On Becoming and Being a Musician: A Mixed Methods Study of Musicianship in Children and Adults

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Statement of Originality

I certify that the work in this thesis is my own.

Signed………………………………. (Dawn Rose)

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Dedication

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Thesis Abstract

Studies comparing musically trained and untrained children and adults provide evidence of structural, functional and behavioural changes associated with experience-specific adaptation within the cortical and subcortical sensory-motor neural networks. Researchers have suggested that changes associated with musical learning may transfer to near domains (e.g. fine motor ability) and/or far domains, such as general intelligence. However, few studies have considered the concomitant development of a range of cognitive, behavioural and socio-emotional measures reflecting emerging musicianship. No other study has attempted to situate these findings within the context of adult musicians' experience. Two studies are presented here; firstly a quantitative longitudinal quasi-experimental investigation of multiple measures of musicianship. 19 children received only statutory school music group lessons over one academic year, and another 19 children received additional extracurricular musical instrument lessons for the first time during that year. A battery of tests included measures of aptitude, intelligence, memory, motor abilities and parental and teacher reports of socio-emotional behaviours. Results showed musical training enhanced hand-eye coordination and fluid intelligence, replicating and extending previous studies. The second study is a qualitative grounded theory investigation of a range of 28 adult musicians reflecting contemporary working musicians in the U.K. This includes nonconformist and popular musicians as well as conductors and music producers. They reflected upon what it is to be a musician, and what qualities they were aware their experiences had brought to their lives. A musicians' model of musicianship emerged which challenges assumptions relating to the concept of transfer effects. The data generates new hypotheses that musical learning supports and encourages flexible cognitive and behavioural skills and creativity that are further enhanced by the concomitant experience of nonverbal communications encompassing music and socialisation.

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Chapter One – Aims, Objectives and Background

1.1 Abstract

As the studies included in this thesis investigated the effects of musical learning using a range of cognitive, behavioural and socio-emotional measures, specific reviews of literature relevant to the samples and measures used are included in each chapter as appropriate. This chapter sets out the overall aims of this thesis, provides background on the development of the concept of transfer effects and synthesises the literature regarding structural and functional changes in the human brain as a result of musical learning. Finally the chapter discusses music education research as a whole and provides an overarching rationale and outlines the aims of this thesis.

1.2 Introduction

Nearly thirty years ago, in his book, The Developmental Psychology of Music, David Hargreaves claimed that there is *"growing recognition that the cognitive, social and affective dimensions of development cannot be studied in isolation from one another* [and that this] *is completely in tune with the needs of music education"* (Hargreaves, 1986, p. 227). The recent works of Koelsch, Müllensiefen, Schlaug and Stewart (e.g. Koelsch, 2014; Müllensiefen et al., 2014; 2015; Schlaug 2015) have contributed novel approaches towards understanding the effects of contemporary musical enculturation, musical affect and musical learning. The work presented in this thesis aims to honour these perspectives by taking a holistic approach to understanding the multiple cognitive, behavioural and socio-emotional skills and abilities involved in becoming and being a musician.

1.3 Aims and Objectives

This thesis considers becoming and being a musician using a mixed methods approach. This approach is necessary in order to provide a wider perspective to a potentially linear concept that musical learning leads to other associated abilities. The evaluation of musical learning with a focus on transfer effects may have arisen because of the interplay between the nature of measurement in music psychology, and requirements for efficacy of learning (in order to provide justification of resources) in music education. This has led to research considering the notion that 'music makes you smarter' (Vaughan, 2000; Forgeard et al., 2008). This idea is initially appealing as it suggests a research agenda for investigating the potential importance of music in children's education. However, the notion of musical intelligence has incorporated many different factors, from the training of discrete skills such as subcortical auditory discrimination ability (Musacchia et al., 2007), to more domain general constructs, such as IQ (Schellenberg, 2004). These, combined with enduring popular notions such as the Mozart Effect (Rauscher, Shaw & Ky, 1995; Steele, Bass, & Crook, 1999) and Gardner's alternative theories of multiple intelligences, which specifies music as one discrete category, may have resulted in the attribution of benefits of musical training that exceed the evidence. This thesis will explore the associated concepts, review and contribute towards available evidence investigating those aspects of the concept of musical transfer effects that hold true and those that may be due to a process of reification.

This thesis explores the development of musicianship from two approaches. The first study presented is a quasi-experimental quantitative design involving 38 seven to nine year old typically developing children. Half of whom were learning a musical instrument for the first time in extra-curricular lessons (EMT), and half of whom where receiving only statutory school music (SSM) group lessons for one academic year. Hargreaves proposed that the specification of objectives for music education *"involves breaking down musical skills into the cognitive, affective, and psycho-motor components, and the evaluation of these objectives draws heavily on psychological assessment procedures."* (Hargreaves, 1986, p. 226). Therefore a battery of six measures was chosen for this study. These measures are fully described in chapter two, as is the participant sample for chapters three, four, five and six, in which these measures were utilised. In a pre-post design, based on previous literature, the study specifically included cognitive aptitude, musical aptitude, auditory memory (chapter three), fine and gross motor skills, and visual-motor integration (chapter four). Data on socio-emotional wellbeing as observed by parents and teachers were also evaluated (chapter five). The data analyses revealed some marked individual differences within the sample, and the impact of neurodevelopment disturbance on music learning was explored in a case study (chapter six).

The studies in chapters three, four, five and six provided a holistic perspective on the cognitive, behavioural and socio-emotional impact of the first year of musical learning for children. This research raised questions about our assumptions of what it is to be a musician, which resulted in a further mixed methods study presented in chapters seven and eight. Chapter seven characterised 28 adult musicians using a personality index and qualitative descriptions of their professional working lives. Chapter eight presents a grounded theory study focusing on the experience of those musicians. During semi-structured interviews, the participants explored what it is to be a musician, and spoke about their journey of becoming and being musicians and the way in which their choices, motivated by their need to do music, impacted on their lives.

Before presenting these studies in detail there are three connected premises that need to be explored in order to provide background and context to the thesis. Firstly, what does the term musician, or musicianship mean? Secondly, what do concepts such as aptitude mean when considered in the context of neuro-imagining studies and research into pre-existing differences between musicians and non-musicians. Furthermore, what information does the literature provide regarding gene-environment interactions and how this impacts on the acquisition of skills in musical learning? Finally, how has the notion of transfer effects developed with regard to music education and music psychology research? The literature regarding these overarching questions form the background of this thesis and are discussed in the following section.

1.4 Background

1.4.1 What is a musician, or musicianship?

Until recently, descriptions of nonmusicians, and/or the musically naïve or untrained seem relatively homogeneous, whilst definitions of musicians in the literature seemed potentially biased towards formally trained musicians in the western classical tradition (Cook, 1998). In a paper elegantly demonstrating high levels of musical sophistication in the general population, Müllensiefen and colleagues (2014) provided robust evidence that the effects of enculturation challenges the concept of a simple dichotomy between the musically trained and untrained.

In comparison, studies have variously described and operationalised the term 'musician' or 'musicianship'. For example, for their study on the effects of musical training on the structure of the corpus callosum, Lee, Chen and Schlaug (2003) determined musicianship on the basis of a questionnaire detailing the type of instrument/s learned, age of commencement of musical training, and possession of absolute pitch. Of their 56 participants (28 males, 28 females) 28 played keyboard only, 26 played a combination of keyboard and stringed or other instruments, and 12 played only stringed instruments. As they found no differences between the single instrument groups (in total corpus callosum area) the musicians were collapsed into one group and compared with a control group who had never learned a musical instrument.

Brandler and Rammsayer (2003) compared mental abilities between musicians and non-musicians (i.e. undergraduate students who had not played a musical instrument). The 35 graduate musicians had been classically trained for an average of 14 years. The musicians participated on the basis that the entrance requirements of the music colleges provided evidence of above average musical ability. They did not describe the instruments learned by the musicians and stated only that music was their main subject and/or they played in the symphony orchestra. Lotze et al., (2003) used functional neuroimaging to compare amateur and professional musicians during actual and imagined performance. Their professional musicians played violin and were recruited from classical orchestras and had played for approximately 35 years, beginning at seven years old, without interruption. The amateur violinists had started later on average, at nine years old, played for an average of 12 years and practised considerably less (two hours per week compared to the professionals who had reported practising for approximately 30 hours per week). The participants in the study by Amunts et al., (1997) were all classically trained musicians who played keyboards though some additionally played violin. Schmithorst & Wilke (2002) describe comparing subjects who had had ten years of continuous musical training or more with subjects who had not in their study of differences between white matter neural architecture between musician and non-musicians.

However, some studies have considered musical learning that has not necessarily led to professional status. For example, in a study investigating the long-term benefits of musical learning on training-driven plasticity, White-Schwoch et al. (2013) documented the length of formal musical instruction within the U.S. school system in 44 older adults. Participants self-reported either no formal training, one to three years of formal training during middle/junior high school, or ≥ four years of formal training continuing into high school/college. The participants reported they had not played or practised since the age of 25. However, the type of instrument or musical training was not recorded. The study found that a moderate amount of musical training in early years was associated with faster neural timing in response to speech in later life.

Whilst some of the differences are due to in part to recruiting a sample specific to the research questions, the description of the participants in general as musicians may be somewhat misleading as the overrepresentation of classically trained professional musicians who earn their living from music might not reflect the population of musicians in the U.K. The 2012 Musicians Union survey suggests that whilst 60% of musicians did attend Music College and have a music qualification, but that there is a *"complex patchwork of roles that make up a musician's portfolio career…and unusual working patterns…with negative knock-on implications"*. (*The Working Musician*, van der Maas, Hallam & Harris, 2012, p. 8).

