others. As others described, when their children were singing, these formed more complex forms of musical expression:

He likes to listen to Bob Marley. So, he always asks for a particular song, and he knows the lyrics. So, what he does he starts humming the drums or the bass, then tune the start of the song, and then he will literally sing the words of the song. (Parent, Participant 16)

As the mother describes here, this shows a more advanced awareness of musical textures, with the capacity to identify independent parts and melody lines. It indicates an ability to maintain their own part, with a growing complexity of the different features and instruments that create the musical texture.

The parental accounts reflected a high level of affection indicating enjoyment on both the part of the children and the parents. The parents took a great deal of enjoyment from hearing their children's vocal utterances, with the importance of their 'little voice' a feature of a number of accounts. Many reflected that this was often for the first time or more regularly that they may do otherwise, 'He was actually joining in the song the other day, I was really surprised I was like what was that?! And you could hear his little voice joining along,' (Parent, Participant 22). Rather than being associated with frustrated or transactional communication for many, these proactive verbalisations were highly significant in being able to engage vocally with their child; 'The singing is a

huge, huge step. And I guess like for me, I just I want to like, obviously encourage it... and just enjoy the fact that I'm hearing his voice for the first time,' (Parent, Participant 7).

The importance of these opportunities for vocal expression as a release was also recognised. This was seen both in the parents' opportunities to hear their own children, but also for their own emotional wellbeing and control. As one reflected:

The singing has been really lovely actually, that never happened before. But I think she's just kind of tapped into something. I hear her sometimes as she's playing, and it'll be song that heard a million times, I'll hear her little voice like, coming out. That's been really, really a gift, actually. (Parent, Participant 12)

As this highlights, the parent perceived the opportunity for vocal expression as an outlet for expressive communication, shared enjoyment and confidence for the children. This importance of music as a way to support vocalisations was reflected across the cohort. As the account below encapsulates, parents noted the importance of singing for their children as a platform that went beyond the limitations of their child's expressive speech capacities:

I would definitely say it's important. And it's funny because he does talk, but not as well as he sings. So, he'll now sing a whole song, all the words complete and everything. So, I don't know how that must feel for him to be able to sing, because it must feel really good. To be able to sing everything out, if you can't really talk, and he's very like, he's reasonably in tune as well. (Parent, Participant 14)

This comment demonstrates how the parents often perceived the changes in singing and vocal expression to music as a step beyond or ahead of that of their child's verbal communication. This

progressed into the ability and increased frequency with which their children were singing along to songs indicates the growing confidence of the children interacting with their musical environments at developmentally appropriate levels.

ii. Aural Engagement

The processes of how the children learned and developed their musical capacities was another theme in the parent accounts ($n = 16$). In particular, this included the processes by which the children's learning happened without clear or traditional instruction, or how the children picked up melodies and songs without appearing to be paying attention. Many ($n = 6$) expressed their surprise at how, when attempting to use the activities on the cards, or integrate more music into everyday life, the responses and engagement of the children were not always clear, yet their subsequent behaviours and knowledge suggested attention was present. Their aural engagement was far greater and more advanced than assumed. As one mother explained in relation to teaching her child melodies on the piano 'he was pretending like I thought he didn't even understand, I thought he wasn't getting it and then one day he is just playing it!' (Parent, Participant 1). In her account, she describes how the overt behaviour of the child seems distracted and avoidant, apparently not paying attention. The child's subsequent skill: 'one day he was just playing it' indicates that the processes of learning the melody were being enacted, just less conspicuously. The statement reveals an assumption about how the child was learning, and the expectation of normative patterns of instruction, whereas instead the child was learning and focusing in different ways. This theme of apparent distraction, despite underlying processes of learning by listening, was reported by others. As one noted, 'He didn't always join in the singing in the choir, but then in the car he afterwards he would sing the song, so he's listening and learning the songs, he's just not singing in there,' (Parent, Participant 19). This awareness and aural musical memory was reported in a similar account by another mother in reference to a song sung in church:

Like even that song, I didn't know he knew the words, until I said, 'oh what song shall we sing?' and he said, 'walking in the light' and...he remembers each one and he sings! But it's weird because he never sings at church. I mean you can tell he is enjoying some songs, but that's what I mean it's like all inside. I mean I knew that about him, but now it's like really clear. He definitely likes it. (Parent, Participant 9)

Evident in both is also the reference to a sort of internal processing, by which the child chooses to listen and aurally process the music instead of always participating. What this suggests is that although externally this is commonly perceived as disinterest or inattention, this may not be the case.

Parents were sometimes aware of these processes and reflected upon how the musical memories of their children were supported by aural learning, particularly the importance of learning by ear. As one noted 'I think he learns by ear, because he just looks and remembers what it is, which I suppose is good in a way also,' (Parent, Participant 13). This was further recognised and capitalised on the role of aural learning to promote further development, 'I've exposed him to quite complicated music. I've done a little bit of that with him, I've played him that note and said, 'What's this?' and he's got it. When I've been playing it, I've said 'Say the names', so he's got a bit of that,' (Parent, Participant 20). Informed by the learning styles that are described in the accounts above, this father is using his recognition and knowledge of the importance of aural learning to further support musical development, with an indication that these aural games are promoting skills in absolute pitch.

The learning by ear that is suggested across these quotations indicates that this is a core learning strategy for autistic children, with the ability to learn and recognise musical material by ear to a greater extent than some may recognise. Woven through the parent's responses, and a feature

across the themes, is the surprise of some of the parents at their children's musical memories and capacities for musical learning. For the children, this in part stemmed from the fact that their musical abilities in singing or in reproducing patterns and melodies were not tied to their developmental abilities in other areas such as talking or writing. The processes of learning also appeared to be more internal and less explicitly demonstrated, with parents unaware that children who sat silently during choir sessions, or seemed inattentive, would be able to pick up and remember musical material.

iii. Pattern Learning and Recognition

When discussing their children's abilities to interact with the instruments, many ($n = 18$) of the parents focused on the development of competencies related to learning patterns and on using the innate patterns within music as a method for learning and development. They reflected that the interest that their children developed with instruments was often driven by interest in patterns, and that their ability to recognise and reproduce these patterns advanced over the course of the project. Parents reflected in particular on how the keyboard facilitated more complex forms of patternmaking, being able to develop from simple repetition to more complex linear and chromatic scales. As one noted: 'He's definitely more experimental with the keyboard, from a few little notes to now going across the board,' (Parent, Participant 7). Here there is a continuance from an emerging awareness of patterns to having the capacity to make regular patterns through change using the pitch progressions of the keyboard. This development of patternmaking symbolised the first steps for the children in beginning respond to and use music appropriately, as one mother described with her son's interactions with the keyboard:

But on the music side like, normally, when I first started doing it, he used to just start and bang. But now I mean, he puts both these fingers on there and he plays. It's a massive

change. I didn't tell him about the two fingers. He does it himself. And he's using his fingers to go 'oh oh oh' [*voice moves up in a three-note pattern*]. (Parent, Participant 4)

This change from banging and exploring the sound-making potential of the instruments to repeating and reproducing simple patterns in sound shows a clear progression. The repetition of the three consecutive notes on the keyboard shows an emerging awareness of making patterns by repeating sounds deliberately. The proactivity 'he does it himself' that the parent mentions further highlights the emerging skillsets that the child had begun to internalise and put into practice.

The keyboard was a particular object of interest for the children, with the predictable and clear patterns of the 12-note octave and sequence of the diatonic, eight note letter scale meaning that patterns could easily be memorised and reproduced. As one mother explained, her son began to watch a YouTube video that used a set of 5 coloured bells with letter notes and was able to reproduce those patterns on the keyboard:

He's just very interested in the piano. He remembers the sequences from the videos, and he can take them to the piano... So, I think what it is he remembers the sequence of the letters and on the bells ... and then he presses that on the keyboard. It's a lot of showing him and imitation. But he's good with learning like sequences and he can sing along to the tune.

(Parent, Participant 19)

The process that is described here, from the recognition of patterns in one medium – a tuned-bell YouTube video - to the piano keyboard whilst also singing along to the tune, highlights the transfer of the pitches as well as the reproduction of the letter patterns. The child is not only repeating or varying chunks of music, but also connecting those patterns across apparatus, from bells to keyboard to pitches, in a coherent way. This capacity of the children to not only recognise, but also

to memorise these patterns and reproduce them, was described as a clear moment of development and enjoyment:

I think he has changed, he picks up stuff very quickly, he's very visual so that type of thing, when I tell him to look and see the patterns, he won't forget them. With 'Baby Shark' I was you know, I was trying to teach him, but he was pretending like I thought he didn't even understand, I thought he wasn't getting it and then one day he is just playing it! (Parent, Participant 1)

But she seems to really like just playing, if she's given us a specific kind of song to learn with the letters and stuff, and if it's something she likes, she'll get into it. And then her memory is great, so once she gets into it, she's flying. (Parent, Participant 12)

One parent's account highlighted that the memorization of patterns extended beyond the keyboard at home with the letter names drawn on, and onto other pianos:

Since you've brought him that keyboard, he knows how to do 'Twinkle, Twinkle little star'. And then he used to use the piano in the nursery. They have a piano and they told me that he played that he played 'Twinkle, Twinkle little star' there, and he was going to the community centre, and he was also playing it there! So, it's transitioned, he's understood that he can play this tune on whatever piano keyboard. (Parent, Participant 16)

The memorisation of the patterns of short melodies highlights the children's ability to confidently reproduce distinctive patterns of musical notes confidently, and a progression into their ability to recognise and reproduce short pieces 'it's transitioned...he can play this tune on whatever piano keyboard'.

This apparently effortless memorisation of patterns was also apparent in the reports from the parents that their children's abilities appeared to surpass their own. As one mother commented in reference to her son's ability to play 'Twinkle, Twinkle', 'Even now... there are missing letters [on the keyboard] and he still knows that that's where it's supposed to be. Like I don't know if I could do that!' (Parent, Participant 14). The genuine interest of the children in reproducing these patterns across instruments in order to play a melody was remarked on, including the self-direction and motivation that the children demonstrated towards learning these patterns. As one explained, 'I think [he] has made so much progress. He's been doing it a lot, and checking it out, using the music apps on his iPad. He will go on YouTube and find the videos of how to play the song' (Parent, Participant 18)

As the accounts above reflect, for many children it was the keyboard in particular that provided a vehicle to develop. While this began by writing the letters on the keys, and following patterns provided with the activity cards, their ability to easily remember these patterns meant that these were less needed as time went on. The accounts suggest that the children responded keenly to the patterns that underpin musical structures and were drawn to the repetition and structure of the piano keyboard, and also that this was a core part of how they learned and were therefore able to reproduce and learn more effectively within these musical spaces.

5.2.2 Theme 2 - Heightened Musical Awareness

From the parent accounts, a second overarching theme emerged that reflected the nature of musical engagement that the children exhibited, and how the children appeared to have a wider musical awareness of music in their environments. Table 16 details the sub-themes within this, with indicative quotations for each. Within the theme of Heightened Musical Awareness, there were clear

differentiations in the way that these changes in musical recognition manifested, depending upon the developmental level of the child.

Table 16 Sub-themes for Theme 2 - Heightened Musical Awareness

Theme 2 – Heightened Musical Awareness	
2.1 Recognition & Interest	‘I think in the past even when you were even like turning on the radio or music he said ‘turn it off! Now he doesn't say off. He listens and sometimes will say louder or like down’
2.2 Attentional Engagement	‘He’s got more sophisticated in terms of what he likes, he recognises tracks more easily and will be like ‘I’ve heard that before’, even maybe he’s starting to recognise instruments’

For those whose children were at the earlier stages of musical exploration, this was most clearly expressed in a subtheme of increased Recognition and Interest (sub-theme 2.1) ($n = 21$) including changes in musical responsiveness, awareness of music in everyday environments and demonstrating pleasure in joint engagement during musical play with others. For others, this increased awareness was further demonstrated in differences in Attentional Engagement (sub-theme 2.2) ($n = 13$), where children began to demonstrate growing musical maturity and empowerment within musical spaces, seeking out their own musical preferences and further taking control of their own musical interactions.

i. Recognition & Interest

Common among the parent accounts was the growth in musical recognition that had been observed in the children over the course of the research ($n = 21$). These changes varied dependent on the original level of musical skill of the child, but many reported clear shift; from either of lack of

engagement or direct rejection of music, to a clear awareness and recognition of music in their environments, taking pleasure in the experience and seeking out their own preferences. For those that were in the emerging musical development, this manifested in changes in initial engagement; moving from an apparent lack of awareness to initial recognition and sensitivity and beginning to show more interest in musical stimulus. As one parent reported 'it used to be he was oblivious to sound, but he seems more sensitive now' (Parent, Participant 4). Others also reported that their children seemed more responsive to musical stimuli: 'But he's become much more engaged when I am humming and things,' (Parent, Participant 7). It was observed that this interest frequently manifested in the child taking more control within these spaces, 'Definitely more responsive, especially when we bring the music element into speech. He's trying very hard to say Alexa, as he likes the idea of the music on demand' (Parent, Participant 11).

The wider awareness of music with different environments was also perceived as evidence of changing types of engagement. As another parent reported, changes in the recognition of how different types of experiences can be gained from music became more prominent:

I think she's more aware of music in general. Like she's, when I put on different types of music, or even if it's like relaxation music, she really kind of just wants that to go on. Or she'll tell me, 'I'm good, I've had enough of that,' you know? There's more of a response to music in general, it's in her environment. (Parent, Participant 12)

The awareness and control of music stimulus here indicates how the child began to become more empowered in their sonic landscapes, both able to seek and take enjoyment from music, but also to recognise when it was not wanted. This growing recognition of the role and presence of music was also observable in overt behaviours. Often these changes were subtle, but patterns of engagement were apparent over broader lengths of time. One parent described how their child's response to

musical stimulus was rare, but occasional behaviours demonstrated his growing recognition for music and his enjoyment within these spaces:

Sometimes I see him dancing, and when my wife has music on, he will respond with some dancing. But he enjoys music like that – he’s not using the instruments yet, he’s not there yet. Although...we went to someplace and they have some instruments like the one you used to bring (castanet) ...and he took the handle and clapped it and tried to do it. It was salsa music, and he was trying to tap along. I don’t know if he remembered doing it with you and then tried to do it. It was a maraca as well and he tried to do that as well. But that experience was good because it was good to see him hearing and listening, because when he doesn’t respond you do wonder. So, it was nice to see him enjoying it, although he don't know how to play properly with it with the coordination. At least we know that the music recognition was there, and he tried to do. (Parent, Participant 24)

This father’s account highlights how the child was beginning to respond more appropriately to the musical stimulus and recognise how to interact in musical scenarios. The use of the castanet and maracas along to the music demonstrates the change in engagement, as the parent notes ‘when he doesn’t respond you do wonder’ indicating both the rarity of this engagement, and also reflecting the assumption of deficit due to their unresponsiveness. Instead, the recognition of how to use the instruments appropriately, drawing on memories from when we played with the castanets together during one of the visits, indicates that the knowledge of how to interact appropriately exists, but that other developmental barriers (such as coordination or overstimulation) still remain.

The changes in engagement that were reported also demonstrate a growing recognition of the enjoyment and capacity for play that can be gained from musical spaces. The children became more confident in their interactions within musical spaces, and as a result, had clearer preferences and

engagement. As one mother reported, their child's increased interest manifested in both reactive and proactive behaviours:

I think in the past even when you were even like turning on the radio or music he said 'turn it off! Now he doesn't say off. He listens and sometimes will say louder or like down. Or is he likes he requests the music he wants. Last week, he said 'I want music'. Normally before, he wouldn't want to listen to the radio and music...And then (on the radio) it was like 'you and you' - he was trying to sing it. And then he was going (moves arms) and trying to dance to it! And then when the music was going faster, he was also trying to go faster. So, he was showing, and he was listening. (Parent, Participant 5)

The changes here are explicit, from actively rejecting musical engagement, to proactively seeking it out: 'I want music'. The requests for change (e.g., 'louder' or 'down') highlights both the child's engagement with the music and an awareness of their own capacity to control and regulate their own experiences of that musical engagement. The behavioural responses, including the dancing and the coordination with the music, going faster and slower, is, as the parent reports, a clear indication of the child engaging with the music, listening and responding to general musical features. The parents' awareness of these listening and behavioural responses also emphasises the significance of these encounters. In light of the child's previous avoidant behaviour; 'he wouldn't want to listen', this was a significant step.

This increased recognition was also manifest in the children's responses to the instruments. As one parent reported, 'There has been times where there's been like a song is on that he likes, and he was sat down and touching on the keyboard. I mean, granted it was out of tune, but it was still making noises... like, yeah, I have seen that,' (Parent, Participant 7). The child's attempt here to play along, touching the keyboard while listening to the song, indicates a recognition of the instruments in the

music produced in the recording of the song, and the sound-making potential of the instruments that they had at their disposal. It suggests a growing awareness of how to play within musical environments, and how to gain enjoyment through overt behaviours and actions.

ii. Attentional Engagement

For those that had demonstrated engagement with music previously, changes were also observed in the types of music that they were engaging and participating in. Some parents ($n = 13$) observed how children engaged with different types of music, in different ways and for longer periods of time. In particular, they reported changes in the kind of attention that children showed, and how these changes impacted the emotional engagement that their children had with music, 'I think he hears and feels music in different environments now where I think like, when we started off with the instruments, it was very much like, you know, cause and effect kind of thing with music,' (Parent, Participant 7) These reflections demonstrate a change in the child's perception of sonic stimulus; moving from cause and effect' and the impact of particular sounds, to having emotional recognition and feeling music in different environments. As one parent reflected, some of these changes were not a new development, but a re-unlocking of interests and engagement that had seemed to have been lost:

I knew that he liked music from when he was nine months old, but then he lost it, and I wanted to bring that back... He's liked jazz since he was little, but he's now come back to it. He is doing the things he used to do with it... in terms of music it's like he is back to his nine-month-old self. (Parent, Participant 4)

This re-engagement highlights how the child was beginning to reassert themselves and become more empowered in interacting with their musical environment. Their growing confidence in

interacting more fully suggests that some of the sensory or coordination barriers that may have existed before had been partially controlled or managed.

This was further reported the ways in which their child was engaging had changed or developed into a greater interest and sophistication, with more attention paid to the significance and active engagement with the music they were listening to,

I think her awareness for music is there. And I think that maybe it's always been there. But we've managed over the course of the year to maybe bring a little bit more into the foreground for her like, 'What are you listening to? What does it mean? Try it maybe, like, show me how to do that', that sorts of stuff. (Parent, Participant 12)

As this account shows, these changes manifested in a more active engagement with the music, with the parents trying to encourage a more reflective relationship with the types and modes of listening that the child was engaging with. For some parents, this was demonstrated in their child's own interactions and musical memory,

He's got more sophisticated in terms of what he likes, he recognises tracks more easily and will be like 'I've heard that before', even maybe he's starting to recognise instruments, so if a trumpet or something is playing, he will hear and recognise that. So, I think that appreciation of that is there a bit more. And he really does like his classical music as well.

(Parent, Participant 13)

This mother's report highlights the child's more active attention to the musical detail of their environment. The reported preference changes here also indicate more perceptual awareness of the

composite elements of the musical spaces, identifying instruments of interests and recognizing chunks of music.

Changes in engagement also impacted children's emotional recognition of musical stimulus. As exemplified here: 'Like, two weeks ago, we were watching like Opera, and it was quite sad. But he was sitting and then he was crying to the opera... And then he said '[x] is sad, very sad! No more music!' (Parent, Participant 5). This emotional response highlights the changing ways that some of the children began engaging with music and demonstrates how the progression of attentional control had an impact on *how* as well as *what* autistic children were able to engage with. It indicates that as musical skills develop and musical exposure increases, the maturity with which they can engage with music also changes, with heightened empathetic and emotional responses.

5.2.3 Links to Sol-EY Framework

Across the accounts it is possible to see how parent's descriptions of their child's musical development aligns with the detailed elements in the Sounds of Intent in Early Years Framework. This can be seen in the reflections on the earliest emergences of sound making, which corresponds to at Sounds of Intent-EY, Level 2, *Making sounds intentionally*: "He has really become...I don't know what the correct wording is, the school says 'vocal' but it's...he's making a lot, a lot of sounds... he really likes 'Hey Duggee' and when it goes 'Duggee' he starts you know vocalise, and a lot of that is to music. (Parent, Participant 7). The further description of associating the character of Duggee with a phrase also indicates a move into Level 3, being able to link sounds with particular people or places. Additional evidence of progression from Level 2 to Level 3, *making simple patterns in sound*, was also reflected in the accounts, again indicating this is a common pattern of growth and development for autistic children: "when I first started doing it, he used to just start and bang. But now I mean, he puts both these fingers on there and he plays...And he's using his fingers to go 'oh oh

oh' [voice moves up in a three-note pattern]. (Parent, Participant 4). The banging on the keyboard and making sounds intentionally (Sol-EY Level 2), had progressed into making simple patterns in sound (Sol-EY Level 3). The parental accounts reflected how vocal development increased over the course of the project, frequently in alignment with the patterns detailed in the Sounds of Intent-EY framework. From moving from expressing themselves in sound (Sounds of Intent, Level 2) to doing so alongside musical stimulus (Sounds of Intent 3 & 4).

Other accounts highlight Level 4 capacities to sing or play distinctive chunks of music: 'positively I'm surprised that he actually can now sing in this way for the nursery rhymes, the 'Wind the Bobbin Up' just then, you can actually make out some words out of it,' (Parent, Participant 17). These were often referenced in passing towards Level 5 abilities, singing or playing full pieces of music in time and in tune; 'he does talk, but not as well as he sings. So, he'll now sing a whole song, all the words complete and everything. (Parent, Participant 14). Furthermore, as the numerous accounts above reflect, for many children it was the keyboard in particular that provided a vehicle to develop and move into Sounds of Intent, Level 5, playing short, simple pieces gradually more in time and in tune. As this description encapsulates: Since you've brought him that keyboard, he knows how to do 'Twinkle, Twinkle little star'. And then he used to use the piano in the nursery. They have a piano and they told me that he played that he played 'Twinkle, Twinkle little star' there, and he was going to the community centre, and he was also playing it there! So, it's transitioned, he's understood that he can play this tune on whatever piano keyboard. (Parent, Participant 16). As the evidence provided in the parental accounts highlight, the direct alignment of patterns of change with the Sounds of Intent framework suggests that the cards were successful in promoting skills relevant at each level, and that through interactions with parents were able to progress to more advanced levels of music making.

5.2.4 Musical Development - Thematic Summary

Across the cohort, the parental accounts demonstrate that there was clear development in musical engagement. These changes could be broadly categorised into two themes; (i) Musical competencies which included changes to musical abilities, which the parents perceived to be learning of patterns and differences in aural recognition and verbal expression, and (ii) Heightened musical awareness, where the parents noted that their children became more conscious of music in their environments, which had the effect of changing both the modes and frequency of engagement, and the empathetic dimensions of their experiences with the musical stimulus. For both themes, these changes were observed during structured play, focusing on the activities based on the cards, and also during everyday life. The prevalence of the accounts that were situated within everyday life suggests that the children were becoming empowered in their interactions with music in their environment, and subsequently engaging with greater awareness and emotional depth within musical spaces. The reflections of the parents highlight how, over the course of the project, they became more aware of their children's own musical capacities, and of how to utilise musical play to promote development. The analysis indicated the accounts of musical behaviours had high relevance to the Sounds of Intent framework, with parent descriptions of patterns of change aligning clearly with the developmental progression detailed in the model.

5.3 Quantitative Results: Musical-Developmental Change

To examine more closely how musical behaviour and skills developed over the course of the project, two core domains relating to musical development were analysed over the four time points to assess changes in behaviour. These domains were 'Musical Development' as analysed by Sounds of Intent in the Early Years, which specifically targeted music-based competencies and interaction and 'Imagination and Creativity in Musical Play' which reflected the modes of play and independent creativity that the child brought to the play. Both domains were analysed during the observational coding scheme, as detailed in Chapter 4. This quantitative section will focus on the changes in musical skills over the course of the project (RQ1.1) as well as on how these patterns of change grow over time (RQ1.3).

5.3.1 Changes between visits- Repeated Measures ANOVA

To first assess initial changes between timepoints, repeated measures ANOVA were run for the separate domains of musical development. The dependent variables were Sounds of Intent-EY scores and Imagination and Creativity in Musical Play with an independent variable of time for each visit. The ANOVA was run using the mean scores in the domains for each participant at each time point.

i. Musical Development: Sounds of Intent-EY

A repeated measures ANOVA found that the Sounds of Intent-EY scores were statistically significantly different at the four different time points during the programme, $F(1.73, 25.97) = 31.6$, $p < 0.0001$, demonstrating a large effect, $\eta^2[g] = 0.33$. As the data violated assumptions of sphericity, as measured by a significant Mauchly's Test of Sphericity, Greenhouse-Geisser epsilon (GGe), and Huynh-Feldt epsilon (HFe) correction tests were run. The mean Sounds of Intent-EY score remained statistically significantly different at the different time points, even after the sphericity corrections

($p[GG] < 0.001$ and $p[HF] < 0.001$). The results above were therefore run with a Greenhouse-Geisser correction to all within-subjects factors to account for these violations.

Post hoc comparisons using Bonferroni correction indicated that the mean score between the Baseline score ($M = 8.60, SD = 2.03$), Timepoint 1 ($M = 9.30, SD = 9.30$), Timepoint 2 ($M = 10.5, SD = 1.35$), and Timepoint 3 ($M = 11.2, SD = 1.82$) all significantly differed from each other (see Table 17).

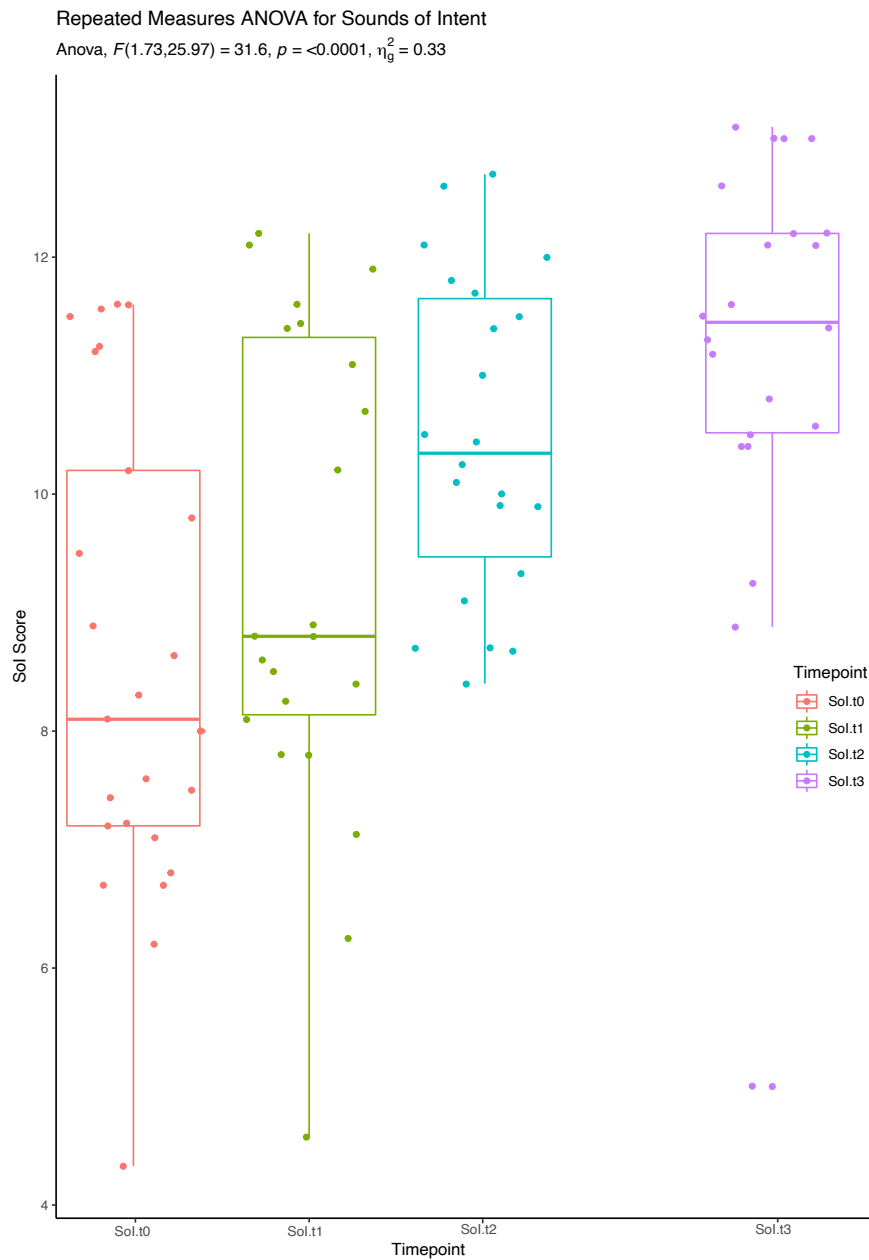


Figure 11 Boxplot of Sol-EY scores by visit

Table 17 Sol-EY Pairwise Comparisons

Group 1	Group 2	n	T	df	p
Sol-EY Baseline	Sol-EY Time 1	25	4.03	21	**
Sol-EY Baseline	Sol-EY Time 2	25	8.30	21	***
Sol-EY Baseline	Sol-EY Time 3	25	7.65	21	***
Sol-EY Time 1	Sol-EY Time 2	25	4.50	18	**
Sol-EY Time 1	Sol-EY Time 3	25	5.09	18	***
Sol-EY Time 2	Sol-EY Time 3	25	4.50	18	**

n.s. not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The significant changes in the Sol-EY scores indicate that the children's musical competencies significantly changed across the course of the project. The high effect score strengthens these results, indicating large gains in musical competencies over time.

ii. Imagination and Creativity in Musical Play

A repeated measures ANOVA found that the Imagination and Creativity scores were statistically significantly different at the four different time points during the programme, $F(4,45) = 20.95$, $p < 0.0001$, demonstrating a large effect, $\eta^2[g] = 0.22$. Mauchly's Tests for Sphericity was non-significant, indicating that the variances of the differences between the levels of the within-subjects factor are equal. Post hoc comparisons using Bonferroni correction indicated that the mean score between the Baseline score ($M = 8.60$, $SD = 2.03$), Timepoint 2 ($M = 9.30$, $SD = 9.30$), Timepoint 3 ($M = 10.5$, $SD = 1.35$), and Timepoint 4 ($M = 11.2$, $SD = 1.82$) all significantly differed from each other, apart from between Timepoint 1 and Timepoint 2, which was not significant (see Table 18).