Bearing this in mind, this thesis explores contemporary musicianship from the starting point of Lehmann, Sloboda, and Woody's (2007) psycho-social model of the distribution of musical skills in society (recreated and enlarged upon in Figure 1.1). This model does not assume that skills are acquired solely through one learning route and as would be accepted with measures of intelligence in the general population, this model assumes levels of skilled musicianship are distributed according to a bell curve. This is important as the Musician's Union (MU) survey described earlier suggests that the U.K. accounts for 10% of global music sales, exporting in excess of £17 billion per annum.

Whilst exact figures are not available regarding genre specific music making, between 2008-9, the U.K. Office for National Statistics recorded that 272,100 people reported being employed in music and visual performing arts. The MU survey (van der Maas, Hallam & Harris, 2012) based on 2000 members states that these musicians have an average annual income below £20,000. 65% of musicians have no pension provision. Prior to identifying as ‘professionals’, 65% of musicians had undertaken four or more years of formal training. 55% of musicians in the U.K. practice for more than five hours per week, 37% less than that. 60% of musicians make their income from teaching, yet only 20% identify as a music teacher. 81% identify as performing artists yet only 58% make any income from this aspect of their musicianship.

At this point, a working definition of a musician is adopted in accordance with the Oxford Handbook of Music Psychology as *“Individuals who are involved in music making…and develop an identity as a musician”* (MacDonald, Hargreaves & Miell, 2009, pp. 463-464). It is evident from this that neither the level of financial reward, nor the types of training undertaken are adequate criteria for defining a musician.

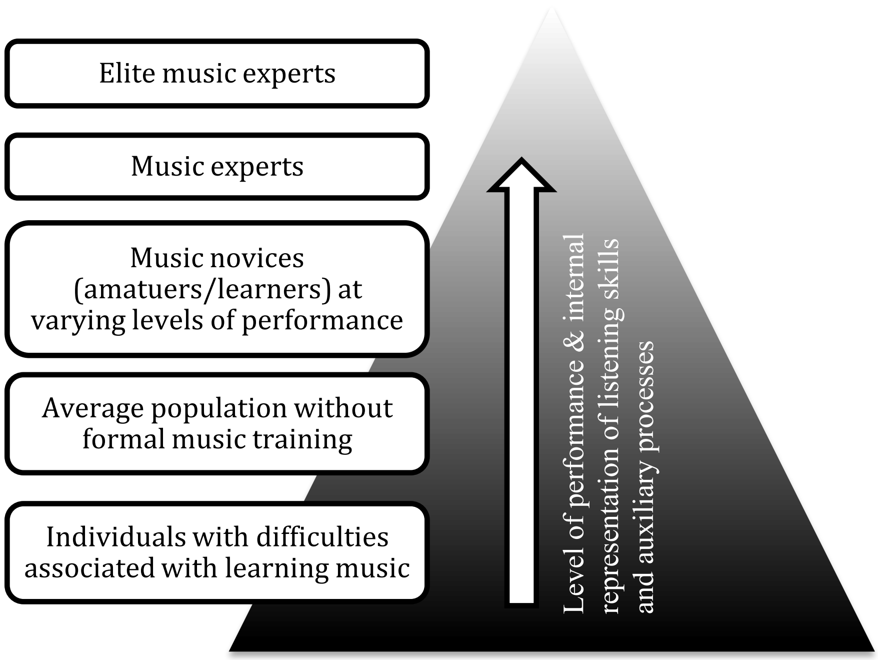

Figure 1.1. A psychosocial model of the distribution of musical skills in society (Lehmann, Sloboda, and Woody, 2007, p. 16)

1.4.2 Measuring musical aptitude or ability?

Whilst both intelligence and musicality are umbrella terms for aggregated sets of skills, they are not necessarily considered equal. In studies of musical learning that utilise measures of intelligence, discernible effects are often taken as evidence for transfer from the musical domain to the cognitive domain. Gardner (1983) suggested that individual differences will be better understood if ability is conceptualised in terms of multiple intelligences rather than in terms of one single generalised measure. Though Gardner claimed that his theory was consistent with biological, clinical, and experimental evidence, recent reading suggests his supposition was far from robust and leaned heavily on anecdotal discourse. Gardner's theory has been highly influential, not least because it has allowed researchers to study the interplay between, or independence of, musical and cognitive intelligences. However, musical studies have often measured what is generally defined as musical aptitude. Lehman (1968) defined musical aptitude rather generally as the potential or capacity for [musical] achievement. Radocy and Boyle enlarged upon this stating that,

"*Audition skills logically* <u>*are*</u>[1] *related to musical success, but musical ability, in a larger sense, is probably an interaction of audition, physical coordination, intelligence, and experience*." (Radocy & Boyle, 1979, p. 272).

However, they then rather ambiguously define musical aptitude as *"broader than capacity, yet narrower than ability"* (Radocy & Boyle, 1979, p. 263), although they also include factors described as genetic endowment and maturation, and those musical skills that develop without formal musical education. When later describing the measurement of musical aptitude, they suggested it is an attempt to assess the *"complex holistic behaviours…that requires integration of many skills"* (Boyle and Radocy, 1987, p. 36). In practice, this has been approached from either an omnibus stance providing one overall score of musical intelligence (e.g. Wing, 1962), or from an atomistic approach deriving several scores of discrete skills (Seashore, 1938). This can be thought of as analogous to reporting either an IQ score, or two separate scores for fluid or crystalised intelligence.

Rainbow (1965) had recognised some difficulties in defining 'nonmusical' or 'extramusical' factors associated with musical aptitude. According to the teachers of 291 music students surveyed in his study, the criterion variables of musical aptitude would include tonal memory, academic intelligence, musical achievement, interest in music and socio-economic background. Notably, musical variables commonly used in measures of musical aptitude, such as pitch or rhythm discrimination were not found to be significant predictors of musical achievement according to the teachers.

This leaves us in a quandary regarding the usefulness of measuring musical aptitude. Are we measuring something that is innate and therefore attempting to establish

[1] Underlined emphasis added to replicate italic emphasis of the authors

pre-existing differences? Does that help us understand the effects of explicit musical training more clearly? Or does the aptitude suggest limitations of trainability based on heritable gene pools to the extent that we really mean to identify a constrained musical capacity? What do aptitude tests measure that suggests some form of training may predict an effect that is either direct or transferable? In order to address these questions, it is important to consider what we know about how musical learning appears to cause representational and functional adaptations in the brain. Therefore, the next section provides some background regarding potential predispositions towards music on a genetic basis, followed by a summary of known general affects of musical learning on structural and functional experience-specific adaptations in the brain.

1.5 Building a Bio-ecological Model of the Affect of Musical Learning

1.5.1 Background

In the late 19th century, German surgeon, Auerbach (1890-1923) recorded a noticeable bulge in the superior temporal gyrus when conducting post-mortems on musicians. He associated this with their profession (Williamson, 2014). Since then, in vivo brain scanning techniques such as electroencephalography (EEG), magnoencephalography (MEG) and functional/structural magnetic resonance imaging (f/s)MRI, have provided evidence of structural and functional differences occurring in the brain as a result of occupational specialisation. Johnson (2011) suggests a framework of interactive specialisation with regard to functional brain development. Together with the following evidence, this framework suggests a range of developing music skills and abilities, which may potentially be observed concurrently. A diagram of this has been provided in Figure 1.2 in order to summarise the literature now considered.

Early evidence pertaining to a causal effect of co-occurring musical ability, creativity and, a particular type of intelligence (i.e. spatial-temporal) on the brain resulted in a neurobiological model known as the *Trion Model of Cortical Organization* (Leng et al., 1990). According to this model the firing patterns of a group of interconnected neurons, spread across a large area of the cortex, are not only similar for musical reasoning and spatial intelligence, but rely on a pattern of cortical development which could be predicted by musical exposure. Although this finding spurred research into what has become known as ‘The Mozart Effect’ (Rauscher, Shaw & Ky, 1995), a different strand of subsequent research has robustly linked active (as opposed to passive) listening, at early developmental periods, with long-term spatial-temporal reasoning ability (see Bilhartz, Bruhn & Olson, 1999; Gromko & Poorman, 1998). Due to the extent of findings in regions across and within the brain, some researchers have begun to consider that *"musicality is a cognitive adaptation"* (Honing & Ploeger, 2012, p. 513).

1.5.2 Updating The 'Talent' Debate

In the early 1990s, Ericsson, Krampe and Tesch-Römer (1993) published results showing that musical expertise reflected thousands of hours of deliberate practice. These findings sparked the 'talent debate'. Howe, Davidson and Sloboda (1998) published a paper attempting to refine an operational definition of 'talent'. Whilst relevant aspects of this paper are discussed in more detail in chapter three, it is important to note that the paper had an enormous impact prompting responses from thirty high profile international researchers. Questions about musicality, framed within the nature/nurture debate were considered from many different points of view. A decade later, an increasing understanding of genetics and gene/environment interactions modified opinions. For example, Ericsson adjusted his stance to include an acknowledgement of genetic constraint by suggesting that, *"…excepting the innate determinants of body size…distinctive characteristics of elite performers are adaptations to extended and intense practice activities that selectively activate dormant genes that all healthy children's DNA contains"* (Ericsson, 2007, p. 4). Remarking on the continued meritocratic appeal of the position taken by Ericsson and his colleagues, Hambrick et al. (2014) conducted a meta-analysis comparing elite performance in chess and music. They found that only 29.9% of variance in music performance could be explained by deliberate practice, leaving 70.1% variance potentially explainable by other factors. To put this into context, another meta-analysis carried out by Macnamara, Hambrick and Oswald (2014) suggested that overall, deliberate practice accounts for 26% of the variance in games (such as chess), 21% variance in music, 18% variance in sports, 4% in education and 1% in professions.