The significant findings in the domain of Imagination and Creativity further demonstrate the changes in musical behaviours and musical empowerment over time that were seen across the project, with the large effect size indicative of this changes in behaviours between the visits. The post hoc t-tests

further indicate however that while there were significant changes between most visits, these changes were not always consistent between every and each visit.

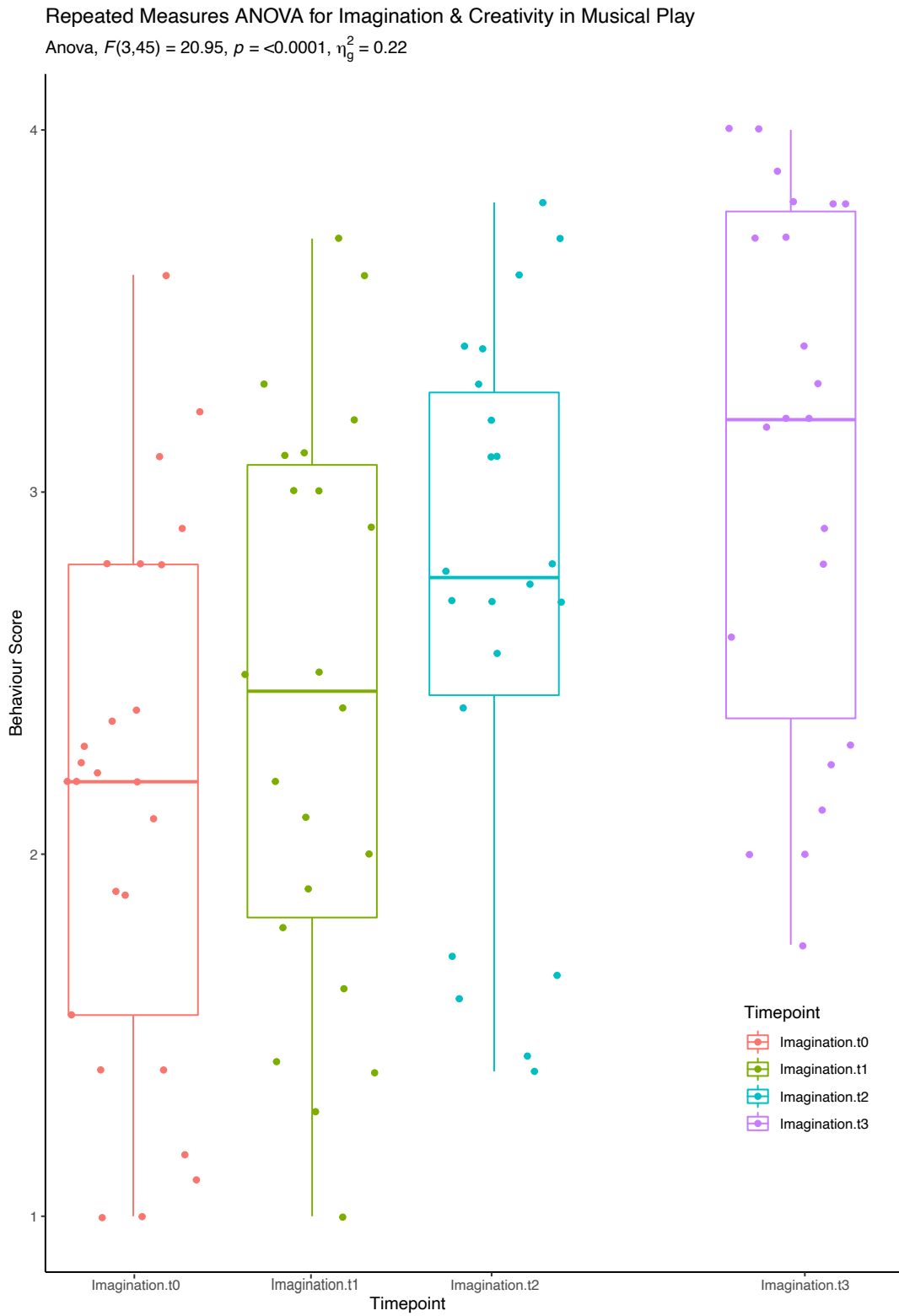


Figure 12 Boxplot of Imagination scores by visit

Table 18 Imagination Pairwise Comparisons

Group 1	Group 2	n	F	df	p
Imagination Baseline	Imagination Time 1	25	2.98	21	**
Imagination Baseline	Imagination Time 2	25	5.75	21	***
Imagination Baseline	Imagination Time 3	25	8.05	21	***
Imagination Time 1	Imagination Time 2	25	1.57	18	n.s.
Imagination Time 1	Imagination Time 3	25	4.91	18	***
Imagination Time 2	Imagination Time 3	25	3.54	18	*

n.s. not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5.3.2 Change over time – Latent Growth Model Analysis

While these results demonstrate that there were changes over the course of the year for both domains of musical behaviour, they reveal less about the modes and trajectories of growth.

Furthermore, they also do not reveal how intra-individual differences and trajectories may change over time. As initial analysis above has demonstrated, there were significant changes in musical behaviours. However, developmental trajectories are complex, with an emerging consensus in developmental science that they are both non-linear and heterogeneous between individuals (Boogert et al., 2018). For autistic children, this is specifically relevant given the heterogeneity of the condition and the spiky profile of autistic abilities. To investigate this complex population for the development of musical abilities, an approach was required that can conceptualise development as a process of dynamic growth over time. Latent Growth Models (LGM's) provide rigorous, longitudinal test of these process of growth, and interrelating factors. While the sample size ($n=25$) for this project represents the lower end of acceptable sample sizes for this statistical method, the range of four time points meant that this type of analysis was still appropriate for the most simple growth models, where the minimum of $n=20$ has been recommended (as discussed by Muthen, 2001).

Longitudinal changes in musical ability were analysed in R using the lavaan package (Rosseel, 2012). At the outset, a univariate LGM of musical development was built to capture changes in each of the single domains (Musical Development and Musical Imagination & Creativity) over time. At each step, the chi-square test, Root Mean Square Error for Approximation (RMSEA), Comparative Fit Index (CFI) and the Standardised Root Mean Square Residual (SRMR) were inspected to evaluate model fit. Good fit was defined as CFI > 0.97, RMSEA < 0.05 and SRMR < 0.05; acceptable fit as CFI = 0.95 – 0.97, SRMR = 0.05 - 0.10 (Schermelleh-Engel et al., 2003). In light of the small sample size, which can impact the reliability of fit measures, the recommendation that rejection of LGM fit based solely on the SRMR was also considered (Shi et al., 2021).

i. Musical Development – Sounds of Intent-EY

Using linear growth factors (with fixed loadings of 0, 0.2, 0.5 and 1) to reflect the spacing of visits over time, an initial univariate LGM of musical development using Sounds of Intent scores showed an acceptable fit. However, problems with the fit of the model were identified with a low χ^2 significance score and high RMSEA. The model was respecified to include a quadratic path (with fixed loadings of 0, 0.04, 0.25, 1), which subsequently showed a good fit.

Table 19 Univariate Latent Growth Model for Sol-EY

Sounds of Intent -EY – Model 1				
Fit: $\chi^2(1) = .016$, $p = .899$; RMSEA < .001 [$<.001 - .217$]; CFI = 1.00; SRMR = .004				
path	estimate	SE	z	p
intercept mean	8.593	0.398	21.583	**
intercept variance	4.234	1.131	3.746	**
Slope mean	3.936	0.581	6.778	**
Quadratic slope mean	-1.452	0.602	-2.412	*
Quadratic slope variance	0.837	8.018	0.104	n.s

n.s. not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The positive slope mean suggest that overall scores increase over time, with the negative quadratic slope indicating that beyond this linear trend, this growth decelerates towards the end. The significant intercept variance at the first timepoint suggests that there was significant variation in the population Sol scores at the beginning of the project, however non-significant variance for both the linear and quadratic slopes indicates that individuals across the project followed similar quadratic growth trajectories.

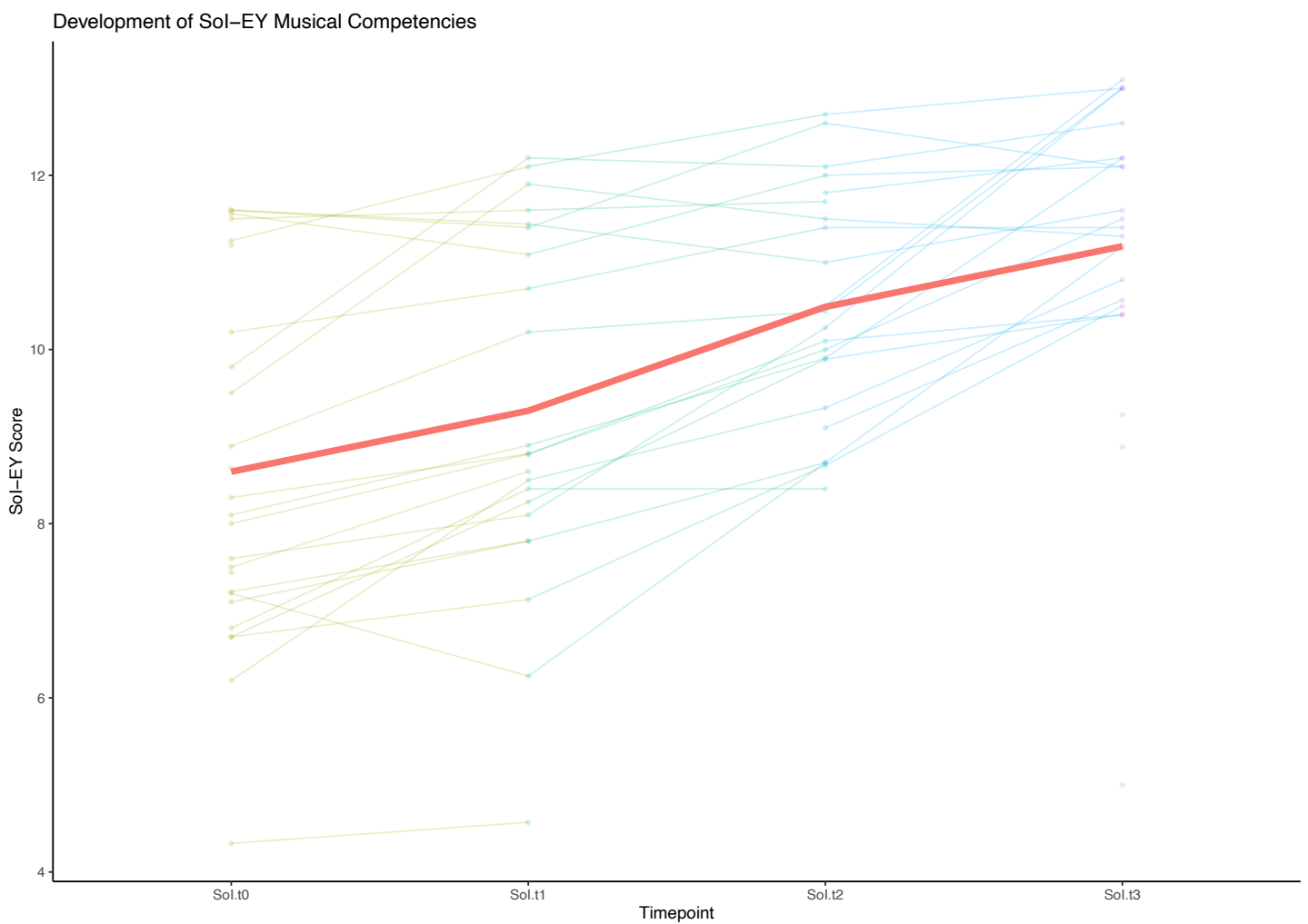


Figure 13 Spaghetti plots of participants scores over time as well as mean trajectories for Sol-EY scores

ii. Imagination and Creativity during Musical Play

Using linear growth factors (with fixed loadings of 0, 0.2, 0.5 and 1) to reflect the spacing of visits over the year, an initial univariate LGM of the scores for the domain of Imagination and Creativity showed good fit. Due to the small sample size, the model was not rejected outright despite the elevated SRMR, as recommended by Lai & Green (2016), with no other respecified models showing a better fit.

Table 20 Univariate Latent Growth Model for Imagination

Imagination and Creativity – Model 2				
Fit: $\chi^2(5) = 4.770$, $p = .445$; RMSEA < .001 [$<.001 - .295$]; CFI = 1.00; SRMR = .077				
path	estimate	SE	z	p
intercept mean	2.218	0.145	15.249	**
intercept variance	0.440	0.113	3.886	**
Slope mean	.818	0.078	10.531	**
Slope variance	-0.149	0.094	-1.584	n.s

n.s. not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The significant positive linear slope suggest that overall scores increased over time. The significant intercept variance also suggests that there was significant variation in Imagination and Creativity scores at the beginning of the project, as expected due to the heterogeneity of the autistic population, however non-significant variance for the linear slope indicates that individuals across the project followed similar growth trajectories.

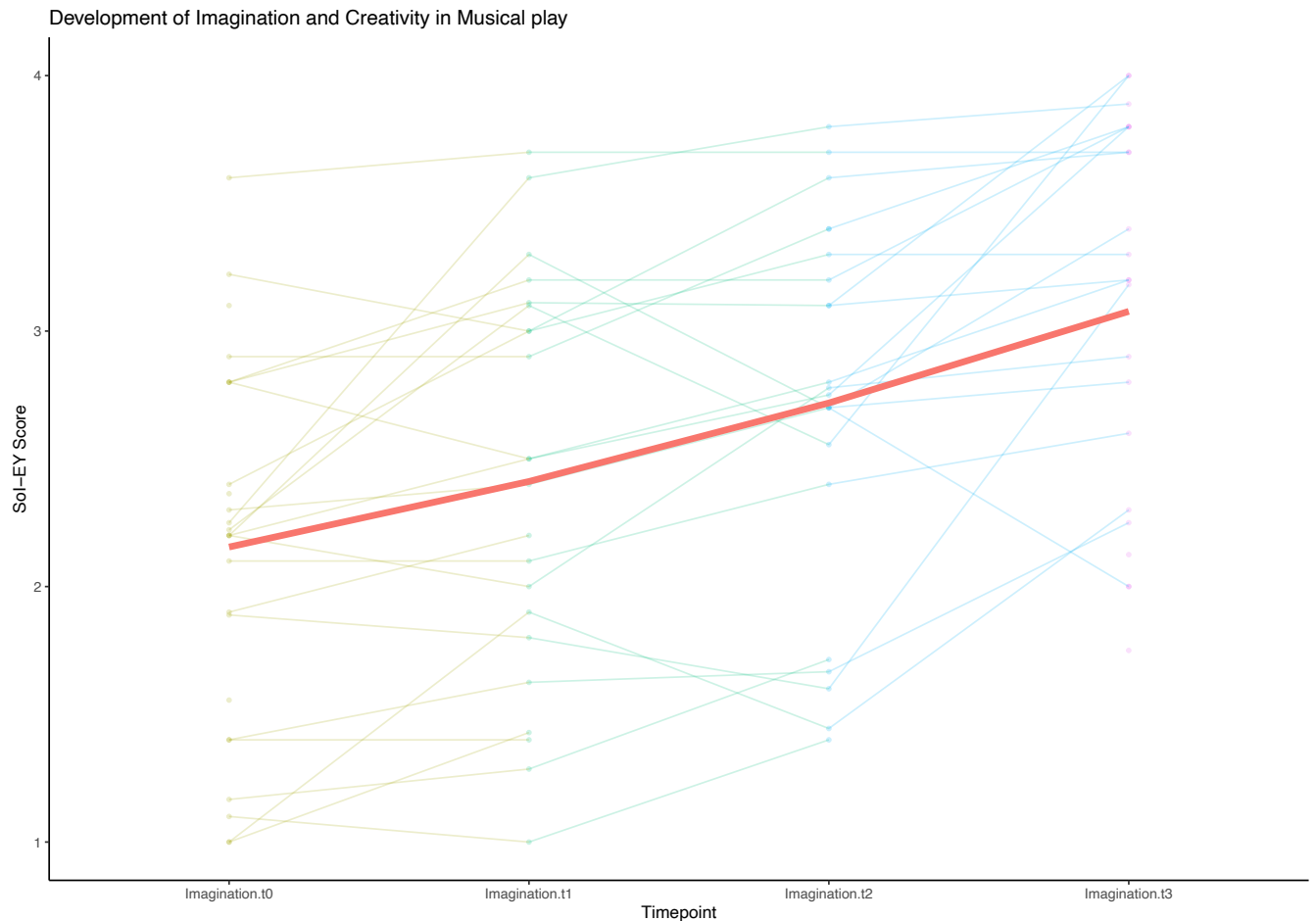


Figure 14 Spaghetti plots of participants scores over time as well as mean trajectories for Imagination and Creativity scores.

5.3.3 Multivariate Growth Models

To examine the impact of external and environmental factors on musical development, a latent growth model was run with time-invariant covariates including baseline measures of Age, Language¹⁰ and Social Communication¹¹ at the start of the project. As with the univariate Sol model, the covariate model was run with a fixed linear loadings of 0, 0.2, 0.5 and 1 and quadratic growth loadings of 0, 0.04, 0.25, 1. Due to issues of power stemming from the small sample size, covariate regressions were only run on the intercept and linear slope factors.

¹⁰ Language was measured on a scale from 1-4 with 4 most severe.

¹¹ Social Communication was measured using the ABI Social Communication Scale at the first visit, using raw scores rather than standardised scores, as recommended by (Seltzer et al., 1994)

Table 21 Multivariate Latent Growth Model, Sol-EY and Behavioural Factors

Sounds of Intent-EY – Model 1.1				
Fit: $\chi^2(11) = 12.954$, $p = .296$; RMSEA = .08[<.000 - .250]; CFI = 1.00; SRMR = .05				
path	estimate	SE	z	p
Intercept mean	11.506	1.604	7.174	***
Intercept variance	2.174	0.436	4.984	***
Age – Intercept	0.009	0.017	0.519	n.s
Language – Intercept	-0.538	0.279	-1.932	n.s
Social Communication - Intercept	-1.246	0.572	-2.179	*
Slope mean	3.557	1.587	2.241	*
Age - Slope	-0.005	0.016	-0.317	n.s
Language - Slope	0.184	0.217	0.645	n.s
Social Communication- Slope	0.183	0.217	0.845	n.s
Quadratic slope mean	-1.321	0.470	-2.809	**
Quadratic slope variance	1.927	0.391	4.928	***

n.s. not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The model indicated that age had no significant impact on either the intercept or the slope, suggesting it was not a factor in acquiring musical competencies. However, both language and social communication abilities had a significant impact upon the intercept scores, with higher scores (therefore higher severity) in both predicting lower Sol-EY scores at the start of the project. These factors had no significant impact upon the slope, suggesting there was no impact upon the rate of growth. This indicates that while there may be access and comprehension issues for achieving children's musical potential that could be seen at the start of the programme, social communication and language difficulties may not be a barrier to musical development overall if children can be properly supported. The significant quadratic slope variance further indicates that there was variability in these growth patterns.

A second multivariate model was run to examine the impact of children's previous exhibitions of musical play behaviours on Sounds of Intent scores. As with the univariate Sol model, the covariate

model was run with a fixed linear loadings of 0,0.2, 0.5 and 1 and quadratic growth loadings of 0, 0.04, 0.25, 1. Due to issues of power, covariate regressions were only run on the intercept and linear slope factors.

Table 22 Multivariate Latent Growth Model, Sol-EY and Musical Play

Sounds of Intent & Musical Play Behaviours – Model 1.2				
Fit: $\chi^2(7) = 7.624$, $p = .367$; RMSEA < .06 [$<.001 - .258$]; CFI = 0.99; SRMR = .05				
path	estimate	SE	z	p
Intercept mean	5.220	1.400	3.729	***
Intercept variance	2.657	0.600	4.429	**
Musical Stim - Intercept	.953	0.383	2.488	*
Slope mean	3.864	1.227	3.148	**
Musical Stim - Slope	-0.034	0.302	-0.112	n.s
Quadratic slope mean	-1.240	0.485	-2.560	**
Quadratic slope variance	1.798	0.343	5.243	***

n.s. not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The model indicated that musical play behaviours had a significant impact upon the intercept scores, with those who had shown frequent independent musical behaviours before the start of the study having higher Sol-EY scores. However, having previous musical interests had no significant impact upon the slope, suggesting there was no impact upon the rate of growth. It indicates that children who previously demonstrated interest in independent musical play had higher musical competencies, but this was not a barrier for growth for those that didn't, while the significant quadratic slope variance further indicates that there was variability in these growth patterns.

5.4 Chapter Summary

This chapter has presented the qualitative and quantitative results highlighting the changing musical behaviours during the four visits. These results were assessed using two data collection tools; quantitative assessment of the Sounds of Intent in Early Years levels (as measured and observed through video) as well as through the analysis of parent accounts during semi-structured interviews. Overall, both the families' qualitative experiences and the quantitative behavioural observations indicate improvements in musical competencies over the course of the four visits during the project.

The directionality of the positive growth factor for the latent growth models highlights two key findings: firstly, that autistic children's capacity to engage with greater maturity and creativity increases over time, regardless of initial ability; secondly, that the LGM's high variance in the mean intercept scores across the population indicates a distinct heterogeneity across the population in initial musical ability at the start of the project. The lack of variance in slope factors suggest that despite initial ability, patterns of growth remain broadly similar over time. These patterns of growth were echoed in the parental accounts, whose experiences of change align with the descriptor in the Sounds of Intent in the Early Years framework, indicating, firstly, that musical-developmental milestones for autistic children have the same features as neurotypical development as outlined in the Sounds of Intent-EY framework. And, secondly, that those trajectories seem to follow similar patterns of change, although modes of engagement may differ. The importance of recognizing these difference modes of engagement was clear in the parents' experiences, as they detailed how their children learn in different ways.

As the accounts documented, there were changes in the parents' recognition of their child's musical ability and potential as they became more aware of how their children learned. In particular, their capacities for aural and pattern recognition were notable, despite first appearing uninterested. This

awareness of developing appropriate pathways for communication and understanding in order to support development was further seen in the multivariate LGMs. Both indicate that contextual factors impacted upon initial scores at the start of the study, with those with greater communicative difficulties scoring at lower developmental level, and those with previously observed musical play behaviours scoring higher. However, the fact that even lower scoring individuals were able to grow at similar rates to their peers over the course of the project indicates that those opportunities for development required more targeted support. The variability of the quadratic growth factors in the multivariate models further highlights the differences in intraindividual growth. This indicates that quadratic growth patterns differ between individuals, with some experiencing more flattening of the curves than others, which is as expected in a heterogeneous population such as the cohort here.

6 Results II: Musical Play in Everyday Life

6.1 Chapter Outline

This second results chapter presents the results highlighting the uses of musical play in everyday life. Firstly, the qualitative findings from the semi-structured interviews with the parents are shown. These detail the themes relating to the dynamics of musical play (Section 6.2.1) and the utility of music in everyday life for scaffolding routine and emotional regulation (Section 6.2.2). Next, the findings from the music in everyday life scale (collected via questionnaire at the end of the study) will be presented to highlight how music was used in everyday life (Section 6.3). Then, the quantitative data, collected through both coded observations of musical play and parent-reported behavioural measures is presented to examine wider musical and developmental changes (Section 6.4). This will highlight differences both in interactive behaviours within musical play, and in wider behavioural outcomes that were recorded at the beginning at the end of the project including social communication scales and measures of self-regulation.

The mixed methodologies of the qualitative accounts combined with quantitative results of changing behaviour enable the contextualisation of children's individual behaviours within musical play and their wider development; providing tangible examples of these changes over time and reflect on the significance of these changes for how parents were able to interact and communicate with their child on a daily basis. Therefore, results will first be presented in regards to qualitative accounts musical play, before considering the reported uses of music in everyday life, and then the changing musical and social behaviours over time.

6.2 Qualitative Results: Musical Play

Parents reported a wide range of uses of music, the most significant of which were opportunities for shared enjoyment during musical play. To contextualise these further, at the final visit, the interviewer asked parents to discuss the role of music in everyday life, and its particular uses to regulate and mediate behaviours. Qualitative analysis was conducted from both the parental feedback through closing interviews and the diary updates that the parents provided between visits. As outlined in detail in Chapter 3, analysis was undertaken using the process outlined by Braun & Clarke (2006), with indicative codes first identified and labelled, then collated into sub-themes and overarching themes through an iterative process of analysis.

Within their responses, these two overarching themes were clearly defined between (i) Musical Play and the opportunities for shared interaction and creativity within those spaces, and (ii) Music in Everyday Life, and the environmental and individual uses of music that emerged as a tool to orientate routines and activities. Table 23 highlights the overarching themes and subthemes of the qualitative analysis.

Table 23 Themes, Sub themes and indicative quotations

Theme	Sub-themes	Descriptor
2 Musical Play	2.1 Scaffolding Interactivity	<i>Capacity of musical play to create platforms for interactive and shared moments of togetherness.</i>
	2.2 Joint attention – Musical Dialogues	<i>Reflections upon the dynamics of musical play as a space to create musical conversations and as an object of joint interest.</i>
	2.3 Stimulating Imagination & Creativity	<i>Opportunities for creativity and imaginative play that emerge uniquely within musical environments.</i>
3 Music in Everyday Life	3.1 Supporting Sensory Needs	<i>Reflections on how musical spaces act as organized and expressive sonic environments, where the audio-sensory experiences in everyday life are alleviated.</i>
	3.2 Promoting Communication & Learning	<i>Role of music as a communication aid, through which information and learning opportunities can be realised more easily, and with greater interaction.</i>
	3.3 Environmental Transitions	<i>Importance of music as a way to move between moments in the day, from moments of high to low energy, and as a way to establish routines</i>
	3.4 Emotional Regulation	<i>Role of music as a regulator, to alleviate distress and promote greater emotional stability, particularly at times of heightened anxiety and during meltdowns.</i>

Within musical play, parents emphasised the importance of musical spaces for creating opportunities for shared interaction as well as for participation in mutually enjoyable activities with their child. The thematic analysis revealed that these accounts were broadly focused on the role of music as a platform for interaction (Scaffolding Interactivity, sub-theme 2.1) ($n = 13$) and for the creation of musical dialogues (Joint attention, sub-theme 2.2) ($n = 9$) and as a medium through which more flexible and imaginative play was enacted (Simulating imagination & creativity, sub-

theme 2.3) ($n = 8$). Within these sub-themes, parents reflected on how musical play impacted on their child's wider development by providing a place in which social and communicative behaviours were enacted proactively and were often sought out by the children themselves. In these spaces, children were able to enjoy and initiate engagement and play in ways that were far less observed in their interactions in everyday life.

Within everyday life, among some ($n = 10$) of the accounts there was the recognition of musical spaces as being alleviatory, with the opportunities for control and expression from the instruments as an important sensory tool, particularly within the context of heightened aural sensitivities (Supporting Sensory Needs, sub-theme 3.1). Parents noted how music could capitalise on their children's musical interests in order to build understanding and teach new skills (Promoting communication and learning sub-theme, 3.2) ($n = 10$), and the ways in which music could ease everyday transitions and environmental stressors (Environmental transitions, sub-theme 3.3) ($n = 11$). The parents also noted how music became more specifically used to support behavioural and emotional control, in particular as an outlet for expression for the children, as well as a way to negotiate changes in mood and energy levels (Emotional regulation, sub-theme 3.4) ($n = 18$). These advantages were sought and recognised by the children as well as mediated by the parents, both to calm down and prepare for activities, and to provide a sense of release and build excitement. Reflected across the themes in the parental accounts was the flexibility of the approaches the families had adopted, with examples and anecdotes integrated from multiple contexts, from spontaneous moments of shared play to more structured occasions of learning and interaction.

6.2.1 Theme 1 - Dynamics of Musical Play

Table 24 Dynamics of Musical Play - sub-themes and exemplar quotations

Theme 1 – Dynamics of Musical Play	
2.1 Scaffolding Interactivity	‘It’s something that engages and connects, it connects both worlds - his world, your world and he gets that attention... by piercing through that, it has allowed him to be more sociable.’
2.2 Joint attention – Musical Dialogues	‘He’ll just copy what I’m doing with my fingers and say ... ‘Ready, steady, go faster, slower,’ that sort of thing...He interacts a lot better now, he has developed with his interaction, so he’ll come and ask you to play with him.’
2.3 Stimulating Imagination & Creativity	‘It stimulates his imagination as well like whatever he is thinking now, its complementing what he is doing on the keyboard, so that’s good in a way because he’s extremely imaginative’

i. Scaffolding Interactivity

As an interactive space, musical play was noted as particularly important for providing opportunities for interaction that would rarely occur elsewhere, by creating a platform where communication and interaction could be easily understood, reciprocated, and enjoyed. Within this sub-theme of music as a space for ‘Scaffolding Interactivity’ the interviews ($n = 13$) detailed the changing ways, modes, and benefits of musical play that the parents recounted with their children. A sense of seeking shared enjoyment was reflected by the parents, and how their children began to relish the opportunities to sing, dance and express themselves with others along to music, and experience musical spaces with others. Parents emphasised the importance of this for children’s well-being and the value in being able to communicate with those in their everyday environments. Musical spaces became a place in which their children sought out and took pleasure in sharing with others. Codes including togetherness, connection, proactive participation and embodiment emerged through the accounts as the parents reflected upon the desires that their children expressed to participate. As one noted:

So, he loves it, even in like assembly...he shows interest in the singing. He likes to be part of music, but he likes to do it in the way he loves, on his own terms... And even the school said, so once a week they have dance, and usually he didn't get involved. But the last weeks, he enjoyed it and he liked to be part of the group and dance. (Parent, Participant 5)

As this comment highlights, one of the important elements for the child is being 'part of the music' and participating in the collective experience of the group singing. As they reflect, this was a way that the child was able to participate on their 'own terms', taking pleasure in the shared interaction, but also in control of their own ability to integrate or remove himself. This emphasises the opportunities that music provides as a controlled environment in which to flexibly participate or observe, either by singing or listening along. The proactive engagement of the child with the musical space highlights how the child has become more empowered in their own musical experiences, seeking out release and enjoyment through dance, and also the sharing of that enjoyment with others in being part of the group. It indicates that there is an awareness of others, and the child has begun to take pleasure in experiencing musical spaces with his peers.

The importance of joint physical embodiment as a way to seek out and share experiences of musical play was also highlighted, in particular in relation to the role of dance. The children's engagement and delight in these experiences was often expressed in surprise, as often these opportunities were actively sought. As one parent reflected, 'We went out on Sunday to my friend's house, and he grabbed my friend, and he was dancing with her. The dancing he would do with music, just dancing with her,' (Parent, Participant 4). The initiative request that is described here as the child seeks to both participate and bring others into that participatory experience highlights the proactivity of the child bringing someone else into their play. It indicates their control within the space, but also the recognition of the enjoyment that can be gained from sharing that experience with others, in

contrast to the stereotypes of aloneness that are regularly associated with autistic play and interaction.

These opportunities for shared experience were also valued by parents as ways to share in these moments of play with their children. It was emphasised that shared musical play offered a medium in which parents and children were able to experience and interact together, as one noted ‘Without communication skills, and you really have to find other ways to connect with him. His instincts are always to play alone, so things like music where you can do it together is really great,’ (Parent, Participant 7). For this particular family, the communicative difficulties of everyday life presented barriers to experiencing these together, as the mother reflects ‘his instincts are always to play alone’. Musical play provided a way to bypass these instincts and create opportunities for connection and interaction that were pleasurable for both child and parent. Her emphasis on connection and togetherness highlights the importance of this element as a valued part of musical play and was something that was potentially missing in normative environments. As these shared musical spaces became enjoyable opportunities for communication for children and their partners, there was also noticeable changes in the modes of social interaction:

When he is singing, he will maintain eye contact and sometimes he will ask for it – if it is a funny, little silly song like ‘Johnny Johnny’, he will *ask* for it. He seems to enjoy it, he’s interacting, he’s properly interacting, he’s actually taking pleasure in the singing with other people. (Parent, Participant 17)

This account echoes the previous parents’ reflections that musical play was a space that can provide an opportunity for mutual pleasure. Their emphasis on ‘he’s interacting, he’s properly interacting’ indicating that this type of interaction and maintaining eye contact was both unique to these types

of engagement and highly significant for parent and child; as 'he's actually taking pleasure in singing with other people' confirms, this delight in the mutual, shared interaction was both rare and valued.

The importance of the mutuality of the shared enjoyment was a significant factor, with the capacity of music to create these shared spaces providing a meeting point of worlds where their child could interact more freely. This was a crucial opportunity for children to express and create social connections that were less accessible in normative spaces, as one parent articulated:

I think being autistic and non-verbal is lonely, and I think the music thing that we did gives him an audience gives him something to be seen...And that's the, you know, the shared sense...it's like you're piercing into his world and giving him that time, that's what he has enjoyed and had a real impact upon him in that way. It's not talking but you're giving him that interaction.... And I think what music does, it allows and makes people engage. If you can't speak...and he doesn't speak to you. But it's something that engages and connects, it connects both worlds—his world, your world and he gets that attention. I think he can be lonely, but I think this, and by piercing through, that has allowed him to be more sociable...More like, connected to people, so now I know I can play with him. (Parent, Participant 4)

As this parent reflected, the importance of musical play came from the capacity to scaffold spaces that mediated some of the barriers in everyday life as 'he doesn't speak to you'. As she notes, music was a place of engagement where her child was able to both receive and respond to that attention, allowing him to 'be more sociable'. Significantly, it provided the capacity for giving the child 'time' and 'attention', indicating that the avoidance of interaction in normative environments may not be entirely due to lack of interest, as the attention received within musical spaces was both a positive and 'had a real impact upon him', alleviating loneliness and promoting sociability. For this child, the

connection that was achieved within musical play provided a platform with which he was able to relish in that enjoyment, without the distractions and stressors of everyday environments.

Reflected throughout this sub-theme was the importance of the mutuality of musical spaces during musical play, which provided an environment that the children wanted to engage, seek out and take pleasure in. The abilities of the children to engage in this way, and both the parents' and children's enjoyment in doing so, highlights the capacity of musical play to provide clearly structured, explicitly understood spaces for interaction, an infrequent experience for the children. The associated socialities of musical play; the eye contact, connections and interactions that were reported with peers, friends and family, emphasises its scaffolding capacity to support interactivity and a space where social communication can be enacted. As the participant children were observed to actively seek out these play opportunities it further supports its role as a safe, enjoyable platform.

ii. Joint Attention – Musical Dialogues

As many of the parents recalled ($n = 9$), the shared spaces that were scaffolded during musical play provided the opportunity for more concrete forms of interaction, and for forming musical conversations and games. They noted the capacity of musical spaces to promote joint attention, during which the children sought out more concrete forms of joint play and turn-taking with their musical partners. For some, the importance of communication was highlighted in the capacity of musical material to structure socially interactive, communicative exchanges. For the children, songs were a device through which they were able to structure clearer forms of turn-taking and interact aurally and physically with their partners.

The instruments also provided a shared point of attention, which many began to realise over the course of the project was an enjoyable way to interact. As one parent described, music was a way in which her child was able to interact imitatively through joint play on the keyboard:

Like if you make the music go up, he raises his voice and when you go down, he goes down. And if he wants to be like, copy...well most of the time, he wants to be like in charge. So, he likes, he wants us to copy. (Parent, Participant 3)

This account reflects how the child enjoyed both responding and being in control of these vocal and instrumental exchanges, recognizing the musical relationships between their partners and responding accordingly. The desire to 'want us to copy' further illustrates the proactivity and interest on the part of the child in creating these musical exchanges, accepting the joint attention of the partner and engaging with its continuity. However, this acceptance of this joint attention was a new development, 'But he's got better, he's not pushing your hand away as much as he was, a couple of months and maybe he'll even let you play with him...he is sitting and playing and focusing for the whole hour,' (Parent, Participant 16). Here, the child's changes in play behaviours, allowing play partners for the first and for more prolonged periods of time shows a shift in the awareness and recognition of the possibilities of musical spaces. Going beyond a simple cause and effect or exploratory modes of play, the child is beginning to recognise and accept the presence of a partner within the space and the possibilities for interactive play that it can bring. As the same parent elaborated:

With the keyboard, he'll ask me to join in with him. So, what we do is he'll take my finger get me tried to get me to copy what he's doing. So, he's playing one note, I need to play the same notes. So, I ended up copying what he's doing...and then he'll just copy what I'm doing with my fingers and say 'Ready, steady, go, stop. Ready, steady, go faster, slower,' that sort

of thing. He interacts, he interacts a lot better now, he has developed with his interaction, so he'll come and ask you to play with him. (Parent, Participant 16).

As detailed, the initial exchange appears to be directed towards repetitive forms of play, directing behaviours with the focus primarily on the instruments. As the play develops, the instructions with 'Ready, Steady, Go,' and 'Faster, slower' indicate a shift towards a more responsive and mutually directed form of joint attention. As the account notes, these modes of play are now sought after 'he'll come and ask you to play with him', indicating that the child has begun to take pleasure in the joint occasions of play.

Parents noted how they had harnessed these opportunities for joint engagement to initiate further interactivity, and to create clearly structured dialogues. As their musical confidence grew, they were able to manipulate these exchanges in order to further bring about moments of joint attention. 'To make him to interact more, I will pause, to make him sing something, and it will be like 'oh its [Bertie's] turn', (Parent, Participant 17). As the parent demonstrates here, songs and play are a way of scaffolding these forms of turn-taking, with the expected musical material providing a script for the child to complete and therefore build an interactive dialogue with the partner. Others described how these often began as imitative exchanges that developed into turn taking:

Now he is making a lot more sounds, he does this 'qwah qwah qwah', so when we make the 'qwah qwah qwah' sounds back, he goes [opens eyes and mouth] and makes them back. It's like a conversation... it's very rare that if you do it first, he doesn't do it...now I might go 'qwah qwah', then he goes 'qwah'. (Parent, Participant 4)

As this details, the repetitive vocal patterns begin as imitation, but as the child develops in their interaction, it is able to develop from turn-taking and complete the phrase. The comment that it's

'like a conversation' is revealing, demonstrating the significance placed on these interactions by the parents with their minimally verbal child. It highlights how through even a simple pattern of three sounds was able to form a script through which interaction was enabled. Similar patterns were also reported within the context of more advanced forms of interplay 'He's got into Frank Sinatra. So yeah, he loves singing 'My Way' and 'That's Why' and he's been doing duets, which is quite nice... because he's been doing it with my husband, and they just take it in turns to sing a few words' (Parent, Participant 20). This demonstrates a development of joint attention, where the child is responding flexibly in order to maintain the musical narrative by continuing the song.

The importance of these shared musical dialogues was further observed as a way to create a more equal two-way conversation. As the parent elaborated, musical modes of turn-taking interaction represented an alternative from interactions in everyday life:

When I notice him singing with my husband, he's cooperating more in a way that we would like him to cooperate sometimes...all the time—sort of actually playing along with the rules a bit more than he would in normal life like playing a game and taking turns...It used to be that in hide and seek he always counted, and we had to hide – he didn't get that you had to take turns. Well, then he started taking turns recently, and actually I was watching him singing with my husband and actually, I was amazed that actually yeah, they took it in turns with a few rows each and he was going along with that. (Parent, Participant 20)

As the parent discusses, the modes of musical turn-taking represented a change that was subsequently reflected in the everyday behaviours. Within these musical spaces, the child is able to understand and therefore partake in structured interaction, using music as a scaffold through which attention could be shared and responded to.

The parent's reflection that capacities and behaviours within musical spaces surpass those in everyday life highlights the potential of musical spaces as emancipating, and as providing clearer rules and scripts for interaction and play. These musical scripts provided opportunities to scaffold further reciprocal interactions. In particular, what joint attention to musical play offered for communication:

I think because it's the way he uses to communicate with everyone. He doesn't know how to communicate with someone new in terms of coming and talking about something, he can't - he knows only single words. His communication usually is only like a one or two words... but music, he goes to my mum, and he starts to sing and he knows my mum will continue the music. He can play with my mum and with everyone else to, it's a way to communicate.

(Parent, Participant 15)

The joint attention described here within the context of song demonstrates the scaffolding of more advanced interactions, beyond those of the child's verbal capacities, relying on musical principles of turn-taking and reciprocity. The parent's reflection that 'he knows my mum will continue the music. He can play with my mum' indicates that the child used these musical interactions as a way to form connections. In the absence of the ability to communicate through other means, his knowledge of the musical structures and its clear reciprocal scripts created opportunities for shared attention, seeking out those musical conversations to play, share and build relationships. The shared attention that was reported within this subtheme, and the emphasis on imitation and question and answer that featured in the descriptions of play highlight the structural advantages of musical spaces. Underlying musical structures of repetition, imitation and question and answer that feature particularly prominently within the musical repertoires of young children created clear scaffolds and scripts which provided engaging and comforting opportunities for joint attention and play for this

group. As the parents reported, these songs and exchanges played a significant role in scaffolding communication by creating musical dialogues through play.

iii. Imaginative Play

The families ($n = 8$) observed how imaginative interactions during musical play also changed, with more advanced forms of creative and pretend play that were less evident in everyday life. Creative modes of play were most often prompted through exploration, while recollection and recreation of songs prompted imaginative dialogues and enabled a sense of release through their imagined musical worlds. The parents recounted how the keyboard became a particular object of fascination for their children. As one recalled, the focus and interest that the keyboard ignited further supported imaginative play:

The keyboard is so interesting to him, and sound obviously plays a big part.... he likes the investigation anyway, investigating how things work, so he could probably sit there for quite a long time and work it all out...It stimulates his imagination as well like whatever he is thinking now, it's complementing what he is doing on the keyboard, so that's good in a way because he's extremely imaginative, which I thought wasn't an autistic trait so much.

(Parent, Participant 14)

The captured interest of 'investigating how things work' described here indicates some of the intense interests featured that are common in autistic children, in this instance seeking to understand the systems and patterns of the keyboard. The link of this type of play to wider imagination is, however, different from the repetitive and restrictive types of behaviour and play that have most commonly been associated with these types of interest. Instead, the parent observes that this intense interest links to more creative forms of expression, where cognition is

'complemented' by playing and sound-making on the keyboard. The description here links with forms of expressive and creative scaffolding, as internal cognitive processes are acted out through the music. The importance of imaginative play for the child as reflected in this account, and the link to this as a non-autistic trait highlights the parent's perceptions of musical environments as a unique space for expression.

These more creative aspects of play were also seen as a progression beyond the more structured elements of the musical play detailed in the program. As children became more confident in their musical abilities, they were able to explore their creative capacities further. One parent described how her son had progressed beyond these prescriptive interactions and turn taking, 'And then he has been doing a bit of experimental thing but will recently just turn on to keyboard and deciding and making up his own tunes which he seemed to like and find quite funny.' The creativity here indicates a further progression in their modes of musical interaction. The capacity for pretend and creative musical interactions that stimulate joy in the child further demonstrate their growing empowerment and awareness of the possibilities of musical play. Parents commented that the musical spaces provided ways to use their imagination in more creative and interactive forms, 'I've seen him, he's using his imagination more. So, he goes to play, but you know, it's using he's using his imagination because he's speaking to himself, like babbling, and making different voices. And he's doing it a lot,' (Parent, Participant 4). Even at these most basic of musical expressions, the parent accounts demonstrate how musical play and sound was associated with more imaginative forms, suggesting pretend play with multiple characters. Further articulations of this were recounted by another parent, who reflected that these imaginative musical encounters played a significant role in the wellbeing of their child:

It's like companionship a little bit, like something else. A lot of time it is thinking that the songs that she's singing, because it's from the movies that she's seen, that she's back in

those things with those characters, so she does get a little bit lost in those things. But I think that's great in a way like imaginative wise. Besides the Frozen ones, there's also the Disney Princess movies, no, Disney Fairies. So, Tinkerbell and all the songs are actually really good. I've got a playlist on those. And she loves just kind of, she'll basically take over, the iPad has the playlist and just sing along with all the songs now. So, I think it's just a way to give herself some companionship. I mean I'm just guessing but I think that's why she enjoys it. (Parent, Participant 12).

Evident in this account is the contextual importance of the musical play. The child associates the music with the characters in the songs, and as she sings along, she is able to form a sense of shared play with the recording. While similar to the experiences of the children playing together, using her own imagination the child is able to situate themselves within that shared space, and form those imaginary dialogues between herself and the characters. This demonstrates that she is able to embody these musical exchanges and re-create the intersubjectivity of a shared musical experience through her own actions. These self-directed actions highlight the child's own recognition of these experiences, as the parent notes: 'it's just a way to give herself some companionship'. In contrast to the shared interactive behaviours in the two subthemes above, the role of imaginative play that was identified by the parents here highlights a more internal, self-reflective musical experience. The behaviours and interests that were shown by the children further emphasise their growing empowerment within musical environments, and their ability to connect musical contexts, memories and to 'get lost' in their own musical experiences and imaginative narratives.

6.2.2 Theme 2 - Music in Everyday Life

Table 25 Music in Everyday Life - subthemes and exemplar quotations

Theme 2 – Music in Everyday life	
3.1 Environmental Transitions	‘It’s part of our strategy now as well, in the morning for breakfast the music is there at the start. And then when he comes home from school, we’ve got these tunes that we play, which calm him down and show him that school is over and it’s into the evening routine’
3.2 Promoting Communication & Learning	‘If we want to go somewhere or do something, we will do it in a sing-song way, like just with a tune like ‘shall we have a bath’ or ‘shall we brush your teeth’ – the singing I do use that for him, because with certain things it makes it clear.’
3.3 Emotional Regulation	‘It helps him cope with life generally, music, you know, if he’s feeling down to listen to music...And it does help him...with his emotions’
3.4 Supporting Sensory Needs	‘He needs that. I don’t know if its sound or what the sensory need is, but he likes those cause-react situations. It’s like it’s the sound of it like smashing on the wall. Or the sound of the door slamming. So, the keyboard is quite good for that because you can lay it all out and get that response’

i. Supporting Sensory Needs

For some of the children with highest support needs, parental accounts ($n = 10$) also discussed how music and sound were able to provide sensorial release and fulfil some of the sensory needs of their children, many of whom frequently displayed adverse reactions to sound. Parents described both aural and physical needs that were fulfilled by musical spaces, including the vibration sensations of the environment and the control they were able to have over their aural stimulus. As some described, music was used as a way to complement wider sensory needs:

Because like in the garden, he wants that 'ring around the roses' like that....I mean that's... I hate to use the word rigid, but, you know, there's like, other songs we *can* sing, but he likes the spinning and the singing of that. (Parent, Participant 7)

The parent's description of the rigidity and spinning is a common behaviour seen in autistic children. The associated relevance of the song's actions of the spinning around in the 'ring of roses' indicates the child's recognition of context to support those behaviours. While the parent's uncertainty at supporting these behaviours is highlighted in their expression of concern about the rigidity of the interaction, there is a growing understanding of how to support those needs for self-regulation, with an example here of how these can be supported in constructive ways.

Other parents also stressed the role of physicality in the children's experiences of musical spaces, where music provided a release to their anxieties and physical stressors,

They've got the space where they just run and dance. They bring people in, drums and dancers. They did do a Zoom version you could put on, but it's not the same. He needs, you know, the sound and the vibrations. (Parent, Participant 4)

As emphasised here, describing the child's musical experiences at school, the sensory experiences of the vibrations and liveness of the music played an important role in the child's musical encounters. The importance of vibrations was reiterated by others, who regularly observed behaviours to seek out those sensations:

On the train...he likes the vibrations, and sometimes he sits on the washing machine to listen and feel the vibration, so there is something about sound. Sometimes he has something really loud against his ears, and he doesn't seem to feel any pain...he would have on the

highest volume, and it was just SO loud, but he wasn't at all bothered by the noise. (Parent, Participant 16)

What is described here is a link between the clear physical experiences that the vibrations of the train or washing machine produce and attempts to replicate that from the instruments and musical experiences. The child's act of putting the instruments against his ears indicates that the feelings of those vibrations were important, with the high volume amplifying those sensations. As one noted, 'The music is the only time he doesn't mind loud noises. He's normally quite sensitive, with music it's fine but any other noise outside of music he won't like it, he'll cover his eyes and his ears,' (Parent, Participant 6). The reason why music provided this sensorial release is unclear here, but it links to some of the speculation that the structure and predictability of musical environments means that loud noises can be more tolerated than within everyday settings.

This was further explicitly linked to sensory needs, with the importance of the children being able to express themselves through sounds, and the control of particularly loud sounds a common account among many of the parents:

He's got that thing like; I don't know if it's a noise thing. But like, he'll throw something, like he'll throw his ship downstairs or like, slam a door or like he needs that. I don't know if it's sound or what the sensory need is, but he likes those cause-react situations. It's like it's the sound of it like smashing on the wall. Or the sound of the door slamming. So, the keyboard is quite good for that because you can lay it all out and get that response. (Parent, Participant 14)

Another parent reported very similar behaviour: 'He likes smacking the windows, but I think he likes the sound, I don't know what it is about smacking the sound of the window that he seems to like.'

(Parent, Participant 9). These accounts provide further indications of the importance of control as a part of providing sensory release. As with the parent above who described the child turning up the volume on the keyboard, the acts recounted here, of producing loud sounds to express or release tension, were linked to the sensory experiences that they created, as well as to the possibilities for instruments to act as support for this. The keyboard, in particular, was noted as an outlet through which these sensory needs could be explored; as one considered: 'But the keyboard yeah... maybe is something to do with the pressing – he likes to press things that's a sensory thing that he does,' (Parent, Participant 22)

ii. Promoting Communication & Learning

A common thread throughout the interviews was the importance of music as a way to communicate, both for the parents to understand how their children were feeling, and as a medium through which speech and verbal development were scaffolded and supported. For those children with limited verbal capacities, parents ($n = 10$) reflected on the importance of music as a medium where communication was more interactive, of a higher quality, and more informative. For some, these included developing pseudo-musical languages, through which they were able to express themselves, as one parent described:

He sings throughout the day and has a different song for different emotions or actions. This indicates when he is feeling upset, happy or in discomfort. Each song signifies how he is feeling. For example, when he is unsure of something and feeling overwhelmed, he sings 'ii45' in tune and this means he needs a break or time out (his own song). He sings Humpty Dumpty when he is happy and even when he is using the toilet to relax himself... When he is sleepy, he will sing Twinkle, Twinkle little star...we never realised how much he uses music to communicate! (Parent, Participant 6)

The recognition by the parents of the possibilities and subtleties of musical communication that are described here highlights the changing importance of music in everyday life. In understanding the role of their children's musicality and everyday singing, commonly regarded as a type of stimming, rather than as a mode of clear expressive communication, the parents can respond more appropriately and engage in these musical dialogues. This adoption of musical motifs, both from common songs and from the child's own creations, also emphasises the variety of musical uses. The child's use of 'Humpty Dumpty' to relax, and the use of 'Twinkle, Twinkle' to soothe, highlights the self-regulation for physical and emotional means. As the parent describes, using a small motif of 'ii45' for when he needed a break further indicates its potential for communicating simply and clearly his acute needs and wants, through proactive expression when verbal communication is not possible or accessible.

The importance of musical communication to articulate the inarticulable was also echoed by parents who noted the importance of music to communicate in these times of crisis: 'When he wasn't speaking, music was quite a good way, especially to communicate emotions,' (Parent, Participant 13). Across the cohort, evident both in the parent accounts and in the children's responses, there was a recognition that music became a way to bypass the struggles and uncertainties so regularly associated with verbal communication, so that they were able to harness the emotional and semantic meanings woven through music as a form of interaction instead.

This ability to surpass verbal expression in order to both convey, and express critical information was described not only at these moments of emotional turmoil, but also for more mundane, everyday forms of interaction and learning. Parents expressed surprise at the comprehension that was associated with some of the routine-based songs that were a regular feature of her son's YouTube watching, 'He copies it, there was one song in the morning or something it was like a song to brush

your teeth and he was singing it as we were getting up on holiday, so you know, it's not like he is just blankly starting at it...there is definitely more going in,' (Parent, Participant 17). The recognition and association of the songs with relevant activities external to watching these online highlights the connection between the musical material and the activity related in the song within everyday life, as a way to embody and link with his own experiences. For many families, using these routine-based songs became a way to more easily scaffold and communicate these everyday tasks, as one reported:

If we want to go somewhere or do something, we will do it in a sing-song way, like just with a tune like 'shall we have a bath' or 'shall we brush your teeth' – the singing I do use that for him, because with certain things it makes it clear. (Parent, Participant 15)

Evident in this account are the benefits of music as support for comprehension, 'it makes things clear'. This description of the use of musical supports, scaffolding verbal development to aid comprehension, again makes use of these casual spontaneous musical material, in 'a sing-song way' rather than more structured compositions and is evidence of their wider and more flexible integration into daily life.

The importance of music as a platform to teach life skills was also reported those who explained that their processes for teaching life skills were heavily reliant on music as a way to structure understanding, 'everything that I teach him about the bathroom we did through music. Because we use music, it started to sink in,' (Parent, Participant 15). As this parent described, these strategies used a combination of pre-existing and ad hoc musical material in order to scaffold understanding, as greater comprehension of the task required can be gained from the recognition of the music alongside speech:

It was other things to, to teach him about brushing teeth, we made up and sang a song about brushing teeth. To wash the hands everything that he will learn or do, he knows about it through song. To teach him I sing to him, either something from what I have heard, or just made up like 'now you wash your hands, hands, hands' so he can be like 'aaah', and he likes that. (Parent, Participant 15)

As described here, the integration of musical strategies to encourage children's everyday behaviours had the benefits of creating enjoyment for the children, making it a game, but also of promoting understanding. As the parent elaborated, this process was two-way, and enabled the child to further communicate these needs in reciprocal ways: 'Sometimes he will come to us and sing the washing hands song, and then we know he wants to wash his hands. If his hands are very dirty, he will come and sing to me and I'll be like yeaah and continue the song with him and he loves it,' (Parent, Participant 15). The exchange reported here highlights the value of these musical dialogues for a minimally verbal child and his caregivers. The child's responses to the handwashing song first indicate his comprehension of its associated task, but as he begins to reciprocate the musical material and integrate it into his own behavioural requests to his caregivers, it adopts new meaning as being not just for task recognition but as a way to initiate those same tasks. The proactivity and interactivity that is described in the exchange also highlights the value of these approaches, as the mother continues the song, creating enjoyment in the shared interaction and scaffolding reciprocal communication.