Early research focused on more specific phenotypes associated with music, such as absolute pitch (see e.g. Lenhoff, Perales & Hickok, 2001; Zatorre 2003), or congenital amusia (see e.g. Peretz, Cummings & Drubé, 2007; Stewart, 2008). These phenotypes can be seen as manifestations of the expression, or lack of, genotype musical traits. More recent studies have used advanced techniques such as genome-wide linkage analyses to search for gene clusters associated with musicality. For example, Gregerson and colleagues (2013) used this technique to analyse the gene pool of families with both absolute pitch and synesthesia. They found a candidate gene, EPHA7 that appears to play an important role in neural differentiation and connectivity in the developing brain. Based on a hypothesis that music performs a social communicative function that serves human evolution, Ukkola-Vuoti and colleagues (2009) analysed genes associated with social bonding and cognitive functions in 19 musical families. They found a haplotype association between tests of musical aptitude and the vasopressin receptor AVPR1A gene. Ukkola-Vuoti and colleagues interpreted their finding as suggesting that the production and perception of music is likely to be related to pathways that affect intrinsic attachment behaviours. A later study (Ukkola-Vuoti et al., 2013) investigating the molecular background of musical phenotypes, using a combination of musical aptitude and musical creativity tests and found low scores on musical aptitude were associated with a deletion at 5q31.1. This chromosome covers the protocadherin-α gene cluster, which is involved in synaptogenesis, differentiation and neural migration. They also found an association between the measures and glucose mutarotase gene (GLAM) at 2p22. This was interpreted as linking musical creativity with the serotonergic systems (which affect mood) influencing both music perception and production. More recently still, Oikkonen and Järvelä (2014) considered how inner ear development might be related to musical aptitude as part of a genetic trait associated with hearing acuity as many tests of musical aptitude rely on auditory discrimination. They identified several single nucleotide polymorphisms (SNPs – pronounced SNIP). These are involved in the developmental regulation of cochlear hair cells and the inferior colliculus, which is important for tonotopic mapping. The strongest SNP was found near the gene coding for the GATA2 binding protein at chromosomal locus 3q21.3. Further associations (with musical aptitude) were found for the protocadherin 7 and 15 genes, expressed in the cochlea and essential for hair cell transduction respectively, and further implicated in amygdaloid complexes. These collections of 10 nuclei in the mid-temporal lobe have been associated with assigning emotion to sensory information (Sah et al., 2003).

These recent discoveries have led Schellenberg (2015) to propose that *"music training is an ideal model for the study of gene-environment interaction but far less appropriate as a model for the study of plasticity"* (Schellenberg, 2015, p. 170). According to Schellenberg, children who choose to study music are confident, co-operative, and possess above-average cognitive ability, motivation, and concentration. He further suggests that these pre-existing individual differences become exaggerated in the musical environment. Consequently, Schellenberg suggests a theory of self-selection for musical ability. He considers that children seek out environments that are consistent with their predispositions. Therefore children with a pre-existing disposition towards music will seek out a musical environment, which may include taking music lessons.

1.5.3 Environment and Opportunity

Schellenberg and other researchers (e.g. Hallam, 2010) have also suggested that pre-existing differences are embedded in social and cultural advantage. For example, higher socio-economic status may provide opportunities for some children, but not others, to benefit from music lessons. Hallam refers to Bourdieu's concept of cultural capital in that social advantage is reproduced. Other studies and interventions have considered this in much greater detail (such as the El Sistema programme in Venezuela, see e.g. Baker 2014). Consequently, the recruitment for this study purposefully incorporated both state and independent schools where extra-curricular musical instrument lessons are offered, but are either heavily subsidised (state schools) or paid for entirely by parents (independent schools). Data was also gathered concerning parents' levels of education and home postcodes (which have been attributed social classifications) in order to attempt to control for these factors that may also contribute to individual differences on the basis of advantage inferred by socio-economic status. Whilst this could not be taken to control for all aspects of social advantage, data was also collected concerning whether the children had chosen the activities they took part in themselves, or whether parents had decided for them and also on the attitudes of parents towards musical learning. By addressing these contributing factors, this study sought to understand more about the process of self-selection if evidence was revealed which suggested this may be an underlying factor in musical aptitude and motivating musical achievement.

Having briefly discussed recent genetics research, social science and theoretical work on musical aptitude, this background review will now consider general evidence relating to the effects of musical learning on the human brain. The concept of transfer effects, and the study of this effect within music education will then be reviewed.

1.5.4 Structural and Functional Neural Adaptation

With regard to processing auditory information, once sound has been transduced, the source signals are integrated en route to the medial geniculate nucleus (MGN) in the thalamus. The MGN relays efferent and afferent connections between the inferior colliculus (the midbrain nucleus receiving input from the auditory brainstem) and Primary Auditory Cortex (PAC; Brodmann's Area 41 and 42). The PAC also receives input from a pathway known as the efferent corticofugal pathway (Plack, 2013). The PAC projects into the secondary auditory cortex where sounds are tonotopically organised (mapped from the hair cells innervated from the basilar membrane in the cochlear) in the lateral aspects of Heschls Gyrus (HG), an area known to be pitch sensitive in mammals (Bendor

& Wang, 2006; Woods et al., 2010). This hierarchical activation continues into the anterior and posterior superior temporal gyrus (Krumbholz et al., 2003; Patterson et al., 2002). Finally, with regard to musical sound, behind HG, a leftward asymmetry in the planum temporale has been associated with absolute pitch perception (Keenan et al., 2001; Schulze, Gaab & Schlaug, 2009) and pitch height awareness (i.e. 'which octave?'), and the planum polare (anterior to HG) which appears to establish pitch chroma ('which note within the octave?') and further into the anterior superior insular cortices (Warren & Griffiths, 2003). Although the absolute size of the HG neural substrate appears to be associated with the amount of time spent practising music, within HG, differences in perceptual preference have been found regarding lateralisation associated with rapid temporal processing (left) or slower temporal and spectral processing (right) regardless of musical expertise (Schneider et al., 2005).

Schlaug et al. (1995) studied musicians using neuro-imaging techniques observing changes in the corpus callosum (CC), the white matter fibre tract that maintains a balance between the facilitation and inhibition of information transfer between brain hemispheres. Schlaug and colleagues reported that musicians (30 keyboard and string-playing instrumentalists) with more than seven years training, in comparison with age and gender matched musically untrained controls, presented with significantly larger anterior CC than non-musicians. Subsequent research showed decreased interhemispheric inhibition in musicians, suggesting that this adaptation enables increased independence between hands (Lee, Chen & Schlaug, 2003; Oztürk et al., 2008; Ridding et al., 2000). Evidence of early adaptation has been observed in children as young as six, who after 15 months of musical training showed differences in the pre-central gyrus (PCG), CC and HG (Hyde et al., 2009). Studies focusing on children will be discussed in more detail in chapters three to six.

The complexities involved in musical learning include planning and executing complex motor sequences, simultaneously coordinating and controlling independent movements with multiple body parts, integrating auditory, visual, tactile and proprioceptive information in a constant dynamic monitoring mode resulting in the phenomenon of 'metaplasticity' (Schlaug et al., 2010; Stewart, 2008). The notion that musical learning supports a dynamic metaplasticity suggests functional as well as structural adaptation has occurred. Evidence emerging from multiple perspectives, such as studies of evoked event related potentials (see e.g. Janata, 1995; Koelsch, 2005), and diffuser tension imaging of the white matter tracts of the brain (see e.g. Bengtsson et al., 2005; Imfield et al, 2009; Schmithorst & Wilke, 2002) is presented in chapters three and four.

James et al., (2014) recently compared musicians and non-musicians and observed multiple brain differences in the two groups. Comparing 20 professional pianists, 20 amateur pianists and 19 non-musicians the authors found linear increases according to levels of expertise in grey matter density (GMD) in the right fusiform gyrus associated with visual pattern/form recognition (Koutstaal et al., 2001) and musical learning (Stewart, 2005). Similarly, increases in GMD were found in the right mid-orbital gyrus, associated with tonal sensitivity (Janata et al., 2002a), self-referential judgement (Denny et al., 2012) and cognitive control of emotion (Ochsner et al., 2009). They cite Janata (2005) as interpreting the function of this area to be *"the nexus of cognitive, affective and mnesic processing"* (James et al., 2014, p. 360). GMD also increased as a function of expertise in the left inferior frontal gyrus spreading from the pars triangularis into the anterior insula, an area they suggest is associated with musical expertise in working memory, executive function (Janata et al., 2002b; Schulze et al., 2011) and syntactic processing for music and language (Tilmann et al., 2006). GMD increases were also found in the left intraparietal sulcus, an area associated with visual-motor coordination in a juggling learning study (Draganski et al., 2004) and is seen as a critical structure for musical note reading (Schön et al., 2002; Stewart et al., 2003). Finally James and colleagues reported GMD increases bilaterally in the posterior cerebellum. This area was associated with motor function (Ito, 2002) but has more recently also been associated with executive function and working memory (O'Reilly et al., 2010; Salmi et al., 2010; Schmahmann, 2009).

As predicted, James and colleagues found an increase in grey matter density (GMD) in the left Heschl's gyrus in high-level musicians. They also found a decrease in GMD in these same participants in the bilateral periolandic and striatal areas related to sensorimotor functions. They suggest the decrease in these areas is due to the principles of economy in movement and that once the visual, proprioceptive and auditory feedback skills necessary to play a musical instrument are increased, the external cues are no longer required (Jäncke et al., 2000; Krings et al., 2000). Regarding the striatum they suggest that models incorporating the cortico-basal ganglia-thalamo-cortical loop (with regard to high movement skill reducing the importance of striatal movement control) should now include the border region of the putamen and the caudate nucleus as research into other areas of expertise (such as chess) has found similar phenomena (Poldrack et al., 2005; Wan et al., 2011).