The shared enjoyment through these musical interactions was used by others as a strategy to negotiate more challenging aspects of everyday life:

I was singing 'you can share, you can share' because it's the 'Sharing is caring' song. Because he has a lot of feeding disorders, I'm always trying to slow him down. He was trying to

request more oranges. And I was like, slowing him down that way by singing to him. And you know, this part of the songs, it's like for you and then that's when I did the handover. And he thought that was hilarious. (Parent, Participant 7)

As this account indicates, the use of specific musical exchanges to scaffold turn-taking and mould interactions to promote more positive behaviours was highly enjoyable for the child. The persistence of these songs to target particular behaviours for autistic children, and their continued use into older age groups where communication difficulties exist, suggest that they have a greater advantage that is potentially recognised. As the barriers to comprehension and behavioural compliance with everyday tasks is more challenging, making use of these strategies appears to be consistently successful even as the children get older. The regularity of using music as a way to communicate everyday tasks such as teeth brushing and handwashing, as reported by the parents, highlights the advantages of using music to create enjoyable interactions during these necessary occasions, to avoid trauma and negative behaviours, to promote understanding and to encourage communication.

iii. Environmental Transitions

For autistic children, processes of change can be stressful, particularly when sudden or disruptive to an established routine. For those with limited communication, parents' attempts to communicate these changes, and to regulate mood according to activities across the day, can be particularly challenging. As some ($n = 11$) reported, during the project music became a way of transitioning between these different routines and moods more easily;

He stimms less at school when they play music, so they have it on in the background, so it's become a big part of his life now, part of everyday life. It's part of our strategy now as well,

in the morning for breakfast the music is there at the start. And then when he comes home from school, we've got these tunes that we play, which calm him down and show him that school is over and it's into the evening routine, and he knows the difference between them.

(Parent, Participant 6)

This account highlights the use of music as a regulating tool; as a strategy to communicate the changes in mood and energy required for each period of the day, but also as an aid for the transition itself by calming the child down. The use of music to alleviate distress is further evidence of the scaffolding potential of these musical spaces. In the case of this particular child, whose stimming behaviours had physical harming effects, a reduction through the mood regulation described here indicates how some of the regulatory burden can be lifted from the child and scaffolded by the music to beneficial effect. The importance of music particularly as a way to negotiate mood and calm down was further emphasised by others, 'It will usually be in the evening, he'll have his headphones on and be on the swing as well, so he'll be swinging and listening... we also quite often have music when we are getting ready for bed as well...he seems to enjoy that,' (Parent, Participant 13). This highlights how the mood regulation provided by music was further incorporated alongside other means (such as swinging here) of supporting the children's own self-regulation, and thereby calming them down. The importance of these musical night-time routines was not isolated only to their autistic children:

But he likes it at night. We sing to them that we have a special goodnight song that we sing to the children before bed. And it's kind of like once they've heard that song that I think both of them calm down. You know, they kind of wait for that song. (Parent, Participant 7).

The mention of the sibling reflects on the use of music in everyday parenting strategies for all children as a way to adjust and transition to bedtime. With this child in particular, the expectation of

the music at night was the only time that he tolerated his mother singing along, with the description of waiting for it indicating his own awareness of its purpose as a mood regulator. Aside from transitioning to night-time routines, parents described more specific uses of music as a mood regulator to transition between activities. For one family, it formed a bridge between shared play time and individual playing time:

It's just like, if she's really frustrated, like I have to go cook dinner or something else, and I say let's put on some music...just the music itself. And it does tend to calm her down. And even if she's doing another activity, it's totally fine. So, whereas before, sometimes I'd really struggle to kind of let her be on her own, with like, an activity. (Parent, Participant 12)

This echoes the regulatory functions of music outlined by many of the accounts above, combined with strategies to negotiate transitions and changes in activities. As the parent describes, transferring from shared activities to individual play was often challenging for the child but the music enabled a way to soothe this distress and direct the child towards individual play. Distraction was also a feature for other families, particular during distressing or difficult scenarios:

For example, the other day we had to do a suppository for the constipation and the only way we could keep him down, and we had to keep him down for fifteen minutes, was for me to lie down with him and we sang together and that was the way we got through it. (Parent, Participant 6)

Encapsulated here is the importance of music to create a shared space of regulation and togetherness, through which music both acts as a distraction from the task at hand, and regulates the distress caused by the environment. While this is not an uncommon use of music in early years parenting, particularly within medical settings, the specific needs of autistic children who struggle

more with these types of procedure emphasises the role of music as a regulatory space. For most families, this most often took the form of behavioural and mood regulation, calming children down in order to transition to new activities, or to negotiate activities that were particularly distressing or challenging.

iv. Emotional Regulation

The themes highlighted above predominantly emphasise the uses of music for the parents to negotiate their children's behaviours and scaffold the demands and environmental necessities of everyday life. However, another dimension to these environmental uses of music that emerged through the interviews was the emphasis on music as a tool for emotional regulation. This included regulating behaviours at times of crisis and during meltdowns in order to soothe and calm children down. Many parents ($n = 18$) perceived it as an outlet through which their children were able to self-regulate, and which they could use as an emotional release. Parents reported how it was used as a way to bring energy levels up, as well as down:

There is upbeat stuff when he needs to do something and get ready, and then at the end of the day its calmer songs like Jose Gonzales' 'Heartbeats', because that calms him down. At school they have also started now using music to calm him and get him settled. (Parent, Participant 6)

The connection between home and school environments highlights the integration of these strategies within everyday life, and the importance of these for a wide range of caregivers to aid behavioural regulation. The use of music within particular activities further aided behaviours and focus in these environments: 'we listen quite a lot when we play board games, we listen to Bach... I just put on the greatest hits, YouTube thing or whatever and she just finds it very soothing' (Parent,

Participant 12). These uses were paralleled elsewhere, as parents observed that the features of the music itself provided comfort and regulation for their children; 'when the music is on, he really...when he is singing its always under his breath but it does, it really calms him, I think the numbers and letters songs he finds comforting' as others also reflected 'I think he finds it soothing. He likes drumbeats, anything with a tune, anything with a melody' (Parent, Participant 18). Other noted that their children began to recognise and seek out different music more,

He loves listening, he really does, we play music all the time. It calms him down really, if he's upset, slow music it really helps him calm down...He kept saying 'Hello' the other day and I was like 'Does he like Adele songs?' Because she has some really slow songs. And he put it on, and he was really calm, quiet and just listening. (Parent, Participant 22)

Common across the cohort was this impression of calm, and the opportunities of music as a way to centre the children's energy and mood. As is evident in the quotations above, there is a clear emphasis on the use of music as a tool for self-regulation. For some, these opportunities for reflective regulation develop these skills to utilise music for its emotional resonance was also reflected, with many viewing it as highly valuable for their children's future:

It could help him cope with life generally, music, you know, if he's feeling down to listen to music, or have some sort of passion, where he could have an outlet...And it does help him ...when his emotions...or if he's upset of it, or if I want him to wind down, singing does help him calm down. (Parent, Participant 16).

When we are doing the music, it was going very well...[and] I think it's so important because music can be so helpful with stress. (Parent, Participant 23).

The concerns that feed through these is the importance of their children being able to manage their emotions as they mature, with music identified as a safe space in which to do this. During the project, parents noted that their children began to explore these opportunities more. For some, this was a new discovery of how to both access and enjoy music on their own terms:

Funnily...he likes listening to music now. Especially so it will be the opera, he is not so much interested in anything else. But I keep the speaker in the kitchen, and he will just take and really go and get it into it – that's his chill out time. (Parent, Participant 17)

The increased interests were specific, here opera, which were independently sought out for quiet moments of regulation and relaxation. The opportunities that music provided for regulation were most often capitalised upon during explicit times of crisis, as one noted: 'But I can see quite a big difference in him...when he gets worked up or is having a meltdown, if I say now, it's music time, he will stop and calm down a lot. The music really helps make him calm,' (Parent, Participant 25). For others, the changes in mood were not just for modulating down and calming behaviours, but also as a way to amplify frustrations, which could be expressed through sound in order avoid a meltdown. These opportunities for release were rare, and parents reflected how musical spaces provided an outlet to avoid further spiralling distress. As one parent recounted:

He gets annoyed it's to the point where he can't say, so he will sort of do an action or make a sound... so it's like when words I guess just take too long. So generally, I think sometimes there's a bit of anger in the playing as well. He'll do it as a way when he is frustrated...But I think that's all for the good really, because it's expressing that. So, it's not always like 'nice, nice, lovely music' but it's also angry, and that's a good thing in itself. (Parent, Participant 13)

Reflected in this account are both the manifestations of the difficulties that so often create communicative barriers and behavioural difficulties for autistic children, and the avenues for alleviation that musical play provides. As the parent describes, these emotions build up to a point 'when words take too long' and reflects the parents' recognition of importance of the differing shades of musical expression. The anger and power that is captured in this account exemplify these differing opportunities for emotional regulation and it demonstrates how music can scaffold these frustrations within a conducive and responsive environment. Importantly, these higher energy uses of music were also reported to promote enjoyment and emotional release. As a parent described: 'he likes to run around and just get lost in it, it's like he has that need – it's like he is keeping himself happy.' (Parent, Participant 12). The need to get 'lost' in the music further exemplifies the importance of musical environments to scaffold those moments of enjoyment and release:

He's much calmer. And when he listens to music, he's actually enjoying it, although it might not be something that an outside person can recognise, you might think that it is a racket, but for him it is definitely doing something great, this is what he does when he is happy.
(Parent, Participant 6).

This quotation reiterates those of accounts above that emphasise the impact of music for regulating mood, while also highlighting the importance of musical spaces as opportunities for release, to express heightened and pent-up emotions. The importance of these opportunities for release were emphasised by many parents, as these musical outlets diverted from more destructive and distressing meltdowns that can manifest due to frustrated communication and emotional dysregulation. These opportunities for musical listening and participation were pervasive and accessible, with both parents and children independently able to utilise its capacity during moments of crisis and need.

6.3 Music in Everyday Life Scale

As part of the closing questionnaire taken at the final timepoint, parents completed the Music in Everyday Life Scale (MEL), (see Appendix 5) (Gottfried et al. 2018) designed specifically for families with autistic children to examine and detail the of the uses and perceived quality of musical play in everyday life. High levels of music use were reported with 96% ($n = 24$) using music (including songs, listening and watching music videos online, at least multiple days a week and nearly half (48%, $n = 12$,) using it every day. For those regularly using music (defined as using more than once a week), the majority (92%, $n = 23$) were using music for multiple contexts. The most prominent area of use was during play, with 84% of parents reporting using music to experience fun and share enjoyment regularly (defined as multiple times a week). 76% of parents reported regular use of music as a way to calm children down, alongside 68% of parents used music regularly for bedtime routines. As similar number (64%) of parents reported regularly used music to scaffold routine.

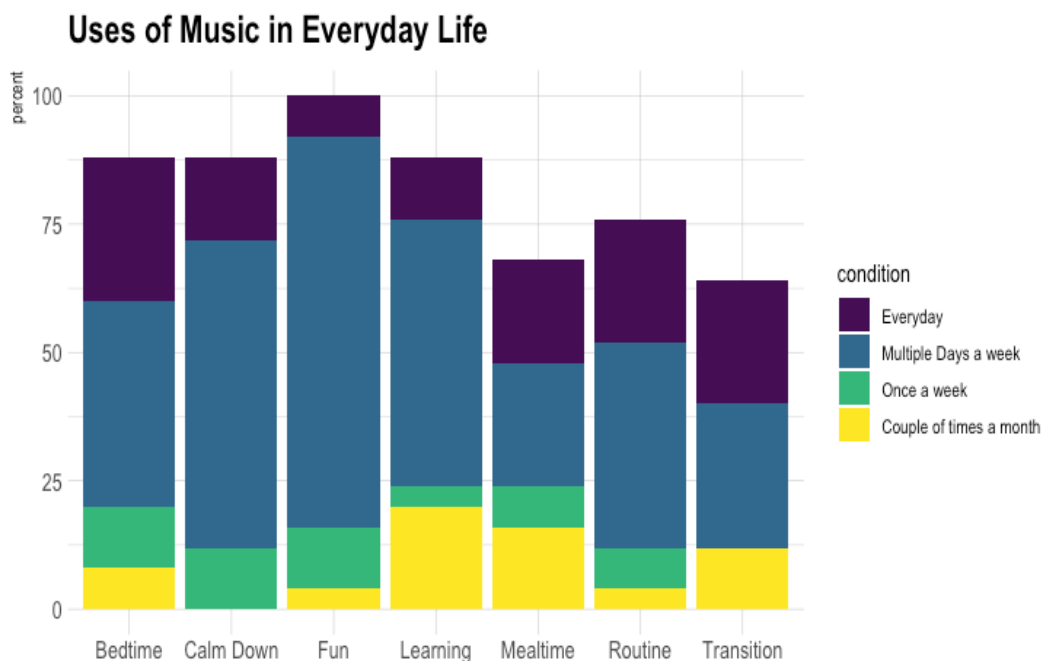


Figure 15 Uses of Music in Everyday Life

6.4 Quantitative Results - Musical Play

As the qualitative results highlight, the shared interaction and imaginative play that musical spaces scaffolded provided numerous opportunities for social interaction and joint play. While associations between musical play and wider social development were reflected in the qualitative data, quantitative data from observational play and behavioural checklists enabled these changes to be tracked more closely. From the observational coding three behavioural domains were used to track changes across various modes of musical play and interaction: 'Joint Play' (tracking joint attention behaviours), 'Responsiveness' (tracking behavioural requests) and 'Reciprocity' (tracking social interaction). This quantitative section focuses on how interactivity in musical play developed over the course of the project (RQ3.1) and how musical play may impact upon wider developmental goals (RQ3.3).

6.4.1 Changes between timepoints – Repeated Measures ANOVA

Initial changes in behaviours for each domain were assessed using repeated-measures ANOVA, using Time as independent variable and the behavioural domains, 'Joint Play', 'Responsiveness' and 'Reciprocity' as dependent variables. For every behaviour, at each of the four timepoints, behaviours were coded at 10 random minutes on a four-point Likert scale framework (outlined in Chapter III) with mean scores taken for each participant at each time point; baseline (.t0), timepoint 1 (.t1), timepoint 2 (.t2) and timepoint 3 (.t3). Analysis was conducted using RStudio, using the (RStatix) and (Psych) packages; due to the missingness of data at some of the time points, listwise deletion was automatically employed.

i. Responsiveness - Repeated Measures ANOVA

The domain of responsiveness measured how the child accepted, engaged with or rejected the partner's attempts to show or direct attention towards of musical instruments. It aligned with ESCS scales relating to behavioural requests. On a scale of 1-4, the behaviours were scored as follows.

- 1** No reaction to investigator or contact offer is specifically fended off.
- 2** Reactions with eye gaze only in combination with clear and directed musical gestures after repeated attempts (delayed).
- 3** Following of eye gaze and clear reaction to partner playing, particularly if aligned with child's interests/musical exploration.
- 4** Flexible reactions independent of the situational context.

A repeated measures ANOVA found that the Responsiveness scores were statistically significantly different at the four different time points during the project, $F(3,45) = 10.96$ $p < 0.001$. Post hoc comparisons using Bonferroni corrections indicated that the mean score between the Baseline score ($M = 2.52$, $SD = 0.61$) and Timepoint 2 ($M = 2.99$, $SD = 0.527$), Baseline and Timepoint 3 ($M = 3.10$, $SD = 0.488$), Timepoint 1 ($M = 2.71$, $SD = 0.697$) and Timepoint 3 were significant (see Table 26), demonstrating a large effect, $\eta^2 [g] = 0.19$.

Repeated Measures ANOVA for Responsiveness during Musical Play

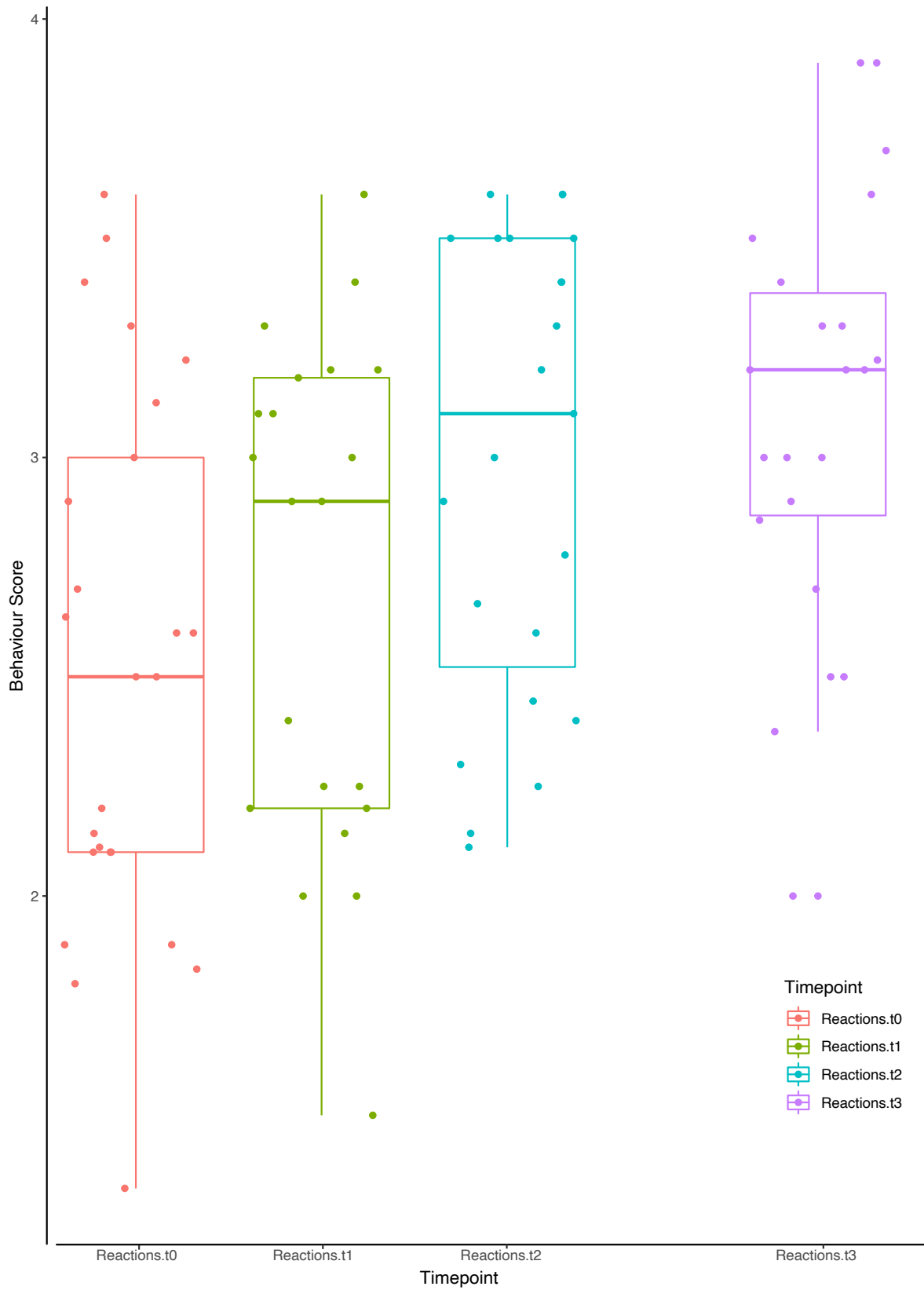
Anova, $F(3,45) = 10.96$, $p = <0.0001$ $\eta_g^2 = 0.19$ 

Figure 16 Boxplot of Reactions scores by visit

Table 26 Responsiveness Pairwise Comparisons

Responsiveness Pairwise comparisons					
Group 1	Group 2	n	F	df	<i>p</i>
Responsiveness Baseline	Responsiveness Time 1	25	2.18	20	n.s
Responsiveness Baseline	Responsiveness Time 2	25	3.95	22	**
Responsiveness Baseline	Responsiveness Time 3	25	5.84	21	***
Responsiveness Time 1	Responsiveness Time 3	25	1.32	18	n.s
Responsiveness time 1	Responsiveness time 3	25	3.54	17	*
Responsiveness time 2	Responsiveness time 3	25	-1.92	19	n.s

n.s. not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

ii. Joint Musical Play - Repeated Measures ANOVA

The domain of Joint Play measured how the child recognised and responded to positive affect and joint exploration during musical play. It aligned with the ESCS categories 'Responding' and 'Joint Attention' and captured musical behaviours that had an emphasis on sharing experiences. On a scale of 1-4, the behaviours were scored as follows.

- 1** No emotional involvement or engagement in joint musical play.
- 2** Short/fleeting acceptance of synchronised moments or joint musical play with positive affect demonstrated.
- 3** Extended joint musical play is tolerated and occasionally sought after. Expressions of joy are frequent and synchronised with partner.
- 4** Musical play is both initiated and flexibly responsive. Joy is spontaneously shared during joint play.

A repeated measures ANOVA found that the Joint Play scores were statistically significantly different at the four different time points during the project, $F(3,45) = 28.65$, $p < 0.001$, demonstrating a large effect, $\eta^2 [g] = 0.35$. Post hoc comparisons using Bonferroni corrections indicated that the mean

score between the Baseline score ($M = 2.01$ $SD = 0.575$), Timepoint 1 ($M = 2.32$, $SD = 0.584$), Timepoint 2 ($M = 2.86$ $SD = 0.615$), and Timepoint 3 ($M = 2.85$, $SD = 0.619$) were significant apart from differences between Timepoint 2 and Timepoint 3, and Timepoint 1 and Timepoint 2 (see Table 27). This highlights the increasing changes in Joint Play abilities over the course of the project, with the most significant differences seen between the scores at the start and the end, whilst changes in between each of the visits were less consistently significant.

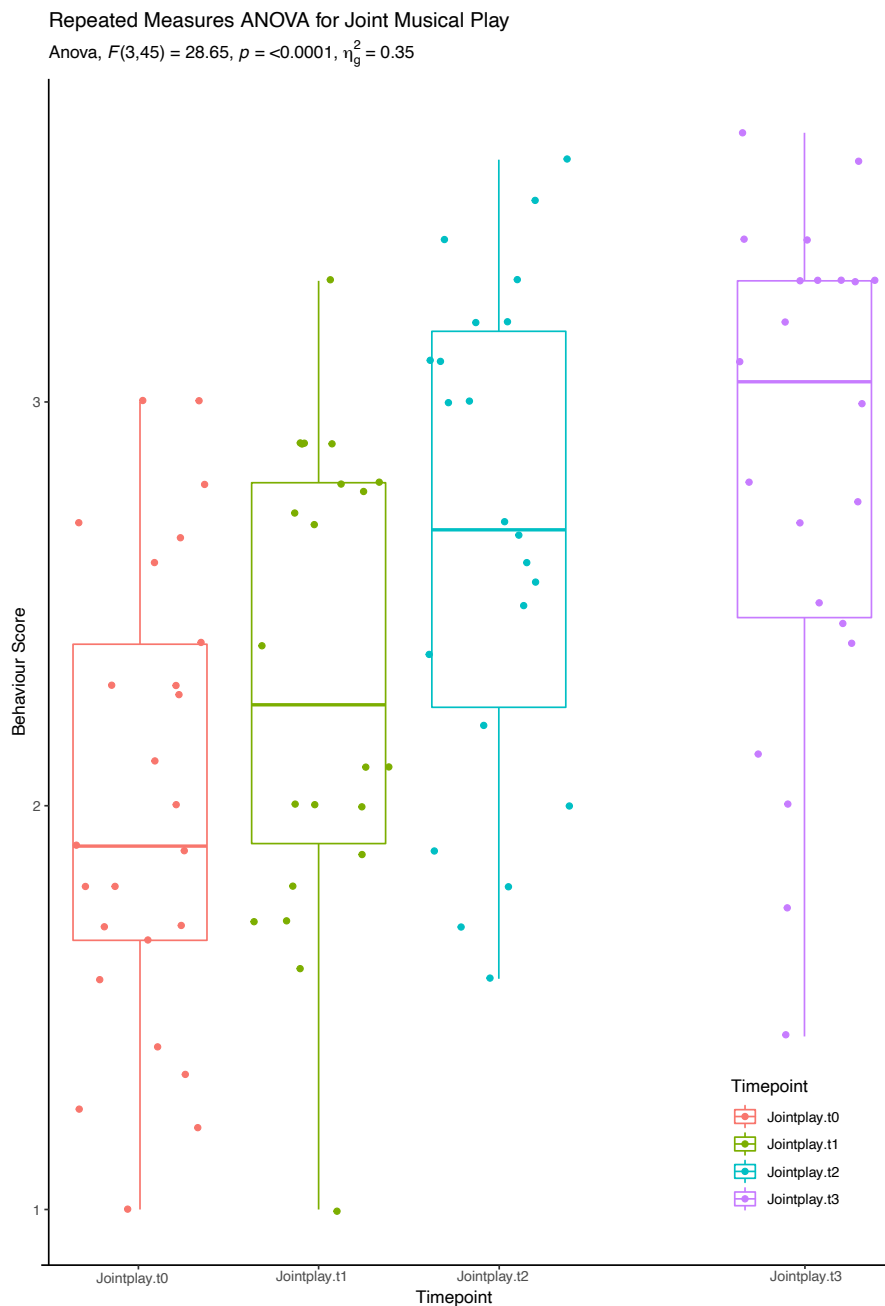


Figure 17 Boxplot of Joint Play Scores by Timepoint

Table 27 Joint Musical Play Pairwise Comparisons

Joint Musical Play Pairwise comparisons					
Group 1	Group 2	n	T	df	<i>p</i>
Joint Play Baseline	Joint Play Time 1	25	2.98	21	*
Joint play Baseline	Joint Play Time 2	25	6.59	21	***
Joint play Baseline	Joint Play Time 3	25	6.36	21	***
Joint Play Time 1	Joint Play Time 2	25	2.79	18	n.s
Joint Play Time 1	Joint Play Time 3	25	6.81	18	***
Joint Play Time 2	Joint Play Time 3	25	2.08	18	n.s

n.s. not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

iii. Musical Reciprocity – Repeated Measures ANOVA

The domain of musical reciprocity measured how the child responded musically and flexibly to partners attempts to share melodies, affect and interests during musical play. It included adoption of synchronous play, shared affect and turn taking. This category targeted the more explicit elements of initiating ‘social interaction’, as detailed in the ESCS. On a scale of 1-4, the behaviours were scored as follows.

- 1** Instruments are not used at all or absence of joint play. No reactions to clear motifs, breaks and verbal encouragement for interplay.
- 2** Turn Taking requires verbal/gestural prompting. No adequate response to musical motifs. Resistance to synchronization.
- 3** Reciprocal play develops through musical prompting (motifs and breaks), but the reaction tends to be imitative.
- 4** The interplay flows naturally and leads to a common shape.

A repeated measures ANOVA found that Reciprocity scores were statistically significantly different at the four different time points during the project, $F(3,45) = 21.51$ $p < 0.0001$, demonstrating a large effect, $\eta^2 [g] = 0.26$. Post hoc comparisons using Bonferroni corrections indicated that the mean score between three points: Baseline score ($M = 1.9$ $SD = 0.647$) and Timepoint 1 ($M = 2.13$, $SD = 0.696$), Timepoint 2 ($M = 2.49$ $SD = 0.707$) and Timepoint 3 ($M = 2.80$, $SD = 0.697$) were significant

apart from differences between Baseline and Timepoint 1, and Timepoint 1 and Timepoint 2 (see Table 28).

Repeated Measures ANOVA for Reciprocity

Anova, $F(3,45) = 21.51$, $p = <0.0001$, $\eta_p^2 = 0.26$

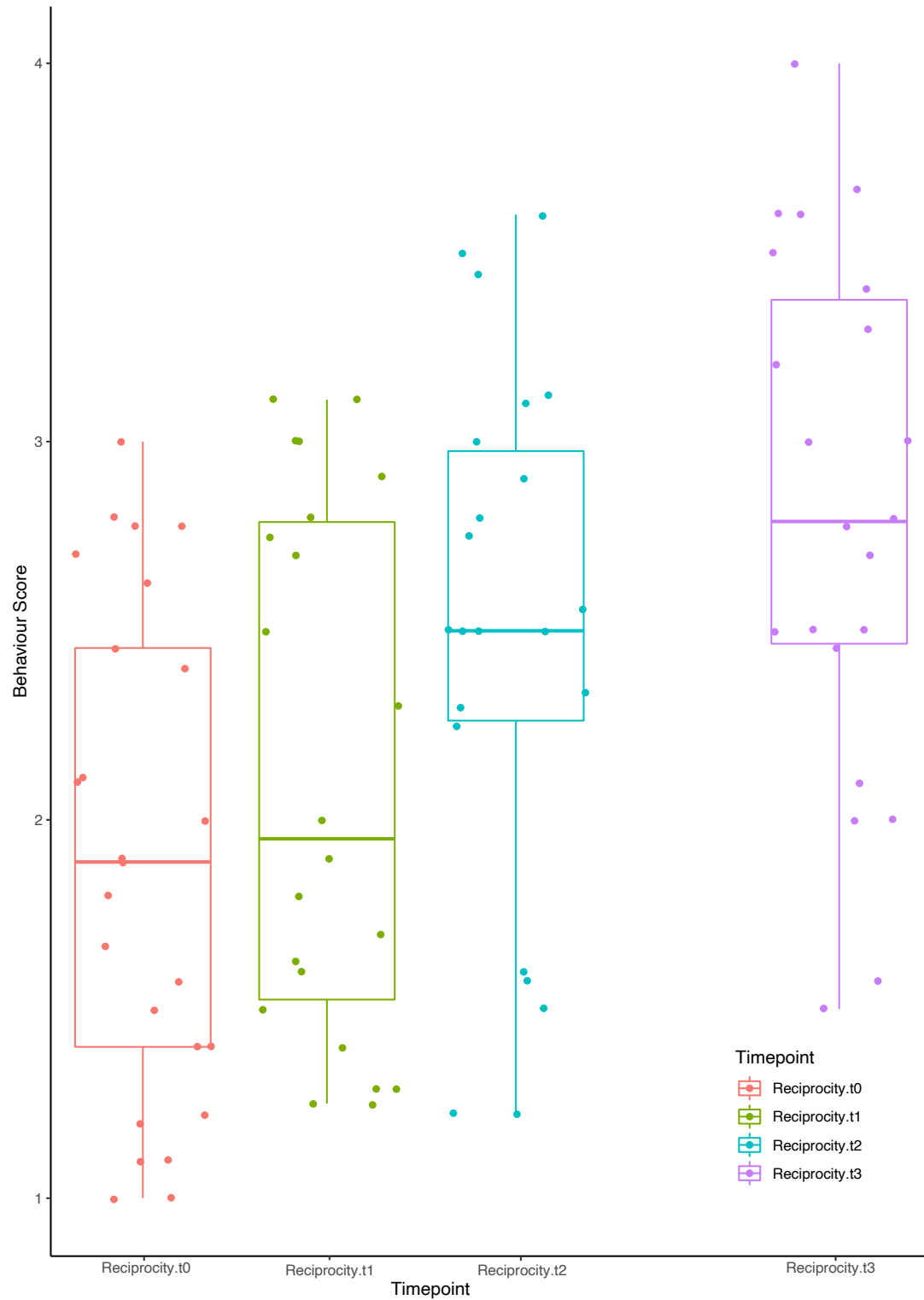


Figure 18 Boxplot of Reciprocity scores by Timepoint

Table 28 Reciprocity Pairwise Comparisons

Reciprocity Pairwise comparisons					
Group 1	Group 2	n	T	df	p
Reciprocity Baseline	Reciprocity Time 1	25	2.72	21	n.s
Reciprocity Baseline	Reciprocity Time 2	25	5.76	21	***
Reciprocity Baseline	Reciprocity Time 3	25	6.43	21	***
Reciprocity Time 1	Reciprocity Time 3	25	2.59	18	n.s
Reciprocity Time 1	Reciprocity Time 3	25	5.43	18	***
Reciprocity Time 2	Reciprocity Time 3	25	3.03	18	n.s

n.s.- not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Upon visual inspection of the data, and confirmed by the repeated measures ANOVA, the results in each musical play domain indicate increasing patterns of growth over time, with significantly different scores between the first and the final time points. The large effect scores for Responsiveness ($\eta^2 [g] = 0.19$), Joint Play ($\eta^2 [g] = 0.35$) and Reciprocity ($\eta^2 [g] = 0.26$) further support the strength of the changes that were found in musical play between the visits, highlighting clear development in each domain. The increase in scores suggests that participants were able to interact at higher levels more consistently for each of the four categories during the observations of musical play; however, the lack of consistently significant post-hoc tests between every timepoint further indicate that these changes form more dynamic patterns of growth.

6.4.2 Change over time – Latent Growth Models

The results from the repeated-measures ANOVA indicated that across the musical play domains, scores increased over time. However, these models provide a limited picture of the patterns of change across the course of the project. Firstly, due to the missingness of data at random visits, listwise deletion was employed, excluding some participants from analysis. Secondly, while this method of analysis can indicate differences in change, it reveals less about rates of growth, and intraindividual patterns of growth within the participant cohort. Therefore, to explore patterns of

growth within these domains more comprehensively and informed by the hypothesis established by the ANOVA results that scores increase over time, latent growth models were run for each domain. The same procedures were used in exploring latent growth trajectories as those detailed in Chapter 5. Longitudinal changes in musical ability were analysed in R using the lavaan package (Rosseel, 2012). At the outset, a univariate LGM of musical development was built to capture changes in each of the single domains over time.

i. Responsiveness - LGM

Table 29 Univariate LGM Responsiveness

Responsiveness – Model 3				
Fit: $\chi^2(2) = 1.71$, $p = .452$; RMSEA < .001 [$<.001 - .391$]; CFI = 1.00; SRMR = .027				
path	estimate	SE	z	p
intercept mean	2.527	0.116	21.819	***
intercept variance	0.257	0.098	2.631	**
Slope mean	1.073	0.317	3.382	***
Slope variance	0.257	1.237	0.037	n.s
Quadratic slope mean	-0.528	0.274	-1.885	n.s

n.s. - not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

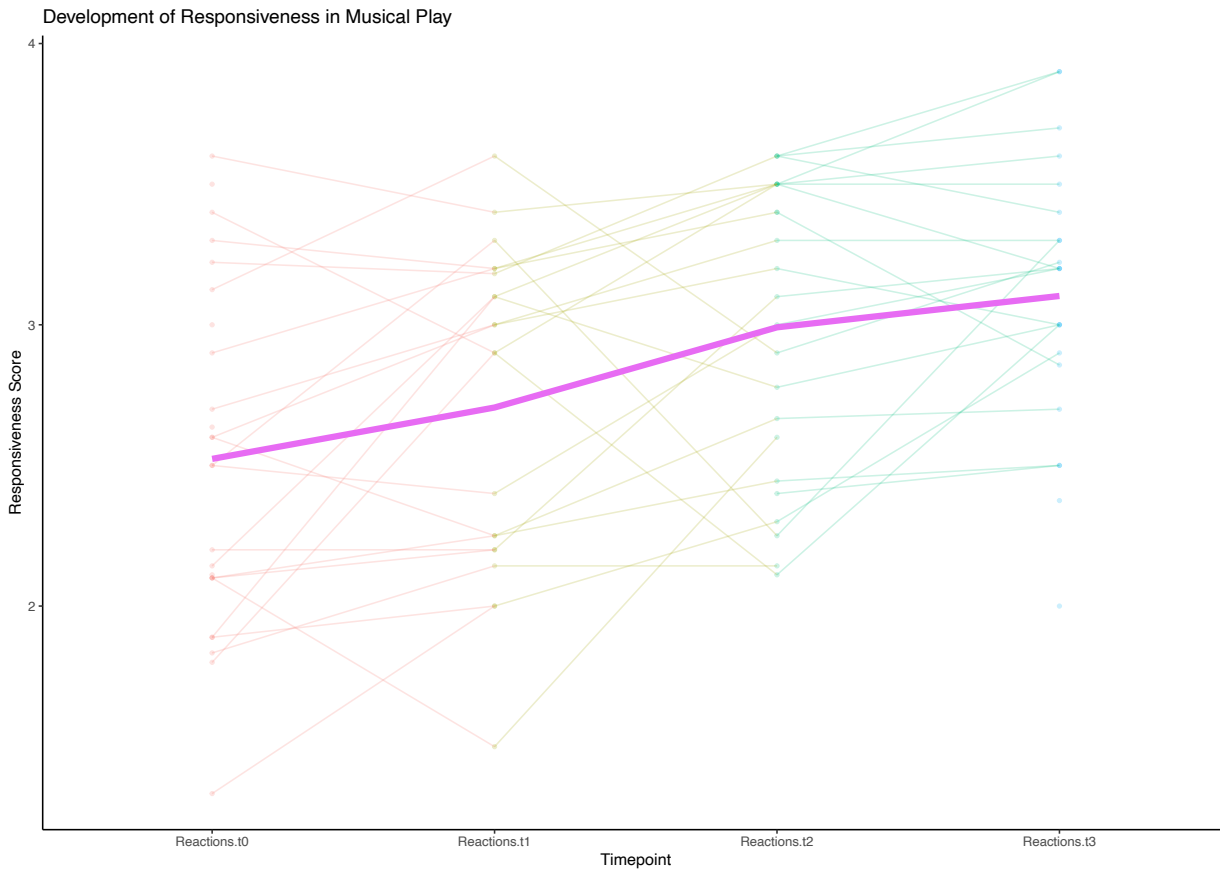


Figure 19 Spaghetti plots of participants scores over time as well as mean trajectories for Responsiveness scores

The Responsiveness LGM showed good fit for a quadratic model, using linear growth factors (with fixed loadings of 0,0.2, 0.5 and 1) and quadratic growth factors of (0, 0.04, 0.25, 1), with the positive linear slope factor indicating that there was significant growth over time. The negative quadratic slope factor suggests that this growth slowed towards the end of the project. While the quadratic slope factor is only approaching significance for this category, the goodness of fit of the quadratic model in comparison to a linear fit model indicates that the quadratic growth trajectory was positive for some participants and negative for others. The significant intercept variance suggests that there was high variation in scores at the beginning of the project, with the non-significant slope variance indicating that patterns of growth remain similar across the course of the project for all the participants.

ii. Joint Musical Play

Table 30 Univariate LGM for Joint Musical Play

Joint Musical Play – Model 4				
Fit: $\chi^2(3) = 1.964$, $p = .580$; RMSEA < .001 [$<.001 - .293$]; CFI = 1.00; SRMR = .09				
path	estimate	SE	z	p
intercept mean	2.023	0.104	19.372	***
intercept variance	0.088	0.069	1.277	n.s
Slope mean ¹²	0.314	0.058	5.405	***
Quadratic slope mean	-0.033	0.011	-3.068	**

n.s. - not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Using linear growth factors (with fixed loadings of 0, 0.2, 0.5 and 1) and quadratic growth factors of (0, 0.04, 0.25, 1) the Joint Play LGM showed good fit for a quadratic model, with the model indicating that there was significant quadratic growth over time for the cohort. The positive linear slope factor, and negative quadratic slope factor suggests that this growth slowed towards the end of the project, a factor supported by the non-significant score in the Bonferroni pairwise tests between the two final observations (.t2 and .t3). The non-significant intercept variance suggests that there was no significant variation in scores at the beginning of the project, and the non-significant slope variance indicating that patterns of growth remain similar across the course of the project for each of the participants.

¹² Due to negative variance errors, slope variance fixed to 0, joint.play.t2 variance fixed to zero

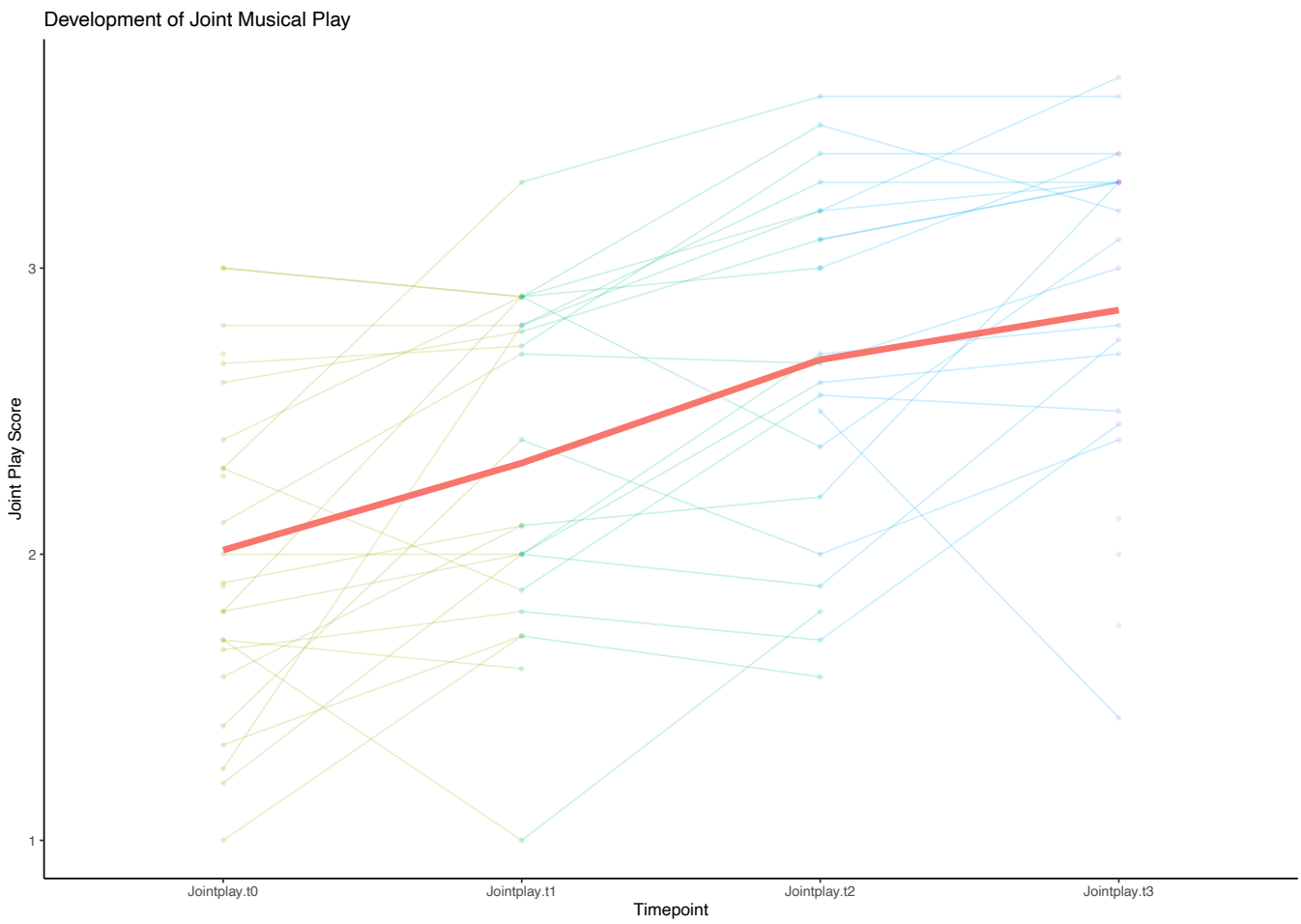


Figure 20 Spaghetti plots of participants scores over time as well as mean trajectories for Joint Play scores

iii. Musical Reciprocity

Table 31 Univariate LGM for Reciprocity

Reciprocity – Model 3				
Fit: $\chi^2(2) = 1.624$, $p = .444$; RMSEA < .001 [$<.001 - .366$]; CFI = 1.00; SRMR = .027				
path	estimate	SE	z	p
intercept mean	1.915	0.123	15.556	***
intercept variance	0.289	0.089	3.232	***
slope mean	1.177	1.581	3.853	***
slope variance	0.303	1.581	0.192	n.s.
Quadratic slope mean ¹³	-0.335	0.320	-1.046	n.s.

n.s. - not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

To correct a negative variance, the variance was fixed at zero for the quadratic slope. This subsequently showed good fit, with significant linear growth over time. The significant variance in the intercept scores indicate that participants began with high variation between Reciprocity scores. However, the non-significant slope variance suggests that despite different starting intercepts, participants grew at roughly the same rate over the course of the project.

The results of the latent growth models confirm the patterns of increasing growth that were observed in the preliminary ANOVA, and further indicate how this growth changes over time. As is common with developmental patterns of growth, the negative quadratic slope means that were observed indicate flattening patterns of growth towards the end of the project as the participants approach the higher end of the developmental scoring system.

¹³ Quadratic variance fixed at zero.

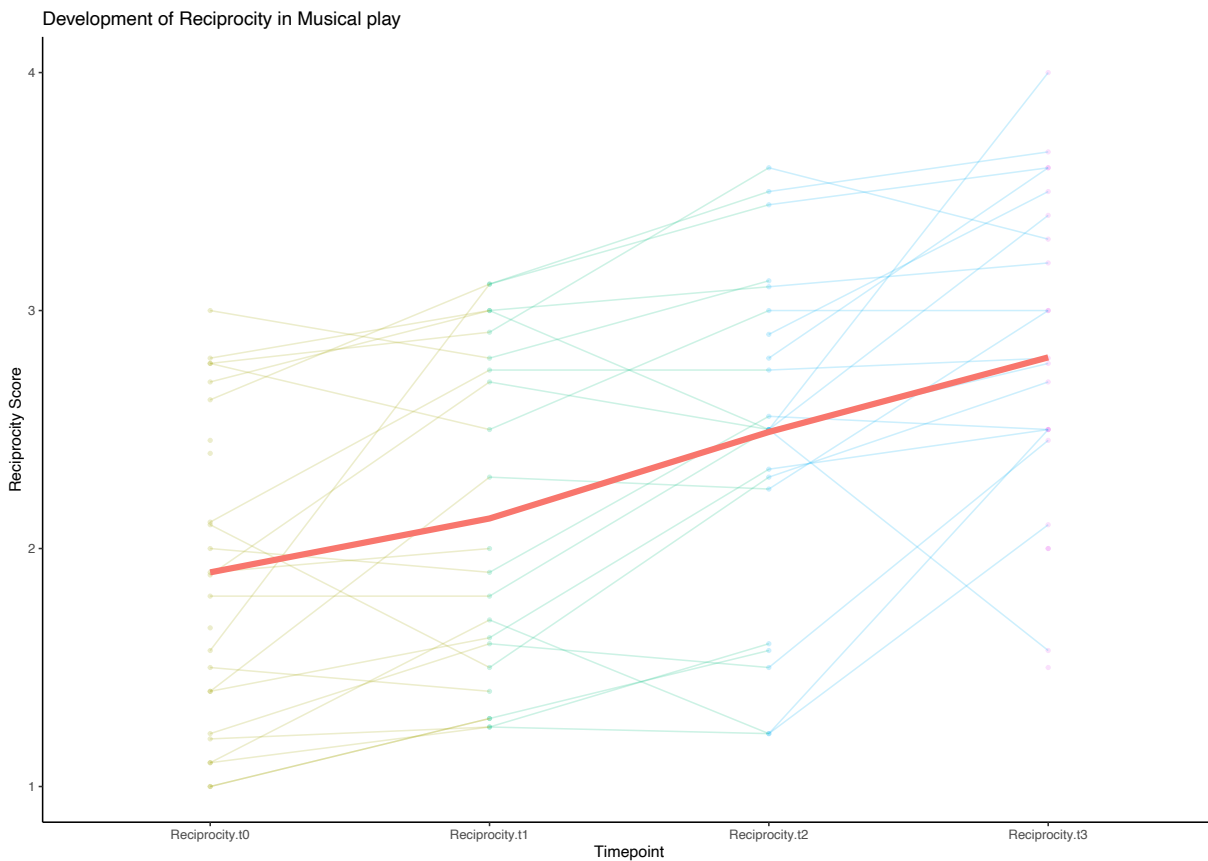


Figure 21 Spaghetti plots of participants scores over time as well as mean trajectories for Reciprocity scores

The significant variance at the intercept for both reciprocity and joint play highlights the variation in scores for the participants at the beginning of the project, indicating that the participants began the project with highly varying interactive abilities within musical play. However, the non-significant slope variances indicate that despite these initial differences, all participants were able to develop at similar rates, suggesting that starting ability did not impact upon growth trajectory. The positive growth rates for every domain trajectory highlight the possibilities for interactive development for autistic children within musical mediums, yet visual inspection of the data indicates there may be further intra-individual variation between these patterns.

6.4.3 Quantitative results – Social Development

Alongside changes in musical play, changes in wider social development were also tracked at the beginning and end of the project, using psychometrically established behavioural checklists completed by the parents. Paired t-tests were conducted to detect changes in the pre and post behavioural measures, of which two were taken; the Social Responsiveness Scale (SRS) (Constantinou & Gruber, 2012) and the Autism Behaviour Inventory (ABI) (Bangerter et al., 2020). Both scales have detailed subscale for social communication and associated behaviours. Within the SRS, a raw score encompassing all elements is calculated, with separate sub-scales within for Cognition, Social Communication, Restrictive and Repetitive behaviours and Motor skills. For the ABI, a Core Score is calculated that includes Social Communication subscale and Restrictive and Repetitive Behaviours subscale, with separate scores calculated for Mood and Anxiety, Self-Regulation and Challenging Behaviours.

Table 32 Pre (T0) and Post (T3) Behavioural Change

Paired T-Tests for Social Communication Measures				
Behavioural Checklist Sub-scales	T	df	p	Effect size (Cohen's d)
Social Responsiveness Scale (SRS) – Raw Score	5.76	24	***	1.15
Social Communication Subscale (SRS)	6.36	24	***	1.27
Social Communication (ABI)	4.07	24	***	.813
Autism Behaviour Inventory (ABI)Core Score	4.16	24	***	.831
Mood and Anxiety (ABI)	0.171	24	n.s	n/a
Self-Regulation (ABI)	4.08	24	***	.816
Challenging Behaviours (ABI) ¹⁴	170		**	0.46

*n.s.- not significant, * p<0.05, ** p<0.01, ***p<0.001*

¹⁴ due to significant Shapiro-Wilk scores indicating non-normal distribution, a paired, Wilcoxon-rank test was conducted for this variable.

Paired-samples t-test showed significant differences for a number of different subscales. There was a significant difference between the overall raw scores for the Social Responsiveness Scale at the start of the project (M=114.0, SD=23.9) and those at the end (M=89.4, SD=30.9); $t(24)5.76$, $p < .001$, with a large effect size (1.15). Looking at the more sensitive social communication subscale, there were also significant differences between the start of the project (M= 91.4, SD= 19.9) and the end (M=71, SD=24.4; $t(24)6.36$, $p < .001$ with a large effect size (1.27). These findings were paralleled in the Autism Behaviour Inventory, with significant differences between the first (M=1.64, SD=0.41) and final core scores (M = 1.36, SD = 0.47); $t(24)4.16$, $p < .001$ with a large effect size (0.831) and further replicated in the social communication subscale scores at the first (M=1.63, SD = 0.53) and final scores (M = 1.29, SD = 0.57); $t(24)4.16$, $p < .001$ with a large effect size (0.831). The replication of these results across both measures indicates that there was an improvement in social communication for the participant cohort over the course of the project.

The psychometric validity of the SRS is particularly significant here as it is known stability over time, indicating that the change in these behaviours was not simply due to natural development and maturational patterns. Less clear changes were seen across wider behaviours. For the additional ABI subscales, no significant changes were observed in the scores for Mood and Anxiety between the first (M = 1.24, SD = 0.428) and final (M = 1.22, SD = 0.576) scores; $t(24)0.171$, $p = 0.866$. In the Self-Regulation subscale significant differences were observed between the first (M= 2.03, SD= 0.511) and final (M = 1.72, SD= 0.46) scores; $t(24) 4.08$, $p < .001$ with a large effect size. For challenging behaviours, a Wilcoxon-rank test found significant changes between the first (M = 1.43, SD = 0.71) and final (M = 1.21, SD = 0.733) scores; $t(24) 170$, $p = 0.02$, with a medium effect size (0.46) The changes across these related domains highlight the wider changes in the behavioural profiles of the children during the course of the project. The smaller effect sizes observed in Challenging Behaviours, and the non-significant changes between Mood and Anxiety scores suggest that the behavioural changes were more acute in social and cognitive domains such as self-regulation and

social communication. Wider contextual factors including the repeated lockdowns and school closures during the COVID-19 pandemic could further inform the interpretation of the differences between those domains.

6.4.4 Interactions over time – Multivariate LGMs

While the results above in the musical play and social communication domains clearly indicate change over time, they are observational and in isolation cannot be causally linked to musical play. To further inspect how these two factors (changes in musical play and changes in social communication) may be related, Latent Growth Models with the covariate of social communication change (as measured by the change in Social Communication (SC) Subscale of the ABI) were ran.

Table 33 Multivariate LGM Joint Play and Social Communication

Joint Play & Social Communication – Model 4				
Fit: $\chi^2(3) = 2.223$, $p = .527$; RMSEA < .001 [$<.001 - .306$]; CFI = 1.00; SRMR = .07				
path	estimate	SE	z	p
intercept mean	2.685	0.220	12.19	***
			1	
Social Communication (SC) baseline	-0.361	0.130	-2.769	**
SC Change	-0.202	0.249	-0.809	n.s.
Slope mean	0.710	0.142	4.994	***
SC baseline	-0.208	0.089	-2.338	**
SC Change	-0.191	0.110	-1.732	*
Quadratic slope mean	-0.090	0.027	-3.349	***
SC Baseline	0.026	0.018	1.455	n.s.
SC Change	0.057	0.021	2.656	***

*n.s. not significant, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

This model highlights the changing patterns of growth, which appeared to be linked to communicative capacities at the start and changing communicative capacities across the project. As found in the Sol-EY scores, the higher the baseline social communication score (associated with

more profound impairment), the lower the starting score. However, the starting intercept of joint play scores was not associated with the amount of social communication change seen during the project. Different trajectories of joint play development were seen for those with less profound social communication difficulties, who showed steeper linear growth. However, those with flatter linear progression but a steeper quadratic curve showed greater quadratic change in joint attention over the course of the project.

Table 34 Multivariate LGM Musical Reciprocity and Social Communication

Musical Reciprocity & Social Communication – Model 5				
Fit: $\chi^2(9) = 9.523$, $p = .390$ RMSEA < .005 [$<.000 - .241$]; CFI = .993; SRMR = .08				
path	estimate	SE	z	p
intercept mean	3.025	0.260	11.652	***
intercept variance	0.227	0.058	3.889	***
SC Baseline	-0.625	0.170	-3.667	***
SC Change	-0.282	0.306	-3.667	***
Slope mean	1.492	0.430	3.470	***
SC Baseline	-0.291	0.205	-1.424	n.s.
SC Change	0.584	0.244	2.398	**
Quadratic slope mean	-0.364	0.300	-1.212	n.s.

As the original univariate model for musical reciprocity had a non-significant quadratic mean, regressions were only run on the intercept and linear slope factors. This model highlights a similar pattern to the joint play results, where the higher initial musical reciprocity scores at the intercept were associated with less impaired social communication. However, the model indicates that those that showed steeper increases in musical reciprocity also showed great social communication change.