The richness of musical learning, experienced in the moment as cross-modal multi-sensory incoming information is thought to re-calibrate templates of musical stimuli already held in the long term memory as part either of an individual's knowledge and understanding of musical hierarchies, and/or autobiographical memories and experiences (Janata, 2009). For example, Groussard and colleagues (2010) found a difference in GMD in adults in the hippocampus, an area of the brain associated with memory and emotion. During a musical familiarity task performed in order to test long term memory, musicians, in comparison to nonmusicians, exhibited stronger activation in the bilateral anterior portion of the hippocampus (extending to the entorhinal cortex on the left and into the parahippocampus on the right). This effect was significant even after controlling for the differences in grey matter density. A qualitative debriefing session was carried out following each scanning session in order to retrieve information regarding the strategies utilised. Personal memories were evoked in 85% of musicians (n=20), but only 30% of nonmusicians (n=20). Musicians reported using phrases such as *"I've played this melody before"* and also reported associated mental imagery, such as *"I can see myself playing this",* whereas the nonmusicians did not. The richness of the detail provided by the musicians describing how they remembered was notable in this study and the neural regions identified in this study have been more strongly associated with long-term autobiographical memory, rather than with working memory components. This suggests memory for detail may need to be meaningful and situated within a context, which would not necessarily implicate any advantage for working memory in musicians. However, in another study, where 60-85 year old participants were given one 30 minute piano lesson per week and practised for three hours individually each week, improvements on test of working memory, motor skills and perceptual speed were evident after six months of musical training (Bugos et al., 2007). Further positive effects of musical training have been observed in aging populations who are new learners. For example, in a study by Verghese et al. study of 2003, groups of 75 year olds were followed for five years. The study reported that those who regularly played a musical instrument were less likely to develop dementia than those who did not, which is encouraging in terms of the potential benefits of plasticity in later years.

Musical learning has also been suggested to be beneficial in developing auditory short term and working memory, and these specifically have been suggested as a mechanism that strengthens early anticipatory mechanisms, potentially linking working memory with intelligence (Alloway et al., 2004; Kane, Hambrick & Conway, 2005; Turner & Ioannides, 2009). Therefore, a brief outline of models of working memory is provided here as background to the study presented in chapter three, which focuses on the effects of musical training and cognitive abilities.

1.6 Intelligence, Working Memory and the Potential Connection with Musical Learning

Several models of working memory have been suggested. This overview begins with the most commonly referred to, the Baddeley and Hitch (1974), and Baddeley, (1992) model of working memory (WM). This consists of four components. Two of these are short-term domain-specific memory systems: the visuospatial sketchpad (responsible for the maintenance of visual and spatial information such as colour, shape, placement and direction of movement) and the phonological loop (for the storage and maintenance of auditory and verbal information). The phonological loop was later divided into two further subsections: a phonological short-term store and an articulatory subvocal rehearsal process whereby an auditory input lasts for approximately two seconds before the trace fades, unless rehearsed. The core component of WM is the central executive. This is thought to govern, regulate, control and coordinate these two (slave) systems. A more recently included fourth component, the episodic buffer (Baddeley 2000; 2003), is thought to provide temporary storage of multimodal information which is then integrated from the various subsystems and with long-term memory (LTM) to form a unitary episodic representation (Lee et al., 2007).

A less compartmentalised concept has been suggested by Kane et al. (2007) whereby WM functions as a link between STM and attentional control reactivating and inhibiting memory traces as appropriate and relevant. This idea is similar to Cowan's embedded processes model of memory, though he places more emphasis on WM as a global space between short-term memory (STM) and LTM with limited attentional duration (Cowan, 1998). Unsworth and Engle (2007) suggest STM and WM employ the same basic process but that they operate to different extents. Their controlled attention framework combines the components of active maintenance (primary; STM and WM) with controlled search and retrieval processes (secondary; WM only), which displaces items from the primary system. Alternatively Ericsson and Kintsch (1995) suggest that the function of WM is the ability to efficiently assess task-relevant information held within the LTM. The more acquired knowledge held in the LTM, the more able an individual is to overcome the limited capacity of their WM. Lee et al., (2007) consider this idea a connectionist approach that implies an interaction between biological factors and experience. Rather than separated systems, they assume increased processing capacity is acquired through learning. As they explain, *"Any architectural changes caused by these factors would have effects on both the processing capacity of the network and the nature of the representations embodied in the network."* (Lee et al., 2007, p. 337).

The extent to which each individual finds the tasks associated with various aspects of these models, either in general or with content/context-specificity to employ storage, attentional resources, and utilise for example rehearsal strategies, is a complex issue both theoretically and empirically. Cowan et al. (2005) showed that when a task requires executive-attentional resources, it could prevent the strategy of continual rehearsal and information grouping. For individuals with higher ability, when attentional resources are not necessarily required, measures of WM can be equated with measures of STM. With children, it has been demonstrated that there are important methodological differences with simple span tests. For example, backwards digit span tests place a much heavier demand in WM than forward digit span tests (see St. Clair-Thompson, 2010; St. Clair-Thompson & Allen, 2013). This will be discussed in more detail in chapter three.

In relation to general intelligence, or '*g'*, Kyllonen and Christal (1990) provided evidence for a correlation between WM capacity and reasoning ability (r = .8-.9), leading them to speculate that WM capacity is the 'Factor X' that underlies individual differences in g. The authors' acknowledged the arbitrariness of the tests they utilised but argued that this reflected the lack of specificity regarding operational definitions of WM (and associated tests). The actual battery of tests devised measured observable (or manifested) variables in the hope of uncovering a latent variable of WM, which could serve as a specific predictor of fluid g.

Engle et al. (1999) were able to distinguish between tasks that require storage (immediate memory) and tasks that require storage plus some form of additional processing, as these had been noted as showing differential patterns behaviourally (in patient populations and predicting reading abilities), and also in neuroimaging studies. Süß et al. (2002) extended these studies to nonverbal tasks and also considered other *"signature functions"* of WM such as coordination, integration, updating and switching (Conway, Kane & Engle, 2003, p. 548). Since both Süß (2002) and colleagues and Engle and colleagues (1999) found a consistent correlation between WM capacity and g of a magnitude between r = .59 and r = .65, Conway and colleagues consequently suggested that WM capacity is *"related to an executive attention ability, which supports the active maintenance of goal-related information in the face of interference"*. (Conway, Kane & Engle, 2003, p. 549).

They cite further evidence from neuroimaging studies of the differences not only between 'storage-only' and 'storage plus some form of processing tasks' but also between verbal and nonverbal tasks. For example, studies indicate storage only tasks activate Broca's area for verbal material but the right-hemisphere pre-motor cortex for spatial material (Smith & Jonides, 1999). However, in contrast more demanding storage plus processing tasks result in both content specific and domain general activation in the dorsolateral prefrontal cortex and anterior cingulate cortex. This evidence led Conway and colleagues to conclude that there is a relationship between WM capacity, *g* and executive attention.

Furthermore, latent variable analyses (or structural equation modeling) suggest WM capacity accounts for between one third and one half of the variance in *g*. If *g* is heritable and stable, a logical deduction is that the aspects of WM that overlap would be limited in capacity. Furthermore, attention and executive functioning are concepts that require self-regulatory skills and which have in common several related process such as inhibition (self-control), cognitive flexibility (situational behavioural adaptation) and planning (action selection). These cognitive skills (e.g. attention) are necessary in order to achieve strategically planned objectives whilst regulating action, especially when considered in the context of environmental feedback (Miyake et al., 2000; Pennington & Oronoff, 1996).

With regard to the potential contribution of reading musical notation, Meinz and Hambrick (2010) conducted a study on WM based on a sight-reading task of piano music. Although deliberate practice accounted for 45.1% of the variance, there was a significant incremental positive effect of WM capacity (7.4%) above and beyond that in which WM capacity had zero correlation with either deliberate practice per se and sight-reading practice specifically. Contrary to the assertion that WM capacity reflects acquired skills (Ericsson 2003; Ericsson & Kintsch, 1995), Meinz and Hambrick suggest there is no link. Instead they put forward the view that WM capacity is highly heritable and *"although necessary for acquiring expertise – will not always be sufficient to overcome limitations due to basic abilities"* (Meinz & Hambrick, 2010, p. 5). In a second paper, Hambrick and Meinz (2011) suggest a 'vocabulary' of skills associated to specific tasks (i.e. domain specific learning) and highlight that it is the interplay between these two factors which is important, specifically with regard to their circumvention-of-limits hypothesis (CoL H_1) notated as Ability x Knowledge. They suggest in *"theoretically neutral terms, working-memory capacity can be thought of as the limits on the ability to simultaneously store and process information"* (Hambrick & Meinz, 2011, p. 3) as measured by complex span tasks.

Moving on to issues surrounding the notion of transfer effects, Hambrick and Oswald (2005) had tested the CoL H_1 by giving participants a series of movements to recall using an isomorphic task. This utilised knowledge of baseball (i.e. templates stored in the LTM, possibly via enculturation) by depicting spaceships flying around a solar system, (i.e. the analogue being baseball players running around the baseball diamond). Although they found a positive effect of baseball knowledge on memory performance in the baseball task, they did not find any transfer to the spaceship condition; that is no WM capacity x Domain Knowledge interaction. Their evidence suggests modal specificities are important (e.g. spatial, auditory), as is situational awareness and different phases within individual learning/performance trajectories. However, it is not clear how the authors tested what previously held knowledge of baseball the participants could recall in this study.

The interdisciplinary usage of the term transfer effects, and differences in methodological approaches to studying this phenomenon may have resulted in differing interpretations by fields of research such as in music education research and music psychology. Therefore, in order to address any contextual inconsistences, a history of the term is briefly recounted in the following section.

1.7 The Concept of Transfer Effects

The term transfer needs to be more clearly described in order for it to be applicable and understandable across disciplines.

Historically, transfer effects were defined as either specific-to-specific skill (Thorndike, 1906) or more holistic (i.e. specific to general, see Judd, 1908). Hargreaves (1986) suggests that the development of the notion of transfer effects can be attributed to Piaget's philosophy of 'learn through play'. According to Piaget, it is during the second stage of developmental learning (from the ages of two to seven) that symbolic play becomes more adapted to reality *"in its functional pleasure and autotelism"* (Piaget & Inhelder, 1969, p. 63, In Hargreaves, 1986). This early notion (of transfer effects) was further developed in the 1970s when music instruction and performance were thought to be able to act as effective reinforcers of social and academic skills. For example, Greer, Randall and Timberlake (1971) suggested that the discriminate use of music listening impacted upon not only vocal acuity, but also on attending behaviour.

Originally, educational psychologists and educators believed that learning via transfer effects in general was dependent on similarity. Ellis (1965) referred to this as the Identical Element Theory. In a contemporary setting, process and efficacy are considered with regard to the extent to which past experiences (i.e. transfer source) affect learning and performance in a new situation (the transfer target, Helfenstein 2005). Salomon and Perkins (1989) suggested that transfer effects can be positive or negative. They introduced the concept of the low road (of transfer), which has a high level of automaticity based on lots of practice. Conversely, the high road (of transfer) requires intentional and mindful abstraction of an idea plus the conscious and intentional application in their theory of learning. Building on this, Bransford, Brown and Cocking, (1999) specified that initial learning must be more than mere exposure or memorisation. They suggest that for learning to occur there must be understanding, which takes time, and which leads to expertise. This learning is then manifested as deep, organisational knowledge that consequently improves transfer. Practice to improve transfer should include students specifying connections across multiple contexts. They noted four key characteristics of learning with regard to transfer effects: 1) the necessity of initial learning, 2) the importance of abstract and contextual knowledge, 3) the conception of learning as an active and dynamic process, not a static product, and 4) the notion that all learning is transfer.

Perkins and Salomon believed that the history of transfer effects is very important to learning theory and educational practice because most of the time, the desired transfer effects do not appear to take place. They suggested that this might be because notions of near and far transfer are *"intuitive,* [and] *resist precise codification"* (Perkins & Salomon 1992, p. 3). For example, when computers came into schools, consideration of transfer effects re-emerged as computer programming was thought to develop problem-solving skills. However, most research failed to support this assumption (see e.g. Beard, 1993; Pea & Kurkland, 1984; Salomon & Perkins, 1987). For example, Simon & Hayes (1976) studied problem solving in mathematics. They found that strategies acquired (in problem solving) were not really carried over to other analogous problem solving puzzles unless the connections/relationships were explicitly pointed out. Indeed, as Dweck (1986) persuasively pointed out, measuring performance on a task in itself does not take into account psychological factors (other than ability) that may influence the outcome. She suggests the late twentieth century move towards a social-cognitive approach of learning has shifted the emphasis towards cognitive mediators such as motivational patterns. Dweck showed that, in terms of goal-orientated behaviours, children tended to display patterns of behaviour. Children whose patterns was characterised as 'mastery-seeking' were persistent in the face of sought challenge and described as adaptive. Alternatively, when the children's patterns were characterised as 'helpless', their behaviours were described as maladaptive in that they were averse to the challenge displaying low persistence in the face of difficulty. Moreover, in terms of measurement, Dweck writes that her research demonstrates how "a focus on ability judgements can result in a tendency to avoid and withdraw from a challenge, whereas a focus on progress through effort creates a tendency to seek and be energized by a challenge" (Dweck, 1986, p. 1041). Pintrich and Schunk (2002) had also differentiated between achievement behaviours, though their descriptors differed slightly in that *mastery goals* concerned gaining competence through the development of skills, whereas *performance goals* emphasised competence in comparison with others. More recently, Pugh and Bergin (2006) found that with regard to motivation, *mastery goals* were more consistently linked to transfer success than *performance goals*. Overall, it is important to note that for children, high achievement in test scores (competence) does not predict the children's confidence for their future scores. Indeed, there also appears to be a sex (or more probably gender) difference. Intelligent girls have shown a tendency toward low expectancies and maladaptive behaviour patterns. It appears that past success did not provide the girls with a strong self-concept of ability, whereas the boys appeared to prefer challenges they could work to overcome (Licht et al., 1984). The mediating influences of motivation and self-concept, not only with regard to transfer effect but also specifically for music education, will be returned to in chapters five, six, eight and nine.

Building on Butterfield and Nelsons' (1991) distinctions as within-task, across-task and inventive transfer, Haskell (2001) proposed a more gradual scheme of taxonomy based on the similarity between tasks and situations. He distinguishes between non-specific transfer, which he outlined as the constructivist idea that all learning builds on present knowledge, i.e. pedagogy. He describes application transfer as the retrieval and use of knowledge from a previously learned task. In comparison, he suggested context transfer (rather counter intuitively) means the context-free transfer between similar tasks, and displacement or creative transfer suggests an inventive or analytic type of transfer that refers to the creation of a new solution during problem solving as a result of a synthesis of past and current learning experiences. Table 1.1 depicts an overview of types of transfer used in current discourse according to Schunk (2004).

Table 1.1. Types of Transfer, adapted and updated from Schunk (2004).

Type of Transfer	Manifestation
Near, Literal, Low Road or Within Task	Intact knowledge transfers to another task directly because there is overlap between original source and transfer target. Contexts similar so well established skills transfer automatically
Positive/Negative	What is learned/not learned in one context enhances/hinders or delays another
Vertical, Contextual or Across Task	Previous knowledge essential to acquire new
Horizontal or Non-Specific	Previous knowledge helpful but not essential
Figural or Displacement	Some aspects of general knowledge used to think or learn about new problem
Far, Inventive or High Road	Involves deliberate abstraction and conscious formulation of connections between contexts as there is no overlap, contexts are dissimilar.
High Road Creative and Forward Reaching	As above for potential contexts
High Road, Application and Backward Reaching	As above for previous situations

In the music psychology literature, with regard to transfer effects, a paper often cited but rarely discussed is *When and Where Do We Apply What We Learn: A Taxonomy for Far Transfer* (Barnett & Ceci, 2002). The authors reviewed the results of 100 years of academic argument on the topic of learning and concluded that the failure to specify dimensions along which transfer can occur has resulted in dialogues that are at cross-purposes. Specifically they claim that there has been a comparison of *"apples and pears"* (Barnett & Ceci, 2002, p. 612). Citing Klausmeier's (1961) assertion that one reason for teaching in school is to enable learning outside school, Barnet and Ceci suggest that investment in education has been based on the assumption that the acquisition of academic skills will enable students to become productive members of society. This suggests that it is both a practical and philosophical aim of society to educate in order to progress via knowledge applied through a good work ethic. They suggest a taxonomic framework would enable rigorous testing of an operationalised definition of far transfer and state, *"If the goal is to encourage transfer from school-based lessons to nonacademic situations in the workplace years later, then something akin to this context must be explored in transfer research if it is to be applicable to the goal in question."* (Barnett & Ceci, 2002, p. 632).

Their investigative review suggested that transfer might emanate from two potential sources: familiarity with the relevant contextual factors (i.e. the domain in question) and the individuals underlying cognitive skills regarding *"encoding, representing, retrieving, mapping, and transferring prior learning"* (Barnett & Ceci, 2002, p. 633). This suggests some aspects impacting on transfer may be heritable, and some trainable. Barnett and Ceci concluded that transfer is multidetermined and that success may be both situationally and contextually dependent.

Regarding continued misunderstandings of the underlying issues of transfer and shared resources, Klingberg more recently stated,

"The effect of training on a particular cortical region using a specific task would only be expected to transfer to other tasks and functions to the extent that the tasks rely on the same neural networks" (Klingberg, 2010, p. 318)

Concerning the misrepresentation of scientific studies with regard to transfer, Bangerter and Heath (2004) investigated the emergence and development of the scientific 'legend' of the Mozart Effect. They suggested that ideas propagate because they address the needs and concerns of social groups. In this case, the parents liked and therefore popularised the idea that listening to Mozart would enhance the intellectual development of their children. Rauscher and Hinton (2006) addressed the extraordinary impact of the original Mozart Effect research (Rauscher, Shaw & Ky, 1995). They confirmed music listening is clearly not music instruction and furthermore their paper had not mentioned any mechanisms of transfer. They discuss transfer and returned to Thorndike's (1913) premise that the similarity of the elements of the domains constrains the amount of transfer possible. They continue that whilst in the late twentieth century transfer became less vague, *"transfer is always a function of the relationship between what is learned and what is tested"* (Rauscher & Hinton, 2006, p. 235). They cite Singley and Anderson (1989) to explain that the overlap between domains is a function of the shared cognitive elements

The popularity of the notion of transfer effects may be in part due to the search for an explanatory mechanism to embody a concept of learning applied creatively. In this instance that requires an understanding of developmental trajectories, representational structural adaptations and functional differences as a result of musical learning. In the well-intentioned attempt to encompass multiple disciplines, it may be that field and context specific use of the terms must be faced in order to avoid unintended attributions. To clarify in this thesis, the use of the term ‘near transfer’ is restricted to associations between the musical skill learned and closely related non-musical abilities. Previous research has shown, for example, that learning to play a musical instrument is associated with the development of fine motor skills (Costa-Giomi, 1999; 2005; Lahav, Saltzman & Schlaug, 2007; Schlaug et al., 2005). In contrast, the term ‘far transfer’ effect is used to describe associations between musical learning and extra-musical abilities such as IQ (Schellenberg, 2004). Literature specifically associated with musical training and transfer effects on cognitive systems will be presented in chapter three, on motor and visual systems in chapter four and on socio-emotional behaviours in chapter five.