6.5 Chapter Summary

This chapter presented qualitative and quantitative results relating to musical play, music in everyday life and its impact upon wider development. Overall, both the qualitative and quantitative results highlighted the changing dynamics of musical play over the course of the four visits during the project. What was reflected in the qualitative accounts was the importance of these playful musical spaces for enacting social behaviours, supporting emotional regulation, and promoting interactivity. Significant for the families were the opportunities for play that these outlets provided, many of whom rarely experienced these types of shared engagement with their children in everyday life. As the parents described, the behaviours that were enacted within these environments were highly interactive, demonstrating competencies such as eye contact, turn-taking and cooperation. These observations were also seen in the quantitative results, with positive changes in interactivity during musical play evident between the visits and over time. The improvements in multiple developmental outcomes, as measured by the behavioural checklists, including social communication and self-regulation, further indicate that there was long term change in children's behavioural profiles. Taken together, the improvements in social communication and musical play over the course of the project suggest a link between the development of interactivity in musical play and changes in wider communication. The relationship between these factors as observed in the covariate latent growth models accentuate this, as those who saw greater social communication change also saw greater musical interactivity changes. The patterns of growth observed in the multivariate models indicate that while these patterns may not be entirely linear, as the joint play scores indicate, the musical reciprocity model demonstrates there is a clear relationship between developments in musical and wider social communication. While establishing causality is challenging, these results highlight the potential role of musical play as a way to support interactive development for this group.

Interpreted alongside the families' experiences, the change in behaviours underline the role of musical play as a platform for the enactment of interactive behaviours within a structure that is of mutual interest and accessibility to both parent and child. These patterns were seen more widely in everyday life, as parents capitalised on heightened engagement with music to structure their child's environments. This was most common as a way to support mood regulation, but also to create teachable moments and help bridge understanding. As many of the families experienced, music was critical in times of crisis and meltdown, where it provided both a distraction and a scaffold for regulation. The sense of calm that music provided was a strong theme across many accounts, with the children's own recognition of these regulating properties evident as they sought out particular songs and albums. The enjoyment that was reflected across the qualitative accounts was also an important factor in the success of these musical strategies, with the children's engagement motivated by seeking pleasure in the shared musical play. In its uses in everyday life as well as the more specific behavioural potentials, the capacity of musical play to provide an enjoyable space in which to express, communicate and be understood was at the heart of these experiences. As perceived by the parents, music provided a platform where avenues for communication and understanding could be realised, and therefore supported.

7 Discussion

7.1 Chapter Outline

This project sought to explore the role of music for autistic children and their families, understand how musical competencies develop in this group, and interrogate the dynamics of musical play. It focused on both how musical skills and creativity develop, in what ways musical spaces may scaffold communication and interaction, and whether musical play can promote wider behaviour development and understanding between families, asking three overarching research questions:

- 1) How do the musical abilities and engagement of young children on the autism spectrum develop over time?
- 2) What is the role of music in the daily lives of autistic children and their families?
- 3) How can musical play promote the development of social competencies and impact wider developmental outcomes of young children with autism?

Across four home visits, interviews, observational and behavioural measures were used to track twenty-five children's changing musical behaviours, the experiences of their families in integrating musical play into daily life, and the impact of these musical play strategies on wider behavioural changes. The results concerning the three research questions will be discussed below, alongside their wider implications for work in the field.

7.2 Musical Development

The first research questions addressed the changing musical competencies of the participants:

- 1) How do the musical abilities and engagement of young children on the autism spectrum develop over time?

1.1 What changes in musical skills and engagement were observed over the project?

1.2 How do autistic children's musical development align with current music-developmental models?

1.3 What are the patterns of growth for autistic children's musical development?

The results from the observational measures using the Sounds of Intent in Early years scores show clear improvement in the participant cohort's musical competencies over time, as observed at the four home visits. This was further evident in the parental accounts, which highlighted the patterns of change that occurred, moving from unstructured vocal expressions and instrumental exploration to more concrete pattern making and imitation, then developing further to identifiable musical segments and whole songs. The descriptions from the parents had close alignment with the Sounds of Intent in Early years framework indicating that musical development in autistic children show similar patterns of gain in competence. However, the trajectories of this growth between individuals and over time are more complex. As Voyajolu (2021) observed, patterns of children's musical development following the Sol-EY framework followed non-linear patterns of growth, which was similarly observed in the snapshots of musical development that were assessed in this project. While these trajectories are similar in their non-linearity (as Voyajolu observed in neurotypical models of musical development using Sol-EY) the indication for this population is that these trajectories and milestones may not be *as* explicitly tied to age. Instead, the Sol-EY measures at the outset of the project indicate that individual factors including communication barriers and behavioural difficulties may play a larger role in realising those initial stages of musical development. Despite these differences at the outset, the fact that all children were able to demonstrate musical growth is an important finding. It supports the evidence of Ockelford (2013), Welch et al. (2009) and Heaton (2009) that has indicated that the affinity and ability for musical processing may be present across the spectrum of diversity.

Indeed, the results highlight the potential to achieve musical competencies may be universally present across autistic children. The patterns of development and competency gain that were described in the parent interviews further support this, as the children's growth from controlling sound to imitation then imagination and creative contribution also follow Swanwick & Tilman's (1986) account of musical development. However, it questions the assumptions that musical development is necessarily tied to age (Young, 2008b). Across the family accounts, it was further evident that the 'potpourri' of songs (Moog, 1968) emerges early in the musical-developmental journal and become a core part of autistic children's communication and play. Indeed, it is worth considering the role of the earlier vocalisations, and the 'variegated babbling [of] short well-structured melodies in which familiar musical elements are creatively combined into new patterns with distinct rhythm and accent' (Papoušek, 1996, p. 106) that has been observed in young children. We see these similar emerging patterns in autistic children, but sometimes later.

The cohort that was studied here, autistic children with high support needs, limited language and profound social difficulties, provides a unique insight into the barriers and patterns for development for this particular population, as their behavioural heterogeneity means that they are often excluded from research. As the results from this project suggest, musical development may be possible for all individuals, yet for those autistic children who are more profoundly affected by communication and behavioural difficulties, there may be complex barriers that impact upon their initial capacity to achieving and accessing their musical potential. As the differences in initial musical ability were predicted by both social difficulties and pre-existing, independent musical expressions, this suggests that a combination of both limited individual exploration and insufficient supports for accessing musical stimulus in their wider environments had an impact. While the role of context upon a child's musical development has been well-documented (Barrett et al., 2012; Voyajolu, 2021), the factors interacting for this particular group appeared to be more related to children's individual independent abilities and propensities, rather than the amount of music in the home. For example,

for those with the most sensitive sensory and behavioural needs, realising their musical potential requires more patience, prolonged exposure, and supporting the child's own musical interests. It has previously been observed that music and language are linked in preschool children (Politimou et al., 2019), which may explain some of the delay; however, it was also apparent that children's musical abilities were not fully realised. As evident in the parent accounts, many assumptions concerning children's musical abilities and potential were made due to their apparent lack of engagement within musical spaces. The supports provided over the course of the project prompted changes in the parents' awareness of what their children were capable of musically, and the different modes of engagement that could be utilized to further support this play. For example, the parents began to recognize their children's expressions and reproduction of musical material in alternative spaces, singing to themselves quietly in the car or before bed. This demonstrated that capacities for musical awareness and aural learning are there, but expressions of this knowledge were frequently enacted on the child's own terms, away from overwhelming group environments and explicitly structured learning settings.

While initial home music-making did not appear to have an impact upon a child's musical ability, the parents played a key role in nurturing their children's musical engagement. Over the course of the project, there was development in the parent's understanding and recognition of the importance of music in the lives of their children. This supports Voyajolu's (2021) observations that contextual factors such as parental involvement *can* contribute to improved musical outcomes, and while fidelity was high across all families, the parents' qualitative responses highlighted their own growing awareness and musical confidence. The greater understanding of strategies to nurture musical development, and their own flexibility in using the resources over the course of the project, mirrored their own children's developmental progress. The results highlight the importance of, as Barrett et al. (2012) term it, the 'spheres of influence' within a child's developmental trajectory, and the importance of parents within this. Active adult-child interactions and the repetition of activities

to support their children's musical interests was particularly important for supporting creative development, and for capitalising on moments of cooperation and interest in order to further nurture their development. The findings also further support the role of parents as 'partners in play' for development and interaction (Young, 2008b; Koutsoupidou, 2020), and the important of playful musical interactions between peers and adults as a way to create conversations that are free from external rules (Kasari et al., 2006).

The importance of these home settings mirrors similar findings that children's independent musical play is more advanced in home rather than educational settings (Trehub & Gudmundsdottir, 2019; Cirelli & Trehub, 2019; Voyajolu, 2021). It was clear from the baseline musical measures that independent musical play was also an indicator of higher musical ability, suggesting individual musical empowerment was an important factor in promoting development. The emergence of this can be further seen in the observations by the parents, who noted the growing musical awareness of their children as the program progressed. This suggests that supporting individual musical development is just as important as providing resources for the parents to scaffold development together with their child. As Barrett (2009) has highlighted, individual music-making plays an important role in children's self-making, and as observed here, may be a significant driver in musical development. The availability and access to the instruments was often noted as an important factor, as the children began to seek them out for exploration independently. This was combined with the wide uses of technology, which with the instruments created limitless opportunities for children to discover and learn. As parents recalled, the ability to request songs on smart speakers or seek out songs on tablets was an avenue of distinct enjoyment for the children and is emblematic of their growing control over their own musical regulation and development. This adds further evidence to Krause et al.'s (2015) observation that the accessibility and ease of musical variety are ever growing, and these findings suggests it is also replicated in childhood music-making. For some, the growth in awareness of these resources and the easy access to musical instruments sparked opportunities to

build upon their own specialized interests. The opportunity to pursue these avenues can have wider implications within a neurodiversity framework. As Grove et al., (2018) have emphasised, supporting the specialised interests of autistic children can be an important factor in building resilience and wellbeing, and in helping parents and caregivers create supportive environments for development. The breadth of resources available on the internet to aid instrumental learning through YouTube videos using coloured patterns or numbers, and the availability of these through smart devices, further nurtured the children's learning styles and interests and was also able to be carried out on the children's own terms and following their own musical interests.

Alongside the musical skill changes observed across the programme, changes in the socio-emotional and creative aspects of musical interaction were also observed in the children, particularly the musical playfulness that the children exhibited. As Wu (2018) noted, expressivity and socio-emotional aspects within musical play are not always reflected in the Sounds of Intent framework; however, imagination and creativity as an additional domain in the observational framework was able to capture these changes. The similar patterns of growth observed in imagination and creativity indicate that these develop in conjunction with musical skill as observed by the Sol-EY. This adds a further dimension to the nature of the development of musical behaviours; they are not isolated to skill gains, but also have wider socio-emotional components. This resonates with many of the observations that the spaces for musical play can help nurture interpersonal communication, and create mutual meaning-making opportunities (Barrett et al., 2012; Ockelford, 2013). While the importance of musical spaces for the development of creativity in young children is widely recognized, this project is one of the first attempts to look in greater detail at musical imagination and creativity in autistic children. The observed changes and integration of creative elements within musical play further question the diagnostic assumptions of autistic children's imaginative capacities as limited or restricted (e.g., APA, 2013). It echoes further the approaches within early intervention research that emphasise the importance of supportive and safe environments in which autistic

children can flourish, and clearly identifies musical spaces as a possible medium for this (Fletcher-Watson, 2018).

Overall, the growth and development in musical interaction, regardless of cognitive and linguistic abilities in the cohort, further supports the observations of Ockelford (2008), Thompson (2012a, 2012b) and Heaton (2003) that musical environments can offer unique platforms for perception and interaction. Even for those children who had the highest support needs, the greater musical awareness and development of skills observed highlights the capacity for musical competencies in this group when appropriate adaptations and strategies are provided. The alignment with the Sol-EY strengthens both the initial observations of Welch et al. (2009) that all children, regardless of cognitive ability, have the capacity for auditory processing and musical engagement, and further indicates that for autistic children, these may be closer to neurotypical models than previously assumed.

7.3 Music in Everyday Life

As has been emphasised across models of musical development and therapeutic music programmes, the role of the contextual environments is an important factor in understanding the place of music in children's lives. Due to the specific supports that autistic children frequently require to navigate their daily environments, one of the research questions sought to understand the wider uses of music, and how these can be better supported within everyday life. Therefore, the second research question addressed:

2) What is the role of music in the daily lives of autistic children and their families?

2.1 For what purposes is music incorporated into everyday routines?

2.2 What is the impact of everyday music-making for supporting family and individual wellbeing?

2.3 How well can naturalistic programs be incorporated into everyday routines?

The families reported a high degree of adaptability in using music in everyday life for a wide range of behavioural, communicative and regulatory goals. The results further Rushton and Kossyvakis's (2021) findings that music has a wide range of uses in everyday life for children with disabilities and emphasise the mix between musical play and musical listening woven through these uses. In response to the resources, the parents were clearly able to use these everyday strategies to greater effect. As they became more confident in using the instruments, they also became more adept at orientating and creating opportunities to use music as part of transitions and routines. Similarly, as the children began to become more responsive to musical engagement, the parents became aware of the creative and communicative capacities of music for both playful and logistical means. What was evident in the current cohort was that the uses of music in everyday life echo those widely used in early childhood, including at mealtimes, to strengthen bonds and to regulate mood (Barrett, 2009; Williams et al., 2015). In the cohort here, to meet their child's needs these uses often persisted into later childhood, as routines developed for earlier learning such as language, feeding or toilet training became engrained as a mode of communication. These uses can be seen in parallel with wider research on music for children with other disabilities, particularly the uses around daily routines (Kern, Wakeford & Aldridge, 2007; Osei, 2009) and for wellbeing (McFerran & Shoemark, 2013; Stensaeth, 2013). The results also support the findings of smaller studies including Stephen's (2008), Kern, Wolery and Aldridge (2007) and Kern and Aldridge's (2006) work, highlighting that embedded musical programs within external environments can have a wider replicability.

The importance of creating musical environments to scaffold communication was evident across the accounts, with many noting the importance of music as a way to develop everyday opportunities for interaction and understanding. This provides a more tangible example of how environmental adaptations, as discussed in naturalistic early interventions models by Zwigenbaum et al. (2015), can be implemented. As neurodiversity frameworks have emphasised, early years research with autistic

children requires understanding of accommodations and supports that can be made within a child's environment to support their own develop and more importantly, to reduce the trauma and barriers commonly experienced in negotiating a neurotypical world (Leadbitter et al., 2021). The musical strategies provided here offer an example of how music-based research can create environmental supports within a neurodiversity framework, encouraging the child's musical interests and interactions on their own terms.

Many of the parents were also highly adept at creating and utilising these musical scaffolds and were able to go beyond the strategies detailed in the resources to respond to their child's interests and needs. The technological literacy of many of the children meant that these interests were often clearly identified through YouTube, and parents were able to effectively respond to specific songs and genres picked out by their children and to engage with these interests on the child's own terms. The importance of responding to clear musical preferences has also been observed elsewhere, particularly in the case of autistic children's learning (Grove et al., 2018), and more widely in the importance of choice and agency during children's musical play to encourage engagement (Koops, 2012). The ability of the parents to respond to these interests and adapt musical strategies within the context of everyday life provides ecological evidence on a larger scale for the many single case and small-scale studies that have detailed the applications of music in supporting autistic children (Osei, 2009). Unique to this study is the relative independence of the parents in implementing the programme, which further provides evidence that with appropriate training and support, the researcher's time in these studies can be reduced.

It was notable from the results that parents reported listening to music and also the active music-making that their children engaged with. Building on both Voyajolu (2021) and Rushton and Kosyvaki's (2021) findings that aural engagement is higher than active music making within the home, the parents' responses here indicate that, given the right support, proactive music-making

can also be supported. In the current project, the resources and instruments played a key role in facilitating these active moments of play. The use of the resources as a way to create more active music-making and implement these strategies into everyday life also proved effective in capitalising on parental knowledge to further empower them in their musical interactions.

The emphasis on imitation and shared sound making in the early level of the cards was reciprocated in the playfulness that was reported by parents. Many noted that the presence and importance of prompts from the cards provided them with ideas to carry on and develop throughout the day. The effectiveness of the parents' input can further be observed from the fact that the outcomes share many of the same features of family centred music therapy. This includes the importance of musical play for bonding, greater language and communication, and improved daily life skills (Hernandez-Ruiz, 2020). The experiences of the families and the findings draw together interconnecting strands of evidence that have been previously observed across research areas in this field. Firstly, it indicates that the benefits that have been observed in therapeutic contexts such as Thompson (2012a, 2019) and Yang (2018), who have emphasised the importance of music in building mutually understood, enjoyable spaces to promote bonding, can be replicated outside of a therapy room. As the parents recounted, these musical moments were valued in their shared play, creating moments of high quality and enjoyable attention. These opportunities for emotional attunement and intersubjectivity as described by the parents further highlight how neurotypical observations of shared intentions, intersubjectivity and emotions that are enacted within musical spaces (Molnar-Szakacs et al., 2012; Rabinowitch et al., 2012) are equally applicable to the shared play within autistic families. The results demonstrate the implications of musical scaffolding within every day, naturalistic contexts, where musical spaces can provide a platform upon which meaning making can be enacted.

7.4 Musical Play

To further contextualise the role of musical play in everyday life, this project also investigated the dynamics of the interactions during musical play and the specific behaviours that were being developed. Investigating these changes in detail further enabled greater scrutiny of the mechanisms through which interactive behaviours may be developing, and the enactment of these behaviours within musical settings. The third research question explored:

- 3) How can musical play promote the development of social competencies and impact wider developmental outcomes of young children with autism?

3.1 What is role of musical play in scaffolding social interaction for autistic children?

3.2 How does interactivity in musical play develop for autistic children?

3.3 Can musical play impact upon wider developmental goals for autistic children?

As observed over the course of the four visits, there was clear development in the interactive domains of musical play, including across responsive, joint attention and reciprocal behaviours. The development of these areas despite pre-existing communication difficulties underscores the amelioration provided by musical environments for development, and further supports the conception of an interactive musical scaffold. As was seen in the observational data and further described in the accounts of the parents, musical spaces provided a platform upon which socially interactive behaviours were displayed. These were often sought out by the children, with synchronisation, eye contact and turn-taking requested, as well as being highly responsive during musical interplays. The importance of the playfulness of these spaces was also reflected upon by the parents, who noted their children's growing confidence in playing imaginatively and subsequently integrating others into their play. From both the observational data and the parents' accounts, the results indicated that musical spaces provide avenues for autistic children to interact on their own terms through material and scripts that are familiar and mutually understood. This further created

opportunities to model and nurture positive and flexible play, in a safe environment between peers, siblings and family members.

Through the analysis of the families' experiences during the project, it became clear that the role of music in everyday life was heavily intertwined with a sense of play and enjoyment, and it was through these playful mediums that music in everyday life was more widely integrated for developmental and wellbeing goals. The importance of nurturing musical play within the families was a core part of the project design, underpinned by the principles that playful interaction can support learning and promote development. Within the context of a musical space, the clearly structured dialogues, and explicit opportunities to enact social behaviours including imitation, turn-taking and behavioural synchrony, provide opportunities to scaffold these behaviours. Exploring both new and pre-existing ways that families utilise music as a strategy for everyday functioning and behavioural interaction can also offer insights in how to design naturalistic programmes more appropriate for this population that can be more effectively implemented. The findings also align with the widely understood uses of music in parenting practices, from the early uses of music in learning (Barrett, 2011) to the role of parents as partners in musical play to scaffold learning and development (Young, 2005; Koutsoupidou, 2020). It also further replicates evidence that has highlighted the role of music for families of children with disabilities, including as a way build relationships and for mood regulation (Murphy & McFerran, 2017; Chou et al., 2019; Rushton & Kossyvaki, 2021), as well as a way to create valued opportunities for play (Corke, 2011; Rushton & Kossyvaki, 2020).

The consistency of behaviours between musical and social play were clear. The improvements observed in this area highlight how interactivity can develop within musical play, with the similarity in behaviours indicating its relationship to wider social interaction. The coding framework that was developed to identify these behaviours, and its alignment with established frameworks associated

with social communication, provide further insight into the modes of interactivity within musical environments. A notable factor in this system was, unlike typical observation frameworks for autistic children (including ADOS) it used a strength-based measurement system. This allowed positive change to be reflected over time, rather than just perceived reductions in deficits, and further highlighted the role of musical play as an alleviatory space. The interactive behaviours reflected across the observations of musical play provided further evidence on a larger scale of the social dynamics of these environments, while also linking them to musical actions including singing together, improvisation and creativity. In particular, the identification of the presence and subsequent improvement of music-social behaviours provides greater depth to the numerous studies that have highlighted the prosocial and intersubjective capacities of musical spaces. This includes studies exploring music's impact on interpersonal bonding with neurotypical children (Kirschner & Tomasello, 2010; Rabinowitch et al., 2012), which has primarily used pre and post measures to investigate music's impact. The results in this study provide preliminary evidence for *some* of the mechanisms by which these prosocial behaviours may be strengthened, with musical spaces platforming interactive behaviours to a greater degree and with more clarity and structure. These insights also support the findings of research that has focused specifically on the improvement of social communication in autistic children after a specified program of joint musical play, including Kim et al. (2008) and Sharda et al. (2018). By placing greater scrutiny on the musical environment, itself, the observational data provides ecologically valid evidence that music can scaffold for the enactment of social behaviours. The improvements of the children within musical spaces, often appearing to surpass that of their everyday communicative capacities, confirm the observations by Ockelford (2013, 2016) that musical play can be an alleviatory outlet for expression for autistic children.

As research with neurotypical subjects has highlighted, the platforming of these interactive behaviours (particularly the breadth of responsive, proactive and interactive modes) that are

possible in musical play and identified in the observations during this project provide some evidence for why these environments may have wider social-communicative benefits. If musical spaces, as this research suggests, provide spaces for the enactment of social and communicative behaviours in a 'safe' space, the actions of imitation, turn-taking and emotional understanding that are at the heart of social cognition may well be further developed.

The results from the behavioural checklists including the SRS and ABI taken at the end of the study further suggest that improvements had been made in social domains, particularly in areas related more explicitly to social cognition. This further supports the evidence provided by Geretsegger et al., (2014), in the impact of music programmes on social development. Unique here however is the nature and length of the programme. As was noted in the evidence reviewed by Geretsegger et al. (2014), the majority of these approaches are short to medium term, with limited evidence of the efficacy of these programmes over longer periods. This project provides the first initial evidence of the impact of these programmes over twelve months with reduced researcher intensity than shorter term projects, suggesting the behavioural development may be longer lasting. Similarly, the strategies and integration of music within everyday life supported during the programme had the aim of becoming embedded into routines, meaning change was more consistent and would hopefully persist beyond the end of the research.

What the results from greater interactivity in musical play and, in turn, improved social outcomes indicate is that the multidimensionality of musical spaces creates opportunities to support development in autistic children. Although the observations in improvements in social interaction were specific to this project, these can also be considered alongside the wider impacts that the play experiences, communicative expression and growing empowerment that musical environments can create. The growth of musical-interactive behaviours and their observed alignment with social behaviours highlight the role of musical spaces in 'making the (social) world understandable'

(Jaschke, 2014). Similarly, the increase in the quality of communication within musical spaces echoes the developing research that indicates that greater understanding of the different communication modes and styles of individuals can support more successful communication (Milton, 2012; Crompton et al., 2020). For many of the children and families participating in this project, the opportunity to create these spaces, and the social communication changes achieved through them, were tangible and significant. As clearer communication pathways through music developed, they were able to understand their wants and needs, which can create meaningful differences in preventing distress and meltdowns. The enjoyment and proactivity of the children in pursuing interaction within musical environments further highlights the importance of developing supports to allow children to interact in safe spaces on their own terms (Fletcher-Watson, 2018).

7.5 General Discussion

This project provides a unique insight into the role of music for autistic children and their families, underscoring the importance of musical play as a medium for interaction and development. The methodological design of the project in using longitudinal, mixed methods meant that both micro and macro perspectives were incorporated into the research. This included the dynamics of musical environments, the families' qualitative experiences and wider behavioural change, which provided a rich picture of how music can be woven into the fabrics of daily routines and choreographed to suit individuals needs and interests. The results emphasise the wide-ranging uses of music in everyday life as a way to regulate, scaffold and transition between activities. Parents were found to be effective and responsive to the programme. The observational data and parent accounts highlighted the development of musical behaviours over time, alongside an improvement in interactivity and creative expression within musical spaces. These changes further aligned with wider behavioural-developmental change, emphasising the potential links between musical play and social development.

The outcomes of this project are significant both in confirming established patterns and behavioural improvements observed in similar studies, and in providing new insight into the changes in musical behaviours for autistic children. The positive social outcome measures align with similar research within music therapy (notably Geretsegger et al's (2014) Cochrane review), but this is the first study to provide evidence of behavioural changes from a musical programme over a longitudinal time frame (greater than six months) using a medium-sized cohort. The ecological validity of the evidence collected also strengthens its quality, providing insight into the enactment of these behaviours within home environments. As others, (Voyajolu, 2021; Cirelli & Trehub, 2019; Trehub & Gudmundsdottir, 2019) have noted, understanding the musical potential of children requires consideration of home environments, as children are more likely to interact at a higher level within this environment. Moving away from the therapy room, the examination of musical behaviours within home settings also highlights how the findings of musical benefits within structured contexts of Thompson (2012a) and Williams et al. (2012) have a wider applicability. As with early intervention models that have explored the role of parents as effective mediators, this project highlights how integrating these two models can be effective, even without the consistent presence of a trained musical facilitator.

The scrutiny that was given to the musical environment itself is also uncommon in the field, particularly within the unpredictability of naturalistic settings. Despite this variability, the consistency of actions that were identified across the participants, and the changes in multiple domains seen through the observational framework highlights the ability of musical play to scaffold relevant and common interactive behaviours. It also gives further insight into these changing behaviours. While others have given details of the interactions in a typical session including the guidance given in the 'Sing & Grow' programmes and 'Musical Bonds' (Yang, 2018), the ability to track and follow behaviours over time within musical environments provides a new understanding of

the changing dynamics of musical spaces and their developmental potential. In particular, the highly interactive capacities of musical spaces that were observed during the project have further endorsed the arguments linking musical play to social development.

However, it is also worth considering these gains alongside the wider changes in playfulness, creativity and interactivity that were observed in the musical spaces. The opportunities for playful forms of interaction and its subsequent role in supporting development have been highlighted by others as an important part of early childhood development, both musical and non-musical (Howard & McInnes, 2013; McInnes, Howard, Crowley, & Miles, 2013). By creating a space in which autistic children felt comfortable to play, creatively and socially, mutual interaction and communication was able to flourish and thus support development. Alongside the recognition of the improvements in social communication amongst the children, these spaces can also be conceptualised as a place in which autistic children can interact without the restrictions of neurotypical social conventions and rules. Part of music's affinity may therefore be in its equitability between neurodiverse and neurotypical partners, creating opportunities for play and creative expression.

The emphasis on enjoyment and play that emerged from the accounts further identifies an outcome that, while not explicitly measured, was a feature across the family's experiences: supporting well-being. Arts-in-health approaches have consistently tackled the ambiguity of what music can 'do', and the emphasis on particular behaviours can reduce the breadth and understanding of the huge range of music's impact (DeNora & Ansdell, 2014; Fancourt, 2017). Through the parents' experiences, it was clear to see how music's growing role in everyday life was serving well-being; by reducing the tensions associated with communication between family members, promoting opportunities to share in play together and strengthen relationships, and through the growing use of music as a vehicle for emotional regulation. Yet the role of these everyday, micro-regulatory practices and their impact remains, to an extent, intangible.

Echoing the neurodiversity framework and moving away from understandings of how music can ‘fix’ illness or promote health through mechanistic processes, it is worth considering the role of music in everyday life within a more general model of flourishing. For the families in the current project, their relationships with music were complex and unstable, both developing over time but also stuttering and jagged (as one described their joy at how they had returned their child’s love of music that he showed at nine months old). Yet for nearly all, the enjoyment that was reflected in the accounts of music in everyday life highlights a richness in their experiences cannot be reflected in a singular variable or behavioural outcome. Instead, they demonstrate variegated change that is manifested through the complexities of everyday life. As their children’s behaviours changed and their needs developed, music was woven into the fabric of everyday communication strategies. Moving away from structured sit-down play sessions, parents were able to flexibly build musical environments into the context of daily life, where the playfulness of musical moments, both ad-hoc and composed, was a core ingredient in the success and engagement of the families with the project.

In light of the complex design and methodology of this project, both the implications and underlying mechanisms fuelling social-behavioural change observed here should not be interpreted too simplistically. The pre-post, RCT-style interventions characteristic of much of the previous therapeutic and behavioural research in this area has a tendency to ascribe greater causal links between music interventions and behavioural change, leading to assumptions about the capacity of music as a ‘treatment’ (DeNora & Andsell, 2014). Similarly, this narrative makes further assumptions regarding the nature of social difficulties in autism, emphasising core-deficit hypotheses where ‘deficient’ behaviours can be isolated, targeted and improved, and neglecting the complexities of cognitive functioning in autistic individuals (Astle & Watson, 2020). In the current project, the integration of multiple modes of musical experiences in everyday life meant that the multi-faceted

nature of emotional, social and interpersonal relationship development was enacted within musical spaces.

To explore how these factors may intertwine, it is worth considering Astle et al.'s (2021) argument that current approaches are overly reliant on diagnostic criteria of neurodevelopmental conditions that poorly fit individuals, which has impacted on identifying barriers and developing appropriate support. The complexities and richness of musical programmes, including the one in this project, mean that the wider benefits, as touched upon above, cannot be isolated from its overall impact. Other factors may also contribute to these outcomes, including the opportunities for closeness described by the parents in relation to their children's musical experiences, which may lead to a greater level of understanding between parent and child and therefore greater improvements in social communication. Similarly, opportunities for children to express, regulate and freely communicate within these musical environments may allow them to work through or bypass some of the communication barriers they may be experiencing in everyday life. For example, the improvements and greater consistency in verbal expression that was noted by the parents can be interpreted both as a sign of greater musical confidence and empowerment, and as indicative of children becoming more confident in their own communication.

The integration of musical support within everyday life also provides further indications of the efficacy of musical-environmental supports that so far have primarily been highlighted in single-case or small samples. This research expands those findings to a wider cohort, and also indicates the role of caregivers and support networks around the children in alleviating the researcher time burden that is characteristic of many of these designs. This is particularly significant given the high support needs of the participant children. Within the area of music and autism, this is one of the biggest sample sizes to date that has focused this closely and exclusively on children with high support needs and most profoundly impacted by communication, language and behavioural difficulties.

Despite the challenges the children and families experienced, their enjoyment and engagement with the project highlights the importance of the musical spaces for the often highly specific needs of those children. The resources that were provided to the families guided parents in relevant activities, as did the provision of musical instruments which the children were able to seek out independently, explore and develop ownership for.

This approach has clear implications for how musical programmes of this nature can be conceived in the future, as the results clearly indicate the strength of embedding these strategies within everyday life and making families part of the research and implementation process. More widely, the orientation and creation of supportive and interactive musical environments in which learning can be achieved may also be applied beyond the context of the home. In particular, integrating these musical strategies within care and educational settings could both further increase the regularity of the programme, and help practitioners to adjust environments within these settings to better support and serve individuals. Similarly, the design that was used in this project involved parents who were not musically trained and only provided with a simple set of musical instruments as flashcards. In light of the findings of this project, this may provide a model to better support a far wider range of families and communities wanting to nurture their children's musical interests. The lack of funding and accessibility of more highly trained, educational and therapeutic opportunities means that parents are in need of guidance as to how to further support their children's musical abilities. Making these types of resources more available can be one way to address this and provide guidance for practitioners and families to adapt their behaviours and environments around those children to future support development.

8 Conclusion

This chapter outlines the main findings from this thesis and identifies the main contributions to knowledge. It considers the results in light of the research questions posed at the outset and presents future recommendations for the resources that were developed as part of this research.

8.1 Contribution to Knowledge

This project provided new insight on the musical lives of autistic children and their families. It adds to the growing body of research using the Sounds of Intent and the Sounds of Intent in the Early Years frameworks, which have identified the musical capacities of young children and those with profound and multiple learning difficulties. Within this framework, this project has highlighted how autistic children show similar patterns of competency growth as observed in neurotypical children, and the alignment of their developmental profiles with the Sol-EY framework. The application of latent growth models indicates that independent musical development may be influenced by behavioural factors rather than age, but that nevertheless autistic children demonstrate capacities for growth and change. Alongside the competencies outlined in the Sol-EY framework, the changes in creative and imaginative play within musical spaces further emphasise the socio-emotional components that may not be reflected with the current Sol-EY framework but appear to change with the development of musical skill.

The children's musical interactions as observed in this project also provide further insights into the dynamics of musical environments. It highlights the interactive, social components of musical play, providing some detail on the potential mechanisms within musical spaces that may play a role in previous music interventions and programmes that have observed improved developmental and social communication outcomes, as was also found here. The growth of interactivity observed during the project further lends credence to the theories of musical scaffolding, where cognitive functions

are offloaded onto musical scaffolds and enacted with lower cognitive load and distress. For autistic children, this provides a model for why music may act as an alleviatory environment, creating a space in which interactions can occur more freely and with less impairment. As evidenced in this project, these scaffolds can be constructed within musical play, and also created flexibly within everyday environments in order to ease transitions and develop routines.

The responses of the families to a tailored set of resources also demonstrated how musical interventions can correspond to a naturalistic, early intervention model. The success of the parents in adopting the resources and strategies into everyday life highlights the benefits of utilizing musical strategies in everyday life, and the potential of these models due to their relatively low cost and accessibility. This design also highlights how to adopt the principles of a neurodiversity framework into musical interventions and move away from a reliance on treatment-based approaches. By creating musical environments that can function as a way to nurture communication, well-being and special interests, they can support children's own autonomy and natural developmental processes. This approach also aligns with arts-in-health understandings of flourishing in the context of music. As this project showed, the findings here highlight the importance of music for a constellation of factors including creative expression, emotional regulation, relationship development and shared interaction for autistic children and their families. These should not only be interpreted in terms of treatment effects, but rather reflect the wider variety, richness of music within everyday lives.

8.2 Main findings

At the outset, this project set out to explore how music was integrated into the lives of autistic children and their families, and whether it could be enhanced to contribute to social and developmental outcomes. The research questions focused on (1) How do the musical abilities and engagement of young children on the autism spectrum develop over time? (2) What is the role of music in the daily lives of autistic children and their families? and (3) How can musical play promote

the development of social competencies and impact wider developmental outcomes of young children with autism? What emerged from the findings indicated that:

- Autistic children demonstrate clear patterns of musical growth over time, although there may be intraindividual differences. These patterns of growth are non-linear, as found in neurotypical models, with quadratic growth indicating that the pace of development slows towards the higher ends of the Sol-EY framework.
- While initial musical ability may be impacted by factors including language and behavioural difficulties, these children can be further supported by a programme of home-music making using card-based resources, which can encourage children with the most profound difficulties to develop both musical competencies and creative expression.
- The progression of musical competency gains follows similar patterns to the neurotypical model. Both listening and active music-making develop alongside parental support and growing individual empowerment within musical spaces.
- Music can be an effective environmental support in everyday life to smooth interactions with the outside world and help orientate autistic children within their environments. This includes scaffolding routine, alleviating distress and smoothing transitions but also has wider implications for creating opportunities for shared moments of play and understanding. These musical platforms can be highly significant for children and families alike in building relationships and nurturing interactive play.
- Musical play enacts behaviours that align with social development and appear to promote social forms of interaction. Autistic children have the capacity to develop interactive behaviours during musical play, which may have wider impacts on development, including social communication.

Overall, this project highlighted the impact of naturalistic musical programmes and the impact of music within the everyday lives of autistic children and their families. Using a set of card-based resources and musical instruments, quantitative and qualitative evidence collected over the course of a year highlighted how families were able to effectively nurture their children's musical development and integrate musical strategies into everyday life. Musical play proved to be a highly interactive and fruitful space of creative expression and development, which parents were able to utilize to create meaningful interactions with their children

8.3 Limitations

Certain limitations on this study meant that the conclusions must be interpreted with this in mind, with future research aiming to address some of the drawbacks covered below. Firstly, issues with the sample should be considered. Although the sample size is good in comparison to other studies using the highly specific cohort that was included in this project, the longitudinal data analysis in particular would benefit from a larger sample in order to confirm the patterns of development that were observed. Cross-sectional data from a greater variety of age ranges would also enable comparisons between musical development in autistic children, and that observed in neurotypical children. The gender distribution of the sample was also not entirely representative of the autistic population as a whole. The heavy weighting of male to female means that the particular conclusions to female pathways of development here are limited. Although gender ratios of autism diagnosis of male-female in the early years are 1:5 (Fletcher-Watson & Happé, 2019), it is widely recognized that autistic girls are underdiagnosed and greater efforts should be made to include them in early years studies. It is worth further noting that two of the participants that pulled out of the study were female, further skewing the sample. While the reasons for withdrawal for each were different and complex, further research could take more account of the specifics of musical engagement of autistic girls and their families. Similar limitations can be found in the geographical location of the

sample; while in terms of ethnicity and income it was highly diverse, the limitation of all the families being located in Greater London mean that they may not be representative of the entire country as a whole. Similarly, the non-probability sampling using is unlikely to reflect the broader population, with those who had displayed the most interest in music, and proactive parents more likely to express interest and participate during the recruitment progress.

The unprecedented circumstances of the COVID-19 pandemic and subsequent lockdowns midway through the study had both clear and potentially unknown impacts on the results of the study. The unequal time differences between visits were unavoidable given the social distancing restrictions at the time, but further studies should aim to follow the children more consistent intervals. Similarly, the impact of the ongoing lockdowns on the development of the children is unknown. While the extended periods of time in a familiar and controlled environment may have enabled some of the children to engage more with the instruments in their home, the impact upon wide psychosocial factors is unclear. As many of the parents reported, the uncertainty and absence from school had an effect upon their children and could be interpreted as a contributing factor to the mood and anxiety scores, as although the qualitative results indicate high uses of music for emotional regulation, significant improvements in these scores were not observed. Instead, what the results may highlight is that in times of critical emotional distress and uncertainty, music can be used effectively to mitigate some of these negative mood and uncertainty outcomes.

An additional limitation was observed in relation to the project design. As has been observed by Hernandez-Ruiz (2020), family and parent implemented programmes place a significant burden on the parents and families themselves, which in the context of children with high support needs, and often complex co-morbidities, can lead to the exclusion of many of the children most in need.

Although limitations on resources in the current project meant that focus could only be placed on the home environment, there is greater potential for many of these musical strategies if they were

able to be implemented more consistently in wider environments. Integrating additional supports and training caregivers within education settings would create wider and more regular implementation and reduce the burden on parents alone.

8.4 Future Research Directions – Policy Implications

The outcomes of this project clearly identify the value of musical supports to autistic children and their families, and their role in supporting wider development. While the resources were particularly focused on the integration of home-based supports and targeted particularly at parental inclusion in the process, the responses of the children and the families mean that there is a far broader scope in this area, particularly for uses within wider community settings, in education and healthcare.

- Firstly, relevant to the continued development of the resources, many of the children developed interests through their own individual explorations, seeking out videos of their favourite nursery rhymes and cartoons, and then sought to replicate those songs in their interactive play with the parents. This often-created challenges for the parents to implement new musical material and games into play, as children were strongly self-directed. In addition, the time-limitations of some of the parents meant that musical material and games detailed in the resources may not have been consistently implemented. Creating animated resources that could be sought out by the children and utilizing this to bridge the gap between virtual forms of music and physical music-making may be an avenue to pursue to further nurture engagement. By animating the resources and songs, the children can access the videos on their own terms, through a medium that they are used to.
- Second, the design of the cards also highlighted more scope for potential development to cater for a wider age range. The original iterations of the cards focus on imitation and copy-me games, which the responses of the children indicated in their most basic form may not

be suitable for older age-groups. Therefore, emphasising how individual interests and technology can be used to encourage interactive musical engagement as part of creative free play based upon their own interests should be further incorporated. However, there was a particular tendency for some families to take a more task-based approach to the cards. For those families, it created the impression of the music less as a space of play, and more as a space of work or tuition, and was particularly noted in those with slightly older children. This approach indicated a potential area for improvement with the cards, making them more flexible and creative for the upper end of the age group (above the age of six).

- Third, the uses of the resources have a wide application beyond those of parents for families of autistic children. Notably, there are implications for creative practitioners working with autistic children, as well as music teachers to understand how to more effectively engage autistic children in their practice. Additional scope may also consider the role of the resources within classroom settings, in particular for teaching assistants and educators to help engage individuals, support their development and create supportive learning environments both through enabling clearer structures throughout the day.
- The findings from this project highlights the need for greater application of these types of models of musical support for autistic children and their families. In consideration of the number of families with autistic children in the UK, there is a much greater potential to widen access to the arts and promote these avenues to support well-being and development in the early years. Aside from the negativity associated with the early years of diagnosis, these types of interventions provide ways for children to have positive and enjoyable interactions with their children. In light of the decimation of early years and arts support within the UK sector, this model offers the potential to provide greater accessibility to a wide range of low income and time limited families.
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Appendix 1

The research for this project was submitted for ethics consideration under the reference: EDU 19/175 in the Department of Education and was approved under the procedures of the University of Roehampton's Ethics and Committee on 4th April 2019.

Appendix 2: Consent Forms

PARTICIPANT CONSENT FORM – Pilot Project

Title of Research Project: Tuning In to Autism

Brief Description of Research Project, and What Participation Involves:

This doctoral research project is being undertaken with Professor Adam Ockelford at the University of Roehampton. Our aims are to explore how the resources we have designed can be used to encourage musical and social development for children with autism. We would like **you** to help us do that by documenting what, when and how you use the resources you'll be given. This will help us better understand how music is learned and experienced by young children with autism. Once our research is finished, we will produce a final set of resources that will be made freely available to *all* families who have a young child on the autism spectrum.

This research is confidential and all data will be anonymised, with names being replaced with codes. Any paper forms containing personal information will be kept securely in a locked cupboard. The video-recorded observations will be kept on password-protected areas in the cloud and on password-protected computers. All data will be encrypted. Only the research team and my PhD examiners will have access to the information that you give us.

Your child's participation in this research is completely dependent on you and your child. This research has been devised in accordance with the ethical guidelines of the British Psychological Society and the British Educational Research Association. This project has been approved under the procedures of the University of Roehampton's Ethics Committee. You have the right to withdraw your child from this study at any point without giving a reason, should you wish to do so.

Investigator Contact Details:

Name	Caitlin Shaughnessy
Department	Applied Music Research Centre, School of Education, University of Roehampton
University Address	Queens Building, Roehampton Lane
Postcode	London SW15 5PU
Email	shaughnc@roehampton.ac.uk
Telephone	07399941251

Consent Statement:

I agree for myself and my son/daughter [.....] to take part in this research project, and am aware that I am free to withdraw at any point without giving a reason by contacting Caitlin Shaughnessy. I am aware that I will be uploading videos onto a cloud-based platform, and these will be used for analysis, but all data will be anonymised in the process of analysis.

I understand that if I or my child do withdraw, my data may not be erased but will only be used in an anonymized form as part of an aggregated dataset. I understand that the personal data collected from me during the course of the project will be used for the purposes outlined above in the public interest.

By signing this form, you are confirming that you have read, understood and agree with the University's Data Privacy Notice for Research Participants and that you have read and understood the Parent Support and Information Documentation.

The privacy notice sets out how your child's personal data will be used as part of the research project. By signing this form, you are confirming that you have explained the content of the Data Privacy Notice for Research Participants to your child, to the extent to which it is possible to do so.

The information you have provided will be treated in confidence by the researcher and your identity will be protected in the publication of any findings. The purpose of the research may change over time, and your data may be re-used for research projects by the University in the future. If this is the case, you will normally be provided with additional information about the new project.

Name

Signature

Date

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator (or if the researcher is a student you can also contact the Director of Studies.) However, if you would like to contact an independent party please contact the Head of Research, School of Education.

Director of Studies Contact Details

Name	Professor Adam Ockelford
Department	Director, Applied Music Research Centre
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Head of Research Contact Details:

Name	Professor Vini Lander
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Tuning In to Autism - Information and Support Sheet for Parents – Phase I

This research will investigate how musical play develops in children with autism, and how specially designed tasks can help social and musical communication. We want to work with parents and caregivers to help us understand how children with autism use music in day to day life, and how it can help everyday activities and interactions. We aim to recruit ten families from the London/Greater London area and the study will last ten weeks.

Over the course of the study, you will be visited three times by a researcher in your home. These visits will last between one and two hours and will be filmed using a discreet camera in the corner of the room.

In the first visit, the researcher will introduce to you our set of **free musical resources including a keyboard and handheld instruments** which detail quick, simple activities (each taking less than two minutes) that you can use to engage with your child through music. The researcher will also participate in a musical play session (which will last around 30 minutes) with you and your child to show how the resources can be used in practice. In this visit, the researcher will also guide you how to upload your own videos to a simple, video collecting app and complete a brief questionnaire about your child and family life.

The subsequent two visits will occur after approximately 5 weeks in the study and at the end of the study. Here, the researcher will again conduct a brief analysis of your child's musical progress, participate in a musical play session (which will last around 30 minutes) with you and your child and discuss, if appropriate, how to use the next stage of the resources. Here you can discuss any behavioural and musical changes you may have noticed in your child, and we will provide any support as necessary. A report will also be provided at the end of the project, which will detail your child's musical abilities and any recommendations for further musical support. At the end of the project, you will be allowed to keep all the resources.

In order for the project to be as successful as possible, and to enable the researchers to give you accurate feedback on how to further encourage your child's interaction, we encourage you to document your child's music-making as much as possible. You are requested to upload short video diaries at least weekly that show your child interacting musically (each video need be no longer 5 minutes), either with or without our musical resources. You will be reminded to submit these, along with answering a question relating to your child's musical development, once a week. You may specify whatever medium is preferable for you to be contacted on, (either via the app or through text/email) and the process of giving feedback and uploading the videos should take no longer that 10 minutes per week.

The researcher will have an enhanced DBS check. All data collected will be encrypted and requests to delete / take down the videos can be made at any time without any reason given. You may also request to 'take a break' in the project, or withdraw, at any times without giving any reason.

If you have any further questions, please do not hesitate to contact Caitlin Shaughnessy at shaughnc@roehampton.ac.uk

PARTICIPANT CONSENT FORM – Main Study Parents

Title of Research Project: Tuning In to Autism

Brief Description of Research Project, and What Participation Involves:

This doctoral research project is being undertaken with Professor Adam Ockelford at the University of Roehampton. Our aims are to explore how the resources we have designed can be used to encourage musical and social development for children with autism. We would like **you** to help us do that by documenting what, when and how you use the resources you'll be given. This will help us better understand how music is learned and experienced by young children with autism. Once our research is finished, we will produce a final set of resources that will be made freely available to *all* families who have a young child on the autism spectrum

This research is confidential and all data will be anonymised, with names being replaced with codes. Any paper forms containing personal information will be kept securely in a locked cupboard. The video-recorded observations will be kept on password-protected areas in the cloud and on password-protected computers. All data will be encrypted. Only the research team and my PhD examiners will have access to the information that you give us.

Your child's participation in this research is completely dependent on you and your child. This research has been devised in accordance with the ethical guidelines of the British Psychological Society and the British Educational Research Association. This project has been approved under the procedures of the University of Roehampton's Ethics Committee. You have the right to withdraw your child from this study at any point without giving a reason, should you wish to do so.

Investigator Contact Details:

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Email	shaughnc@roehampton.ac.uk
Telephone	07399941251

Consent Statement:

I agree for myself and my son/daughter [.....] to take part in this research and development project, and am aware that I am free to withdraw at any point without giving a reason by contacting Caitlin Shaughnessy. I am aware that I will be uploading videos onto a cloud-based platform, and these will be used for analysis, but all data will be anonymised.

I understand that if I or my child do withdraw, my data may not be erased but will only be used in an anonymized form as part of an aggregated dataset. I understand that the personal data collected from me during the course of the project will be used for the purposes outlined above in the public interest.

By signing this form, you are confirming that you have read, understood and agree with the University's Data Privacy Notice for Research Participants and that you have read and understood the Parent Support and Information Documentation.

The privacy notice sets out how your child's personal data will be used as part of the research project. By signing this form, you are confirming that you have explained the content of the Data Privacy Notice for Research Participants to your child, to the extent to which it is possible to do so.

The information you have provided will be treated in confidence by the researcher and your identity will be protected in the publication of any findings. The purpose of the research may change over time, and your data may be re-used for research projects by the University in the future. If this is the case, you will normally be provided with additional information about the new project.

Name

Signature

Date

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator (or if the researcher is a student you can also contact the Director of Studies.) However, if you would like to contact an independent party please contact the Head of Research, School of Education.

Director of Studies Contact Details

Name	Professor Adam Ockelford
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Head of Research Contact Details:

Name	Professor Vini Lander
Department	Head of Research, School of Education
University Address	University of Roehampton
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Email	vini.lander@roehampton.ac.uk
Telephone	020 8392 3865

Tuning In to Autism Support and Information Sheet for Parents – Phase II

This research will investigate how musical play develops in children with autism, and how specially designed tasks can help social and musical communication. We want to work with parents and caregivers to help us understand how children with autism use music in day to day life, and how it can help everyday activities and interactions. We aim to recruit thirty families from the London/Greater London area and the study will last one year.

Over the course of the study, you will be visited four times by a researcher in your home. These visits will all last between one and two hours and **will be filmed** using a discreet camera in the corner of the room. In the first visit, the researcher will introduce to you our set of **free musical resources (including a keyboard and handheld instruments)**, which detail quick, simple activities (each less than two minutes) that you can use to engage with your child through music. The researcher will also guide you how to upload your own videos to a simple, video collecting app and ask you to complete questionnaires about your child and family life, which should take no longer than 25 minutes to complete. In this visit, the researcher will also participate in a musical play session (which will last around 30 minutes) with you and your child to show how the resources can be used in practice.

The next two visits will occur after approximately 4 months and 8 months. Here, the researcher will again conduct a brief analysis of your child's musical progress, participate in a musical play session (which will last around 30 minutes) with you and your child and discuss and discuss, if appropriate, how to use the next stage of the resources. Here you can discuss any behavioural and musical changes you may have noticed in your child, and we will provide any support as necessary.

The final visit will be at 12 months and consist of a final play session, as well as a closing interview and questionnaires (which should take less than 15 minutes to complete). At the end of the study, you will receive a report that assess your child's musical abilities and the progress they have made over the study, and further directions and support which may be valuable for your child. You will also be allowed to keep all the resources given to you during the study.

In order for the project to be as successful as possible, we encourage you to document your child's music-making as much as possible. To enable the researchers to give you accurate feedback on how to further encourage your child's interaction, you are requested to upload short video diaries at least bi-monthly that show your child interacting musically either with or without our musical resources. Each video need only be a maximum of 5 minutes. You will be reminded to submit these, along with answering a question relating to your child's musical development, every other week. You may specify whatever medium is preferable for you to be contacted on, (either via the app or through text/email). The entire process of giving feedback and uploading the videos should take no longer that 10 minutes every other week.

The researcher will have an enhanced DBS check. All data collected will be encrypted and requests to delete / take down the videos can be made at any time without any reason given. You may also request to 'take a break' in the project, or withdraw, at any times without giving any reason.



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If you have any further questions, please do not hesitate to contact Caitlin Shaughnessy at

Appendix 3: Details of Flashcards

	Tag Line	Sol Level	Reactive/Proactive/Interactive	Category	Main Descriptor	Behaviours	Activities
1	Make different sounds with your voice for me to enjoy	Level 2	Reactive	Sounds Interesting	Shows an Awareness of Sound	Listening and Responding	1.1 Get close to me 1.2 Let me feel and see as well as listen to what you are doing, how your tongue and lips move, the buzz in your throat 1.3 Hum and click 1.4 Bubble and squeak 1.5 Vowels and consonants 1.6 Long sounds and short sounds 1.7 Whisper and shout 1.8 Funny and sad 1.9 Play the sound and silence game - make a sound with your voice and then stop! Do it again and again 1.10 Wobble your head, wriggle your body, dance around when you make a sound and stop moving when the sound stops
2	Show me the sounds that everyday things and musical instruments can make	Level 2	Reactive	Sounds interesting	Shows an Awareness of Sound	Listening and Responding	2.1 Shaking containers with things that rattle and instruments like maracas 2.2 Banging things together: wooden spoons on pots and pans, drums, tambourines and claves 2.3 Rubbing a brush on a tray or playing a guiro <i>Remember that I may be particularly sensitive to certain sounds which I may find exciting or distressing - or both</i> <i>Be sensitive to my reactions and give me plenty of time to get used to new experiences. There's no rush!</i> <i>I may prefer to explore new things for myself (proactively)</i>
3	Encourage me to make sounds with my voice	Level 2	Proactive	Sounds Interesting	Intentionally makes or controls sound (Vocal)	Making Sounds and Music Myself	3.1 Try me with a microphone and amplifier 3.2 Let me see what I am doing in a mirror 3.4 Record what I do and let me hear it back 3.5 Try me with voice-changing apps 3.6 Let me hear how my voice sounds different in other places, such as places that echo 3.7 Encourage me to make sounds when you move me around, swinging or swaying, like 'see saw' or 'whoosh'
4	Help me make sounds with everyday objects and musical instruments	Level 2	Proactive	Sounds Interesting	Intentionally makes or controls sound (Applied)	Making Sounds and Music Myself	4.1 Give me everyday objects to play with that are safe and make different sounds 4.2 Show me how musical instruments make sounds in much the same way, by banging or shaking or scraping 4.3 Make instruments with me out of everyday objects, and then show me how to play with them - containers filled with rice or dried peas, for example, or shells tied together with string