Changes in policy that require educators to justify music provision have re-ignited interest in the transfer effects of arts based learning (Branscombe, 2012). The final section of this introductory chapter relates to difficulties and issues specifically associated with research and music education.

1.8 Issues in Music Education Research

Benefits associated with arts in general have long been studied. Research carried out in the U.S. have shown that children who were highly involved in the arts in middle and high school outperformed children who were not involved in the arts on a multitude of academic indicators such as mathematic and reading proficiency, (Catterall, 1998; Catterall, Chapleau, & Iwanaga, 1999). Importantly, this relationship held when socio-economic status was taken into consideration. The students involved in the arts earned higher grades and test scores, were less likely to drop out, and watched fewer hours of televisions than students who were not involved in the arts. However, these studies are correlational and simply showed that those who chose (or were chosen) to study arts were also high academic achievers. Furthermore, it is not clear in the studies whether the arts classes are part of the school curriculum, or are extra-curricular activities. In response to results suggesting a causal relationship between arts participation and positive academic outcomes, Heath (1998) proposed a ‘High Energy’ hypothesis that suggested that the children’s energy was positively channelled by extra-curricular activities in general. This was supported by Eisner’s (2001) comparison of Scholastic Aptitude Test (SAT) scores, which suggested, *"the very process of sticking to something (whether art or an academic subject) leads to a better academic performance in other areas"* (Eisner, 2001, p. 35).

In 2004, the *Handbook of Research and Policy in Art Education*, was published, and based on a review of some 200 studies, concluded that *"there is (as yet) no compelling evidence that study in an art form leads to improved academic functioning."* (Hetland & Winner, 2004, pp. 4-5). The authors noted that few studies had explained in detail the nature and quality of the 'arts' instruction. They explained the lack of explicit description was problematic because explicit hypotheses can be associated with specific types of training. For example, drama training may lead to increases in empathy or self-expression. Painting or drawing may lead to increases in visual-spatial awareness and or fine motor skills. In turn, the nature of the activity may, or may not have affected the interpretation of the outcome. This is apparent in particular with regard to our understanding of near transfer.

Undoubtedly, the purpose and intention of testing in education has always been a difficult issue whether measuring the efficacy of arts programmes or academic attainment. Lehman (1968) outlined the two-fold criticisms about the process of general testing. First, tests may be inadequate and unfair, and second, test results may be misunderstood and/or misused. Boyle and Radocy (1987) specifically considered musical ability testing. The raised issues about the moral, social, political and legal implications of measurement and evaluation and suggested that care should be taken on several levels; a) to acknowledge the limitations and dangers of testing, b) to understand the relative merits and uses of norm-referenced and criterion referenced measurements, and c) to consider the approach to competency based teaching and mastery learning and the variables influencing these factors. This sentiment has motivated the approach taken in this thesis. The complexities of the issues involved have been considered by engaging in an ecologically valid mixed methods approach to understanding potentially co-occurring cognitive, behavioural and socio-emotional changes associated with levels of musical learning.

Returning to Hetland and Winner's report of 2004, the authors noted an explicit concern that when instrumental reasons become the chief justification for arts education, teachers may feel compelled to alter their methods, turning

"...strings of music notations into multiplication problems and bill this as music education, the kind likely to improve mathematics scores. Or they may teach the physics of sound in music class rather than the aesthetics of sound, or have student build musical instruments (because they may improve their spatial qualities) rather than learn to play these instruments." (Hetland & Winner, 2004, pp. 49-50).

Hetland and Winner conclude that we need to shift the focus and refine research methods used in studies of music training. They propose that research should centre on understanding teaching and learning in the arts, and that in addition to investigating transfer effects, studies should investigate the possibility of 'non-cognitive transfer'. By this they mean asking questions about the inclusive environments of schools which takes arts seriously, and the attendance of students in places of study which are more tolerant and focused on social justice. They suggest that searching for reasonable links between specific arts and other subjects may reveal more reasonable expectations of transfer from the arts to higher-order cognitive skills such as reflection, critical thinking, creative thinking, the ability to tolerate ambiguity and resistance to premature closure when solving messy problems.

Ultimately, their sentiment is that

"...if we become swayed by today's testing mentality and come to believe that the arts are important only (or even primarily) because they buttress abilities considered more basic than the arts, we will unwittingly be writing the arts right out of the curriculum." (Hetland & Winner, 2004, p. 50).

Consequently, the current study adopts a holistic approach to the study of a range of skills developed during the process of music learning in children. The study of adult musicians is focused on understanding what being a musician entails, and the methodology is designed to overcome what ethnomusicologists describe as "*sciencing* about music" (Merriam & Merriam, 1964, p. 25).

1.9 Overarching Rationale and Aims of the Study

People have long been interested in the effects musical training has on an individual's development. Research in neuroscience suggests that musical activity has a marked effect on the developing brain. Genetics studies suggest pre-dispositions towards music may be expressed beginning with inner ear development. Pre-existing differences may also affect the structural and functional development of the brain, and in particular impact upon social and emotional behaviours. Results from investigations in personality traits associated with high musical achievement suggest that openness to experience is an important factor common to musicians. However, whilst results from studies of musical aptitude suggest some heritability regarding musical dispositions, behavioural studies suggest that some, but not all of these manifestations of musicality are observable following substantial training. Little is known about the developmental trajectories that lead children to progress with music, suggesting studies of individual differences of typical and atypical early musical learning may enrich our understanding of this process.

As highlighted in this review there is no consensus amongst researchers about what constitutes a strong methodological approach. Consequently, one objective for this research was to explore alternative ecologically valid designs to study the affect of musical enrichment in children. Furthermore, conceptual problems regarding the types of musicians that are considered experts and therefore suitable for scientific study, were also addressed. The studies carried out in this thesis aimed to address some of these limitations by undertaking a longitudinal study to gather data on concurrent aspects of development in children and comparing this with data gathered from a range of musicians representative of the population of contemporary musicians currently working in the U.K. In summary, the research questions addressed in this thesis ask:

1) By measuring musical aptitude over time in a musical training study, is it possible to understand how pre-existing differences affect learning trajectories and outcomes, or whether the effects of training are innately constrained?

2) By concurrently measuring the development of musical, cognitive, behavioural and socio-emotional abilities, can we reveal any relationship between them?

3) If so, what are the theoretical implications regarding domain specific or domain general mechanisms for transfer of learning?

4) How can our understanding of typical and atypical developing musicianship be enriched?

The next chapter describes the methods and the measures that were used in the studies presented in chapters three, four, five and six. The participants are also characterised using quantitative and qualitative data obtained from the parents, who also feature in this analysis.

Chapter Two – Methods and Measures for the Child Study

2.1 Abstract

This chapter provides detailed summaries of the six measures administered in the child study, the recruitment procedures used, and the characteristics of participants. It also includes a statement of ethics, a description of the research design and procedure, and an overview of the statistical analyses undertaken. The aim of the study was to evaluate the impact of extra-curricular music training (EMT) in comparison to statutory school music (SSM) lessons on a range of cognitive, behavioural and socio-emotional measures. Previous studies have shown that extra-curricular musical instrument lessons can improve both direct skills as measured with near transfer tasks and indirect abilities such as general intelligence (see e.g. Costa-Giomi, 1999; 2005, Forgeard et al., 2008; Schellenberg, 2004). However, no other study has investigated the possible co-emergence of these hypothesised benefits in the same group of children. Based on previous studies a battery of tests was devised in order to measure potential change over time in key areas including fluid and verbal intelligence, musical aptitude, memory, motor skills, visual motor integration, perception and coordination, and socio-emotional wellbeing. The following section describes the measures used in the order in which they are presented in this thesis.

2.2 Measures

2.2.1 Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999)

The WASI was developed to meet demands for a short reliable measure of fluid and crystalised intelligence in clinical, psycho-educational, and research settings. Four subtests combine to provide the Full Scale Intelligence Quota (FSIQ) score. The four subtests are described in detail in Table 2.1. They were administered in the following order: vocabulary, similarities, block design, matrix reasoning.