							4.4 Make me my own 'sound den', with instruments and other sound makers for me to explore on my own
							4.5 When I play outside, show me the fun I can have with natural outdoor sound makers - scrunching in the gravel, splashing in puddles, banging sticks or jumping in a pile of leaves
5	Have conversations in sounds with me	Level 2	Interactive	Sounds Interesting	Interacts with others using sound (Vocal)	Making Sounds and Music with Others	5.1 You can start, or wait for me to make a sound 5.2 Sometimes I might make different sounds and sometimes I might seem to copy what you do 5.3 You can copy me or do something different 5.4 Whoosh me round and round as we make sounds together with our voices <i>Get close to me so I can touch your face and make eye contact if I want</i> <i>Give me lots of time to respond to the sounds you make - be patient!</i>
6	Play with me making everyday sounds, inside and outside, and musical instruments	Level 2	Interactive	Sounds Interesting	Interacts with others using sound (Applied)	Making Sounds and Music with Others	6.1 If I'm banging a pot or pan or tapping a glass, sit next to me and bang or tap one too! Perhaps I may let you tap or bang the same object 6.2 Sometimes we can make a lot of noise together, playing sounds makers or instruments at the same time 6.3 Sometimes you can help me learn to take turns by waiting until I've finished my go before you start 6.4 You could copy what I do, or make different sounds for me to listen to 6.5 Make sounds outside with me: throw pebbles in a pond, splash in a puddle with me, jump in a pile of leaves
7	Make patterns in sounds with your voice to catch my attention	Level 3	Reactive	Copy me, copy you	Reacts to simple patterns in sound (Vocal)	Listening and Responding	7.1 When you have my attention, make patterns with your voice like 'ma,ma,ma,ma,ma' and 'pa,pa,pa,pa,pa' 7.2 Say 'up,up,up...high' and 'down,down,down...low' and move me as you make sounds 7.3 Now do a 'to and fro' 7.4 Sing patterns going up and down that don't have words 7.6 Whistle them if you can <i>It might help me to be up close to your face, and I might want to touch your mouth to work out what is going on</i> <i>Sometimes I may not appear to be paying attention, but that does not necessarily mean that I am not listening</i> <i>Record what I do, so I can watch later</i>
8	Tap into my love of pattern	Level 3	Reactive	Copy me, copy you	Reacts to simple patterns in sound (Applied)	Listening and Responding	8.1 Make simple tapping patterns on different objects, including percussion objects 8.2 Notice if any sounds catch my attention, and try them again using a different sound maker or instrument 8.3 Now try patterns on the keyboard 8.4 Make a pattern just using one note 8.5 Now make a little tune that goes up a few notes on the keyboard....and down again <i>Record what you do, so I can watch later</i>
9	Encourage me to make patterns in	Level	Proactive	Copy me, copy	Makes simple	Making Sounds and	9.1 Give me the time and space to experiment with pattern-making with my voice

	sound	3		you	patterns in sound intentionally (Vocal)	Music Myself	<p>9.2 Respond to the patterns in sound I make by moving, and stopping when I stop</p> <p>9.3 I might seem to get stuck in making only one pattern - in which case you could encourage me to make different ones</p> <p><i>Record what I do and let me hear it back</i></p> <p><i>Try to move me on from just being 'proactive' to being 'interactive'</i></p>
10	Encourage me to make patterns on sound makers and musical instruments	Level 3	Proactive	Copy me, copy you	Makes simple patterns in sound intentionally (Applied)	Making Sounds and Music Myself	<p>10.1 Encourage me to transfer my interest in making patterns in sound by giving me musical instruments to tap instead</p> <p>10.2 Give me a keyboard to play with too</p> <p>10.3 Or give me an app that lets me play with patterns!</p> <p>10.4 Help me understand the pattern of the black notes or white notes by labelling the keys with colours or letter or both</p> <p><i>Some autistic children (like me!) may not need much encouragement to make patterns in sounds by tapping everyday objects like glasses and cups</i></p> <p><i>This is because I find the sounds they make are fascinating - perhaps more important to me than the usual function of the objects</i></p>
11	Echo the sounds I make with my voice, and give me time to copy yours	Level 3	Interactive	Copy me, copy you	Copies others' sounds and/or is aware of own sounds being copied (Vocal)	Making Sounds and Music with Others	<p>11.1 Try to move me from just making sounds with everyday objects to musical instruments</p> <p>11.2 Copy the sounds that I make with my voice</p> <p>11.3 Give me time to think about what I've just heard - it might take me a while to realise that I'm in control</p> <p>11.4 The important thing is to encourage 'give and take' - so the interaction isn't just one way</p> <p><i>Like lots of autistic children, I may well like to copy the sounds you make ('echolalia')</i></p> <p><i>This is a normal stage of development, but I may stay in it for a while</i></p>
12	Copy the sounds I make with everyday objects and instruments and encourage me to copy what you do	Level 3	Interactive	Copy me, copy you	Copies others' sounds and/or is aware of own sounds being copied (Applied)	Making Sounds and Music with Others	<p>12.1 Encourage me to copy you by making a sound on an object or instrument I have made before...I may not need much encouragement</p> <p>12.2 Sit me in a circle of three or four people; one makes sound with her voice, then next person copies...and round the sounds goes</p> <p>12.3 Copy sounds and patterns I make on instruments or other soundmakers</p> <p>12.4 Show me that I can control what you do</p> <p>12.5 First use a soundmaker or instrument that is the same as mine</p> <p>12.6 Now use a different instrument to copy the same patterns and then swap!</p> <p>12.7 Gradually make the context more 'musical' by using only instruments</p>
13	Sing short, everyday phrases to me	Level 4	Reactive	Bits of Pieces	Recognises musical motifs and the relationships between them (Vocal)	Listening and Responding	<p>13.1 Listen to the communication songs with me and show me that you can sing them too....</p> <p>13.2 Start with 'hello!' - repeat it several times, followed by my name</p> <p>13.3 Then try goodbye</p> <p>13.4 Next show me how to sing 'yes please' and 'no thank you'</p>

							<i>Try learning the phrases that you can use for people's names, activities and places</i>
14	Play me repeating patterns on instruments, sound makers and with technology	Level 4	Reactive	Bits of Pieces	Recognises musical motifs and the relationships between them (Applied)	Listening and Responding	14.1 Play me simple patterns on a drum or tambourine, like 'rat-a-tat-tat' on the drum 14.2 Play me patterns of three or four notes on the keyboard like 'C-D-E, C-D-E, C-D-E' 14.3 Sing or play familiar patterns for me that I know from my favourite sounds, TV Programmes, adverts or toys 14.4 Make recordings of everyday patterns, then of you playing them, so I can work out the connection in my own time
15	Give me that microphone	Level 4	Proactive	Bits of Pieces	Reproduces or creates distinctive musical motifs (Vocal)	Making Sounds and Music Myself	15.1 Encourage me to sing short bursts of music I've heard from the communication songs 15.2 I might find using a microphone and amplifier motivating 15.3 Try putting different effects on my voice, such as echo or reverb 15.4 Remember I want to move when I sing <i>Once I'm confident, turn it up loud!</i> <i>Record what I do and let me hear it back</i>
16	Help me to play short musical phrases on instruments	Level 4	Proactive	Bits of Pieces	Reproduces or creates distinctive musical motifs (Applied)	Making Sounds and Music Myself	16.1 Place your hand under mine and show me how to make short rhythms on percussion instruments 16.2 Encourage me to copy what you do by looking and listening 16.3 Show me how to play short, simple patterns on the keyboard 16.4 Start with simple, rhythmic patterns that stay on the same note 16.5 Now introduce patterns that use two or three notes and that start on C 16.6 Its fine for me to use one finger to start with...then encourage me to use my thumb and other fingers too <i>I may like to learn on my own by looking and listening to recordings of you playing</i> <i>I may find it helpful if you refer to the names of the notes (with stickers or colours)</i> <i>Record what I do for me to see!</i>
17	Play 'call and response' games with me using your voice	Level 4	Interactive	Bits of Pieces	Engages in musical dialogues using motifs (Vocal)	Making Sounds and Music with Others	17.1 When I sing short patterns of sounds, copy what I do and encourage me to do the same 17.2 Play 'call and response games' - you could use some of the communication songs, like 'What's your name?...My name is Jack' 17.3 At first, I may just copy what you do, so you could model the interaction with others 17.4 Play the game with other people in a small circle - one person could be the leader for others to follow, or you could play 'pass the pattern' from one person to another
18	Play 'call and response' games using instruments	Level 4	Interactive	Bits of Pieces	Engages in musical dialogues using motifs (Applied)	Making Sounds and Music with Others	18.1 Encourage me to make short rhythms using a drum or tambourine, and copy what I do, then swap over - see if I will copy you 18.2 Next, instead of copying me exactly, change the pattern slightly (like a 'question and answer') 18.3 Perhaps try rhythms on one note at first 18.4 Then use little phrases of two or three notes 18.5 Now take turns: I play something, you play something, I play something, you play something etc. - hooking the patterns together to start to make music together over time

							18.6 Start with children's songs with actions to help make the structure clear, such as 'The wheels on the bus'
							18.7 Try folk songs and working songs from your culture, like 'What shall we do with the drunken sailor?'
19	Sing me lots of different songs with simple structures that I can understand	Level 5	Reactive	Whole songs, in time and in tune	Attends to pieces of music, anticipating prominent structural features and responding to general characteristics	Listening and Responding	19.1 Sing pop songs (which often have simple structures) like 'We will rock you' and 'Hallelujah'
							19.2 Try classical melodies from your culture: for example, in the West 'Ode to joy'
							19.3 Gradually sing longer and more complicated songs
							19.4 Hum the songs I know and then play me instrumental versions of the same songs (available on the internet)
							19.5 Play me instrumental pieces that have a lot of simple repetition like 'Can Can'
20	Play me recordings of simple instrumental pieces that I can follow and take me hear all sorts of music in different places	Level 5	Reactive	Whole songs, in time and in tune	Attends to pieces of music, anticipating prominent structural features and responding to general characteristics	Listening and Responding	20.1 Let me hear street musicians and buskers
							20.2 Try relaxed performances of classical music and musicals
							20.3 Play me music that tells a story like 'Peter and the wolf' and 'The Sorcerer's Apprentice'
							20.4 Take me to children's concerts and 'relaxed' performances
							20.5 Give me lots of praise and encouragement when I sing!
							I might just like singing in on my own at first, and feel a bit shy if I think other people are listening - Perhaps family on their on own may be enough of an audience to start with
21	Encourage me to sing songs on my own	Level 5	Proactive	Whole songs, in time and in tune	Performs, improvises or composes simple whole pieces of music (Vocal)	Making Sounds and Music Myself	21.1 Show me that I'm in control: do the actions to the songs that I sing
							21.2 Show me what fun it can be to sing for different family members
							Record what I do, so I can watch later
22	Help me to <i>play</i> what I can sing	Level 5	Proactive	Whole songs, in time and in tune	Performs, improvises or composes simple whole pieces of music (Applied)	Making Sounds and Music Myself	22.1 Help me play simple songs that use only a few notes like 'Mary had a little lamb', or 'Oh when the Saints'
							22.2 Show me using my preferred style of learning - for example using a simple 'score', written out letters or colors
							22.3 Or, I may prefer to just copy what you do, a bit at a time
							22.4 Or I may like to watch how to play using a recording on a tablet
							22.5 Once I'm confident, turn it up loud, and encourage me to play for other people!
23	Sing songs with me that I love over and over again	Level 5	Interactive	Whole songs, in time and in tune	Performs, improvises or composes simple pieces of music with others (Vocal)	Making Sounds and Music with Others	23.1 Encourage me to sing songs with you
							23.2 I might well like to sing the same song over and over again - but that's fine - its just the way I like to learn things
							23.3 I may find it easier to move when I sing, and when someone plays or claps a beat (and, if possible, plays chords as an accompaniment)
							23.4 Try singing rounds with me like 'London's burning' and 'Frère Jacques' - someone else can help me with my part at first
24	Let me join your band!	Level 5	Interactive	Whole songs, in time and in tune	Performs, improvises or composes simple pieces of music with	Making Sounds and Music with Others	24.1 Start by doing something together with me - it could be a tune on the keyboard, or a pattern on the drum
							24.2 Then, try playing a simple accompaniment while I carry on playing my part

					others (Applied)		24.3 Try to make up new tunes together, with or without words
							24.4 Encourage me to improvise
							24.5 Give me the chance to make music with other children - it might be easier if they are a bit older than me at first

Appendix 4: Pilot Study Questionnaire



Background Information

Today's Date:

Relationship to Child:

1. What is your child's date of birth?

2. What is your child's gender?

Female	Male	Prefer not to say
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3. When were they diagnosed with an Autism Spectrum Condition?

4. Does anybody else in the family have a diagnosis of Autism?

Yes	No	Prefer not to say
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5. How many siblings does your child have?

6. What best describes your child's level of language?

No language	Signs	Single words or 2/3-word utterances	Simple Sentences	Full Sentences
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Musical Experience

7. Please tell us a bit more about your child; what do they regularly like to play with? (*e.g. which toys, video games, musical instruments, sports etc.*)

8. How often does your child demonstrate adverse reactions to sound? (*such as putting their hands over their ears*)

Always	Often	Sometimes	Rarely	Never
--------	-------	-----------	--------	-------



9. How often does your child sing or hum to themselves?

Always	Often	Sometimes	Rarely	Never
--------	-------	-----------	--------	-------

10. How often do you sing to your child?

Always	Often	Sometimes	Rarely	Never
--------	-------	-----------	--------	-------

11. How interested do you think your child is in music?

Extremely Interested	Very Interested	Quite Interested	Somewhat interested	Not at all
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12. Do they incorporate music as part of their play?

Always	Often	Sometimes	Rarely	Never
--------	-------	-----------	--------	-------

If so, please elaborate (e.g. do they make up songs to sing with their toys?)

13. Have they had any formal music training or musical therapy previously? (e.g. group music therapy in June 2018)

Appendix 5: Main Study Questionnaire**2. Socio-Demographic Details**

Please provide some information about your family background - this is important for us to know the accessibility and diversity in the research

2. Which of the following best describes your current relationship status?

- Married
- Widowed
- Divorced
- Separated
- In a domestic partnership or civil union
- Single, but cohabiting with a significant other
- Single, never married

3. What is the highest level of school you have completed or the highest degree you have received?

- Completed GCSE's
- Left school before completing qualifications
- Completed A Levels (or high school diploma)
- Some college but no degree
- Associate degree
- Bachelor degree
- Graduate degree

4. What is your annual household income?

- Under £15,000
- Between £15,000 and £29,999
- Between £30,000 and £49,999
- Between £50,000 and £74,999
- Between £75,000 and £99,999
- Between £100,000 and £150,000
- Over £150,000

5. How many adults live in your household?

6. How many children currently live in your household?

7. What best describes your child's ethnicity?

- | | | |
|--|--|--|
| <input type="checkbox"/> White - British | <input type="checkbox"/> Any other Mixed/multiple ethnic background (please specify below) | <input type="checkbox"/> Black British - African |
| <input type="checkbox"/> White - Irish | <input type="checkbox"/> Asian/Asian British - Indian | <input type="checkbox"/> Black British Caribbean |
| <input type="checkbox"/> White - Gypsy or Irish Traveller | <input type="checkbox"/> Asian/Asian British - Pakistani | <input type="checkbox"/> Any other Black/African/Caribbean background (please specify below) |
| <input type="checkbox"/> Any other White background (please specify below) | <input type="checkbox"/> Asian/Asian British - Bangladeshi | <input type="checkbox"/> Arab |
| <input type="checkbox"/> Mixed heritage - White and Black Caribbean | <input type="checkbox"/> Asian/Asian British - Chinese | <input type="checkbox"/> Any other ethnic group (please specify below) |
| <input type="checkbox"/> Mixed heritage - White and Black African | <input type="checkbox"/> Any other Asian background (please specify below) | |
| <input type="checkbox"/> Mixed heritage - White and Asian | <input type="checkbox"/> Black British | |

Other (please specify)

8. What is your current religion, if any?

- | | |
|---|---|
| <input type="radio"/> Christian/Protestant/Methodist/Lutheran/Baptist | <input type="radio"/> Muslim |
| <input type="radio"/> Catholic | <input type="radio"/> Buddhist |
| <input type="radio"/> Sikh | <input type="radio"/> Hindu |
| <input type="radio"/> Greek or Russian Orthodox | <input type="radio"/> Atheist or agnostic |
| <input type="radio"/> Jewish | <input type="radio"/> Nothing in particular |
| <input type="radio"/> Other (please specify) | |

3. Child Details

9. What best describes your child's level of language?

- No Language
- Signs
- Single words or 2/3 word utterances
- Simple Sentences
- Full Sentences

10. How often does your child demonstrate adverse reactions to sound?

- Always
- Often
- Sometimes
- Rarely
- Never

11. How interested is your child now in music?

- Extremely interested
- Very interested
- Somewhat interested
- Not so interested
- Not at all interested

12. How often do they incorporate music as part of their play?

- Always
- Usually
- Sometimes
- Rarely
- Never

4. Music in Everyday Life

In each question, please mark the option that best describes your child's behaviour over the past month

13. In the past month, how often did you sing with your child?

- Everyday I sang with my child
- Multiple times a week I sang with my child
- Once a week I sang with my child
- A couple of times a month I sang with my child
- Not at all

14. How do you think your child overall responded to your singing

- It was a very positive experience for my child
- It was a somewhat positive experience for my child
- It was neither a positive nor a negative experience for my child (e.g. my child continued with his/her activities; his/her response was difficult to understand.)
- It was a negative experience for my child

15. In the past week, how often did you play musical instruments with your child? (Please don't include toys that play recorded musical tunes.)

- Everyday I played musical instruments with my child
- Multiple times a week I played musical instruments with my child
- Once a week I played musical instruments with my child
- A couple of times a month I played musical instruments with my child
- Not at all

16. How do you think your child overall responded to playing with instruments with you?

- It was a very positive experience for my child
- It was somewhat a positive experience for my child
- It was neither positive nor a negative experience for my child
- It was a negative experience for my child

17. In the past week, how often did you listen to music with your child

- Everyday I listened to music with my child
- Multiple days a week I listened to music with my child
- Once a week I listened to music with my child
- A couple of times a month I listened to music with my child
- Not at all

18. How do you think your child overall responded to listening to music with you?

- It was a very positive experience for my child
- It was a somewhat positive experience for my child
- It was neither a positive nor a negative experience for my child (e.g. my child continued with his/her activities; his/her response was difficult to understand.)
- It was a negative experience for my child

19. In the past month, how often did you play with music apps on a smart phone or tablet with your child?
(Please consider apps for playing musical instruments and composing original music)

- Everyday I played music apps with my child
- Multiple days a week I played music apps with my child
- Once a week I played music apps with my child
- A couple of times a month I played music apps with my child
- Not at all

20. How do you think your child overall responded to playing a music apps with you: (Please tick only one)

- It was a very positive experience for my child
- It was somewhat a positive experience for my child
- It was neither a positive nor a negative experience for my child (e.g. my child continued with his/her activities; his/her response was difficult to understand.)
- It was a negative experience for my child.

21. In the past month, how often did you notice your child singing to themselves?

- Everyday my child sings to themselves
- Multiple days a week my child sings to themselves
- Once a week my child sings to themselves
- A couple of times a month my child sings to themselves
- Not at all

22. In the past month, how often did your child play with musical instruments by themselves?

- Everyday my child plays with musical instruments
- Multiple times a week my child plays with musical instruments
- Once a week my child plays with musical instruments
- A couple of times a week my child plays with musical instruments
- Not at all

23. In the past month, how often did your child play with music using musical apps?

- Everyday my child plays with musical apps
- Multiple days a week my child plays with musical apps
- Once a week my child plays with musical apps
- A couple of times a month my child plays with musical apps
- Not at all

24. In the past month, how often did your child listen to music by themselves?

- Everyday my child listens to music by themselves
- Multiple days a week my child listens to music by themselves
- Once a week my child listens to music by themselves
- A couple of times a month my child listens to music by themselves
- Not at all

25. Do you or any family members currently play a musical instrument as a hobby or a profession?

- Yes
- No

26. If the past month, how often did you and/or other family members play their instrument in front of or with your child?

- Everyday musical instruments were played in front of or with my child
- Multiple days a week musical instruments were played in front of or with my child
- Once a week musical instruments are played in front of or with my child
- A couple of times a month musical instruments are played in front of or with my child
- Not at all

5. Music in Everyday Life - Part 2

27. In the past week, what style or genre of music did your family listen to?

	Not at all	One day of the week	A couple of days of the week	Almost every day of the week	Every day of the week
Music from your cultural heritage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Classical music	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jazz music	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Children's songs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pop music	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relaxation music	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dance Music	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please describe)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify)

28. Frequency of music use to support activities in daily life - We use music (singing, listening, playing) in different ways, in order to help my child:

	Not at all	Multiple days a week	Once a week	A couple of times a month	Not at all
Calm Down	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
At meal time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
At bed time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Understand daily routine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have fun and experience enjoyment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transition smoothly between activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Learn new things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. Behaviour Inventory

We would like to know some more about your child's behaviour - For the person that you are rating, please think about each statement and respond based on how he or she behaved over the past 7 days:

FREQUENCY- How often does a behaviour occur? Think about how extreme this behaviour is when it occurs, how long it lasts and how often it interferes with daily life.

OR QUALITY - How independently does this person carry out a behaviour? Does he, or she, require a lot of help and support, just a few prompts or reminders, or is the behaviour spontaneous, occurring without help? Think about how many situations, places, or settings you see him or her or do this. If you have not observed the behaviour in the past 7 days, select the "not at all" option.

29. Social Communication	Not at all	With Support	With Some Reminders	Without Help
1. Shows appropriate affection towards familiar people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Pays attention to or notices what other people are doing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Responds positively when others try to start social interactions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Gives things to others in order to get help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Is flexible when playing with others or taking part in social activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Is creative or imaginative in play or other activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Is able to take turns in conversation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Directs facial expression towards other people to communicate feelings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Offers information about his/her own thoughts or feelings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Waves 'hello' and 'goodbye'	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. Uses common gestures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Combines body language with words or sounds to support communication	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. Uses tone of voice appropriately	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

30. Social Communication				
	Never	Sometimes	Often	Very Often
Responds to other people's emotions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Looks when he/she is called or praised	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Looks where another person is looking or pointing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shows pleasure in shared interactions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Uses facial expressions that are appropriate to the situation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Resists affection from familiar people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shows inappropriate affection towards unfamiliar people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has difficulty interacting with peers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Says socially inappropriate things OR makes inappropriate social approaches	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attends to parts of sentences and misinterprets whole sentences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. Behaviour Inventory - Part 2

Based on your child's behaviour over the last seven days, to what extent did they:

31. Restrictive and Repetitive Behaviours

	Never	Sometimes	Often	Very Often
Gets upset over small changes in routine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has difficulty being flexible	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Resists trying out new things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Insists on doing things the same way each time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is fixated on certain topics or activities and unable to move on	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has a very limited range of interests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Repeats /echoes what others say	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Insists on saying words and phrases over and over	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has mannerisms or odd ways of moving his/her hands or fingers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Makes repetitive movements	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Behaves in a way that can cause injury to self	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Over-reacts to common smells	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Over-reacts to noise or sounds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Over-reacts to touch or being held	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is overly sensitive to certain food textures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

32. Mood and Anxiety				
	Never	Sometimes	Often	Very Often
Cries over minor annoyances and hurts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Worries about minor things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is tense or anxious	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clings to adults or is overly dependent on them	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is anxious in social situations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Appears sad	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is fearful of specific objects or situations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has sleep problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
33. Self Regulation				
	Never	Sometimes	Often	Very Often
Has difficulties waiting his/her turn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Acts without thinking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Acts recklessly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Switches quickly from one topic or activity to another	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has difficulties playing or engaging in leisure activities quietly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fidgets	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has difficulty remaining seated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is excessively active	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

34. Challenging Behaviour				
	Never	Sometimes	Often	Very Often
Is verbally aggressive towards others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is physically aggressive towards others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reacts with aggression when he/she is upset or stressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Throws things inappropriately	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Runs away	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Takes or grabs things that belong to others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Has temper outbursts or tantrums	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. Behaviour and Communication

These are more general questions regarding your child's social interaction using a Social Responsiveness Scale - For each item, please circle the number that best describes your child's behaviour over the last month. If the question is not applicable due to your child's support needs, e.g. they don't speak yet or interact with other children, please answer 'Don't Know'.

35. Seems much more fidgety in social situations than when alone
 Not True Sometimes True Often True Almost Always True Don't Know
36. Expressions on their face does not match what they are saying
 Not True Sometimes True Often True Almost Always True Don't Know
37. Seems self-confident when interacting with others
 Not True Sometimes True Often True Almost Always True Don't Know
38. When under stress, he or she shows rigid or inflexible patterns of behaviour that seem odd
 Not True Sometimes True Often True Almost Always True Don't Know
39. Doesn't recognize when others are trying to take advantage of him or her
 Not True Sometimes True Often True Almost Always True Don't Know
40. Would rather be alone than with others
 Not True Sometimes True Often True Almost Always True Don't Know
41. Is aware of what others are thinking or feeling
 Not True Sometimes True Often True Almost Always True Don't Know
42. Behaves in a way that seems strange or bizarre
 Not True Sometimes True Often True Almost Always True Don't Know
43. Clings to adults, seems too dependent on them
 Not True Sometimes True Often True Almost Always True Don't Know
44. Takes things too literally and doesn't get the real meaning of conversation
 Not True Sometimes True Often True Almost Always True Don't Know
45. Has good self-confidence
 Not True Sometimes True Often True Almost Always True Don't Know

46. Is able to communicate his or her feelings to others

Not True Sometimes True Often True Almost Always True Don't Know

47. Is awkward in turn-taking interactions with peers (e.g doesn't understand the give-and-take of conversations)

Not True Sometimes True Often True Almost Always True Don't Know

48. Is not well coordinated

Not True Sometimes True Often True Almost Always True Don't Know

49. Is able to understand the meaning of other peoples tone of voice and facial expressions

Not True Sometimes True Often True Almost Always True Don't Know

50. Avoids eye contact or has unusual eye contact

Not True Sometimes True Often True Almost Always True Don't Know

51. Recognizes when something is unfair

Not True Sometimes True Often True Almost Always True Don't Know

52. Has difficulty making friends, even when trying their best

Not True Sometimes True Often True Almost Always True Don't Know

53. Gets frustrated trying to get ideas across in conversations

Not True Sometimes True Often True Almost Always True Don't Know

54. Shows unusual sensory interests (e.g. spinning objects) or strange ways of playing with toys

Not True Sometimes True Often True Almost Always True Don't Know

55. Is able to imitate others' actions

Not True Sometimes True Often True Almost Always True Don't Know

56. Plays appropriately with children their age

Not True Sometimes True Often True Almost Always True Don't Know

57. Does not join group activities unless told to do so

Not True Sometimes True Often True Almost Always True Don't Know

58. Has more difficulty than other children with changes in their routine

Not True Sometimes True Often True Almost Always True Don't Know

59. Doesn't seem to mind being out of step or "not on the same wavelength as others"

Not True Sometimes True Often True Almost Always True Don't Know

60. Offers comfort to others when they are sad

Not True Sometimes True Often True Almost Always True Don't Know

61. Avoids starting social interactions with peers or adults

Not True Sometimes True Often True Almost Always True Don't Know

62. Thinks or talks about the same thing over and over

Not True Sometimes True Often True Almost Always True Don't Know

63. Is regarded by other children as odd or weird

Not True Sometimes True Often True Almost Always True Don't Know

64. Becomes upset in a situation with lots of things going on

Not True Sometimes True Often True Almost Always True Don't Know

9. Social Communication Part 2

65. Can't get his or her mind off something once they start thinking about it

Not True Sometimes True Often True Almost Always True Don't Know

66. Has good personal hygiene

Not True Sometimes True Often True Almost Always True Don't Know

67. Is socially awkward, even when trying to be polite

Not True Sometimes True Often True Almost Always True Don't Know

68. Avoids people who want to be emotionally close to them

Not True Sometimes True Often True Almost Always True Don't Know

69. Has trouble keeping up with the flow of a normal conversation

Not True Sometimes True Often True Almost Always True Don't Know

70. Has difficulty relating to adults

Not True Sometimes True Often True Almost Always True Don't Know

71. Has difficulty relating to peers

Not True Sometimes True Often True Almost Always True Don't Know

72. Responds appropriately to mood changes in others (e.g. when a friend's or playmate's mood changes from happy to sad)

Not True Sometimes True Often True Almost Always True Don't Know

73. Has an unusually narrow range of interests

Not True Sometimes True Often True Almost Always True Don't Know

74. Is imaginative, good at pretending (without losing touch with reality)

Not True Sometimes True Often True Almost Always True Don't Know

75. Wanders aimlessly from one activity to another

Not True Sometimes True Often True Almost Always True Don't Know

76. Seems overly sensitive to sounds, textures or smells

Not True Sometimes True Often True Almost Always True Don't Know

77. Separates easily from caregivers

Not True Sometimes True Often True Almost Always True Don't Know

78. Doesn't understand how events relate to one another (cause and effect) the way other children his or her age do

Not True Sometimes True Often True Almost Always True Don't Know

79. Focuses their attention to where others are looking or listening

Not True Sometimes True Often True Almost Always True Don't Know

80. Has overly serious facial expressions

Not True Sometimes True Often True Almost Always True Don't Know

81. Is too silly or laughs inappropriately

Not True Sometimes True Often True Almost Always True Don't Know

82. Has a sense of humour, understands jokes

Not True Sometimes True Often True Almost Always True Don't Know

83. Does extremely well at a few tasks, but does not do as well at most other tasks

Not True Sometimes True Often True Almost Always True Don't Know

84. Has repetitive, odd behaviours such as hand flapping or rocking

Not True Sometimes True Often True Almost Always True Don't Know

85. Has difficulty answering questions directly and ends up talking around the subject

Not True Sometimes True Often True Almost Always True Don't Know

86. Knows when they are talking too loud or making too much noise

Not True Sometimes True Often True Almost Always True Don't Know

87. Talks to people with an unusual tone of voice (e.g. talks like a robot or like they are giving a lecture)

Not True Sometimes True Often True Almost Always True Don't Know

88. Seems to react to people as if they are objects

Not True Sometimes True Often True Almost Always True Don't Know

89. Knows when he or she is too close to someone or invading someone's space

Not True Sometimes True Often True Almost Always True Don't Know

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