Table 2.1. Descriptions of the subtests of the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999)

Subtest Description	Measures	Administration	Scoring	Note
Vocabulary Example Question: What is an alligator? Example Answer: ‘An alligator is a scaly animal with sharp teeth that lives in a swamp’	Crystalised abilities of word knowledge, verbal concept formation, and fund of knowledge.	Beginning with an age appropriate word, the examiner reads each word verbatim and asks the examinee to explain what the word means. The words are also shown in the stimuli book (the first four are pictures, rather than words).	Two points awarded for a correct figurative use of the word, a good synonym or several descriptives. One point awarded for a genuine use of the word, a correct but not definitive attribute, or an unelaborated example of the word in use. Zero points were recorded for a demonstration that was not elaborated with words that showed no real understanding even after query, or an incorrect answer.	Americanisms were altered to U.K. appropriate substitutions. For example Vacation became Holiday. Due to the age range of participants in this study up to 30 items were administered. Testing terminated following five consecutive scores of zero.
Similarities Example Question: How are a circle and a square similar? Example Answer: ‘They are both shapes’	Verbal reasoning and concept formation by asking the participant to describe how two objects are alike	Beginning with pictures of items, the child points or says which one does not belong to the same family (ages six to eight). From nine years upwards, the examiner says pairs of words with increasingly difficult concepts, such as bowl and plate.	Two points were awarded for a response that was pertinent and expressed general classification identifying both members of the pair (such as ‘apples and pears are fruits’). One point was awarded for responses that were pertinent to the pair but more general (such as ‘apples and pears are food’). Zero points were recorded if response incorrect or irrelevant.	Due to the age of participants in this study, up to 24 items were administered for this subtest. Testing is discontinued after four consecutive scores of zero.
Block Design The participant tries to copy two-dimensional geometric designs provided in the stimulus book with any/all of up to nine identical three-dimensional blocks.	Measure the ability to analyse and synthesise abstract visual stimuli, visual perception and simultaneous visual-motor learning and coordination.	Both the design and blocks have two colours (red and white), which are divided as triangles and squares. The participant must manipulate the blocks in order to present the design.	Two trials are allowed for designs one through four, scored as incorrect (zero points), correct on the second trial (one point) or correct on the first trial (two points). Designs five to 13 have scores graded according to the speed in which the design was completed.	All thirteen items were administered, as there was no age restriction. This test is discontinued when three consecutive trials are incorrect.
Matrix Reasoning A series of pattern matching tasks	Measures visual information processing, spatial and nonverbal reasoning skills.	Two priming examples are provided to enable the participant to learn the task, which requires that one option from five is selected in order to match the pattern.	Scores are either zero if the choice was incorrect or don’t know, or one for a correct choice.	This test is discontinued after four consecutive scores of zero. For this age range, up to 32 items were administered for this subtest.

Of those subtests, vocabulary and similarities comprise a Verbal IQ (VIQ) whilst matrix reasoning and block design together form the Performance IQ (PIQ). Raw scores were transformed to *T* scores according to the age of the participant. Test-retest correlation coefficients are presented in Table 2.10 as a direct comparison of reliability for all measures.

The WASI was U.S.[2] standardised on 2, 245 individuals, age ranging from six-89 years. The sample was stratified on the variables of race/ethnicity, sex, socio-economic status and geographic region according to data from the 1997 U.S. census. For children aged six-16, the total sample size was 1, 100 with 100 participating from each year group.

2.2.2 Gordon's Primary Measure of Musical Audiation (PMMA; Gordon, 1986).

Gordon saw musical aptitude as *atomistic* in that it has multiple dimensions, and that these were not related to general intelligence. He criticised Wing for assuming musical aptitude to be *"a unitary trait of which intelligence is an overall part"* (PMMA Manual, 1986, p. 5) and which yields only a composite score. He suggested that musical aptitude was more likely to include aspects of personality and include *"aesthetic-expressive-interpretive dimensions"* (PMMA Manual, 1986, p. 5). Gordon also asserted that musical aptitude, like other aptitudes, is normally distributed.

The PMMA tests separates tonal and rhythm stimuli based on a taxonomy of 1114 tonal and 486 rhythmic patterns which Gordon created. It also offers a composite score, which is the summation of the two components. The test uses a same/different paradigm. It does not depend on verbal ability or cultural specificity as pictographic symbols are used to denote which pair is being presented. The participants circle either two smiling faces for 'same', or a smiling and frowning face for 'different'.

Gordon's PMMA is a test designed to measure musical aptitude in children up to the age of nine years. This is the age at which Gordon suggests musical aptitude becomes stabilised and *"is no longer increased or decreased by the environment"* (Gordon, 1981, p. 6).

The raw scores (max 40 points) are standardised using percentiles based on data gathered from 873 children in nine elementary schools in New York state, with the

[2] UK norms are not provided for WASI. They since have been for WASI-II (2011), though this test was not available for use in this study.

sample divided equally between the first to the third grade classes[3]. The manual states (Gordon, 1986, p. 85) that the sample is heterogeneous in terms of socio-economic status. Table 2.2 presents the test-retest reliability by grade as reported in the manual (Gordon, 1986, p. 91).

Table 2.2. Gordon's Primary Measure of Musical Aptitude test-retest reliability coefficients (Gordon, 1986)

US Grade	UK Year	Tonal	Rhythm	Composite
Grade 1	2	.70	.66	.75
Grade 2	3	.70	.73	.76
Grade 3	4	.68	.66	.73

Gordon's development of the PMMA was motivated by his dissatisfaction with the musical aptitude tests then available. Gordon states specifically that the PMMA measures the ability to audiate, which Gordon describes as taking place *"when one hears music through memory or creativity, the sound not being physically present except when one is engaging in performance"* (Gordon, 1981, p. 8). However, as the description that follows explicates, the test is in fact an auditory discrimination tests based on a typical same/different paradigm. In fact Gordon devised two tests (the primary and intermediate measures of musical aptitude) to measure *"the potential for music achievement"* (Gordon, 1981, p. 3). This he proposed enabled him to consider developmental factors in musical achievement. In the current study the primary measure was used.

According to the manual, the tonal test should be completed before the rhythmic test, preferably on different days within one week but no more than two weeks apart (Gordon, 1986, p. 29). The audio stimuli are presented via a recording. First an object is stated (e.g. Tree) which corresponds to a picture of the object on the answer sheet. Then, a set of tones is played. After a short gap (approximately three seconds) either the same set of tones is repeated, or a different set of tones is played. The child circles two happy faces for 'same', or a happy and a sad face for 'different'. For the rhythmic tests, the only difference is that the stimuli presented are monotone, and it is the differing duration of the tones that is either the 'same' or 'different'. Both tests comprise of 40 items and provide practice examples (four tonal and two rhythmic) to ensure that the children understand the task prior to commencement. Each test takes 10 minutes to complete. There is no penalty for unanswered questions, and the components can be combined to form a composite

[3] The PMMA is U.S. normed. Chronological ages are identified differently in the UK school systems from the U.S. To ensure no misunderstandings take place, aged six to seven years U.S. Grade 1 is equivalent to Year 2 in the U.K. Similarly, seven to eight years is Year 3 (rather the 2nd Grade) and eight to nine years is UK Year 4 (as opposed to U.S. Grade 3).

musical aptitude score. The raw scores are standardised according to academic year and presented as percentile ranks.

2.2.3 Children's Memory Scale (CMS; Cohen, 1997).

The CMS is a standardised measure designed to evaluate learning and memory function in children from five-16 years old. The core and supplemental tests are effective for use with children with neurodevelopmental disorders and are used for both clinically and for research purposes (Strauss, Sherman & Spreen, 2006). As no single model of memory is universally accepted, Cohen created an illustration of the flow of cognitive mechanisms in what he describes as a 'Milk-jug Model' (as depicted in Figure 1.2, CMS Manual, p. 7). The flow of this model suggests directed attention focuses the short-term or immediate memory, which then could divide into auditory verbal or visual nonverbal aspects forming working memory. Cohen describes the process between working memory and long-term memory as learning. From long-term memory he then divides declarative memory (which includes episodic events and semantic facts), and procedural memory (which includes skill learning and classic conditioning) before the final aspects of retrieval, which includes free recall and recognition recall. Cohen used this model when developing the CMS. The measure was standardised on a representative sample of 1000 typically developing children ranging in age from five to 16 years based on the 1995 U.S. census. Although U.K. norms are not available, this test has been widely used in research carried out in the U.K. (see e.g. Bennett & Heaton, 2012; Stansfield et al., 2005).

The CMS is comprised of nine subtests, which measure memory in (a) auditory verbal, (b) visual/non-verbal, and (c) attention/concentration domains. Table 2.3 depicts the core and supplemental subtests used within this thesis.

Reliability coefficients for these age groups for the tests and subtests used range from .61 to .91 and test-retest stability (corrected r^2) from .59 to .89. Practise effects up to one standard deviation have been observed with a median retest interval of 65.3 days. However, the test-retest period spanned eight to nine months in this study. Raw scores are standardised according to age in yearly increments. These CMS subtests took between 15-25 minutes to administer.

Table 2.3. Subtests used from the Children's Memory Scale (Cohen, 1997)

Domain	Subtest	Description	Administration
Domain A – Learning & Memory	Word List Learning	Assesses the ability to learn a list of unrelated words using auditory short term memory	The examiner says a list of ten words, after which the child is asked to recall as many of those words as possible. The child is then reminded only of words they did not recall and asked to repeat again as many of those ten words as possible. This is repeated four times in total.
	Word List Recall	Assesses ability to consolidate learning a list of unrelated words using auditory long term memory	After the Word List Learning task (described above), the examiner speaks a distracter list of ten new words and the child asked to recall as many of these new words as possible immediately. Then child is asked to recall the first word list they learned again.
Domain C – Attention & Concentration	Digit Span Forwards, Backwards and Total	Assesses auditory short term memory (Digit Span Forwards) and auditory working memory (Digit Span Backwards)	The examiner separately presents lists of randomly chosen digit orally, both backwards and forwards (known as Digit Span Forwards (DSF) and backwards (DSB). The examinee repeats as many digits as they can recall from these lists in separate trials assessing the ability to recall sequences of graduated length. For the age group studied herein, eight items were administered for DSF and seven for DSB, with two trials per item. Testing is discontinued after a zero score for both trials within an item.
	Sequences	This test of attention and concentration is described as "placing a heavy demand" on working memory (CMS Manual, Cohen, 1997, p. 151).	The examiner asks participants to say a set of semantically grouped numbers or words under timed conditions. These tasks range from saying the alphabet, or multiplication tables, or recalling the months of the year in reverse for example. The most difficult level requires children to combine the alphabet with its placement number in order (e.g. A1, B2, C3 etc.) assessing the ability to mentally manipulate and sequence auditory/verbal information as quickly as possible.

2.2.4 Movement Assessment Battery for Children, 2nd Edition (MABC-2; Henderson, Sugden & Barnett, 2007)

This standardised test is used to evaluate motor skills in children and adolescents. The measure assesses sensorimotor functioning and motor coordination; specifically focusing on gross motor ability (e.g. jumping, catching), fine motor ability (e.g. drawing, writing), motor coordination and the integration of visual, audio and kinesthetic information. There are three composite scores: Manual Dexterity, Aiming & Catching and Balance. Each composite comprises of a number of subtests (see Figure 2.1) that are used to test two to six year olds, seven to 10 year olds and 11-16 year olds. However, data from the three age bands cannot be directly compared in experimental studies because the tasks used vary according to age groups. Test-retest reliability is reported by the authors as between .73 and .84 for components and .80 for the total score.

In this study, the second age group (seven to ten years) tasks were administered. These tasks are described in Table 2.4. These tasks took up to 30 minutes to administer. Scoring is scaled according to age and task on a specific score sheet during the administration.

Each subtest record also provides space for qualitative notes such as ‘holds head at odd angles’ or ‘goes too fast for accuracy’, which can be ticked or other notes added. Handedness is also noted. Best attempts raw scores are standardised and combined to form part of the respective component. Percentiles are also provided for the three composite scores.

Table 2.4. Descriptions of tasks of the Movement Assessment Battery for Children Edition (2nd Edition, Henderson, Sugden & Barnett, 2007)

Composite	Task	Description	Administration
Manual Dexterity	Peg Board	Placing pegs in any order into holes on a board	Two trials timed, each hand separately
	Sewing	Threading string through holes in piece of hard plastic using both hands together	Two trials, timed
	Drawing a Trail	Drawing a line between outlines on a trail	A second trial is conducted only if no errors were recorded during the first trial. Errors are marked if pen marks are observed outside the outline
Aiming and Catching	Throwing and Batching a Ball	Throwing a tennis ball against a wall and catching using one or both hands, under or over arm, without a bounce aged nine-10, bounce allowed for ages seven and eight	Five practices, ten trials
	Bean Bag	Throwing a bean bag onto a marked circle at a prescribed distance (six mats away) using one or both hands, under or over arm	Five practices, ten trials
Balance	Wobble Board	Balancing on a wobble board, each leg separately for up to 30 seconds	Two trials are required if maximum time not achieved on first attempt
	Walking a Line	Walking heel-to-toe along a marked line for approximately 15-20 steps (dependent upon foot size).	If trial completed first time, second trial is not required
	Hopping	Hopping from mat to mat on each leg separately (five mats each leg, hit or miss)	If five hops are completed on the first trial, the second is not required

2.2.5 The Beery–Buktenica Developmental Test of Visual Motor Integration (VMI) and Supplemental Tests of Visual Perception (VP) and Motor Coordination (MC), 5th Edition (Beery, 2004).

These three tests (VMI, VP and MC) are designed to assess the extent to which individuals aged between two and 18 years can integrate their visual and motor abilities (hand-eye coordination). Whilst some individuals may possess good manual skills, and others may possess good shape perception, the extent these skills are integrated within individuals can be assessed using a specific task. Standardised and normalised six times between 1964 and 2010 with a U.S. population of more than 12,500 children, the Beery VMI has been described as a valid measure of visual-motor integration (Goyen & Duff, 2005; Parush et al., 2010). The reported test-retest stability coefficient is .88 (Beery, 2010). The subtests in the Beery VMI can be used as stand alone tests, but the manual advises administration in the order they appear in Table 2.5

Table 2.5. Summary description of the Beery Test of Visual Motor Integration, Visual Perception and Motor Coordination (Beery, 2004)

Test	Description	Administration
Beery Visual Motor Integration (VMI)	30-item sequence of geometric shapes to be copied by hand, free form, into the boxed space provided directly below the shape to be copied	10-15 minutes allowed
Visual Perception (VP)	This requires identification of the matching geometric target from a choice of possible similar forms (30 items), which the child marks on the record form	This is a timed task (3 minutes)
Motor Coordination (MC)	This requires the child to trace a shape (30 items) staying in between double lined paths on the record form	This is a timed task (5 minutes)

Practice examples are used for all three tests. The tests can be administered in groups. Items are either ‘score’ (1 point) or ‘no score’ (0 point) according to strict criteria (see Manual, Beery, 2004, pp. 28-88). Raw scores are converted to standardised scores and percentiles according to chronological age. Test scores were standardised on the basis of chronological age to the year and month (rounded if >15 days to the next month i.e. 8 years, 3 months and 16 days became 8 years and 4 months) in accordance with the manual. The results can be interpreted in the context of norms shown in Table 2.6.

Table 2.6. Standardised score interpretation of the Beery Visual Motor Integration Test (Manual, Beery, 2004, p. 90)

Standard Score	Performance	% Of Age Group
>129	Very High	2
120–129	High	7
110–119	Above Average	16
90–109	Average	50
80–89	Below Average	16
70–79	Low	7
<70	Very Low	2

2.2.6 Behavioural Assessment System for Children, 2nd Edition (BASC-2; Reynolds & Kamphaus, 2004)

The BASC-2 provides a systematic approach to surveying a broad range of behaviours in individuals aged six-25 years. Parents and teachers are asked to report on adaptive and clinical behaviours in assessments designed for Preschool (P: two to five years), Child (C: six to 11 years), and Adolescent (A: 12–21 years) groups. The final assessment, College (COLL: 18–25 years) is self-report only. The Child (C: six to 11 years) teacher and parent reports were used in this study

The BASC-2 is normed test based on the 2001 U.S. population census, with samples matching the population percentages for gender and ethnicity. The manual states that geographically the North East of America was underrepresented for Preschool and Child levels of the teacher report and that overall, students with emotional/behavioural disturbance, speech and/or language impairment are over-represented in the general norms. Standardisation was based on pilot surveys that included 6,000 teacher ratings, 8,000 parents' ratings and 12,000 student self-reports. Age and gender appropriate standardised scores (norms) representing typically developing children were used for this study. Here information is provided only for the measures relevant to this study.

Parent and teacher reports are comprehensive measures of behaviours in the community and home environment as well as the school settings. The survey contains between 150 and 170 items (age appropriate descriptors of behaviours) that the respondent rates on a four-point scale of frequency: Never, Sometimes, Often and Almost Always. This takes 10-20 minutes to complete.

The Self-Report of Personality was not used as the items alter between the ages of seven and nine, making this self-report measure inappropriate for this study.

Table 2.7. Copy of Table 2.2 Scale and Composite Score Classification of the Behavioural Assessment System for Children (2nd Edition), Reynolds & Kamphaus, 2004, p. 16)

Classification		
Adaptive Scales	Clinical Scales	T Score Range
Very High	Clinically Significant	70 and above
High	At-Risk	60-69
Average	Average	41-59
At-Risk	Low	31-40
Clinically Significant	Very Low	30 and below

Table 2.7 shows the levels of severity of risk the survey indicates the individual may be at if individuals score at the levels depicted. Diagnosticians often use the term ‘at-risk’ to indicate the presence of significant problems that, while requiring treatment, may not be severe enough to warrant a formal diagnosis. Clinically significant denotes a high level of maladaptive, or absence of adaptive behaviour. The range corresponds to two standard deviations from the mean.

Table 2.8 describes the scales included in the parent and teacher reports. Table 2.9 shows which scales make up the composites for the parent and teacher reports of the BASC-2 for this age range.

Table 2.8. Adaptation of Table 7.6 Teacher and Parent Scale Definitions (Behavioural Assessment System for Children 2nd Edition Manual, Reynolds & Kamphaus, 2004, p. 60)

Scale	Type	Definition
Activities of Daily Living	Adaptive	The skills associated with performing basic, everyday tasks in an acceptable and safe manner
Adaptability	Adaptive	The ability to adapt readily to changes in the environment
Aggression	Clinical	The tendency to act in a hostile manner (either verbal or physical) that is threatening to others
Anxiety	Clinical	The tendency to be nervous, fearful, or worried about real or imagined problems
Attention Problems	Clinical	The tendency to be easily distracted and unable to concentrate more than momentarily
Atypicality	Clinical	The tendency to behave in ways that are considered "odd" or commonly associated with psychosis
Conduct Problems	Clinical	The tendency to engage in antisocial and rule-breaking behaviour, including destroying property
Depression	Clinical	Feelings of unhappiness, sadness, and stress that may result in an inability to carry out everyday activities or may bring on thoughts of suicide
Functional Communication	Adaptive	The ability to express ideas and communicate in a way others can easily understand
Hyperactivity	Clinical	The tendency to be overly active, rush through work or activities, and act without thinking
Leadership	Adaptive	The skills associated with accomplishing academic, social, or community goals, including the ability to work with others
Learning Problems	Clinical	The presence of academic difficulties, particularly understanding or completing homework
Social Skills	Adaptive	The skills necessary for interacting successfully with peers and adults in home school and community settings
Somatisation	Clinical	The tendency to be overly sensitive to and complain about relatively minor physical problems and discomforts
Study Skills	Adaptive	The skills that are conducive to strong academic performance, including organisational skills and good study habits
Withdrawal	Clinical	The tendency to evade others to avoid social contact

Table 2.9. Adapted from Table 7.7. Summary of Teacher and Parent Composite Scale Scores (Behavioural Assessment System for Children 2nd Edition Manual, Reynolds & Kamphaus, 2004, p. 66)

BASC-2 Child	Externalising Problems	Internalising Problems	School Problems	Behavioural Symptoms Index	Adaptive Skills
TRS – Child	Hyperactivity Aggression Conduct Problems	Anxiety Depression Somatisation	Learning Problems Attention Problems	Hyperactivity Aggression Depression Attention Problems Atypicality Withdrawal	Adaptability Social Skills Functional Communication
PRS – Child	Hyperactivity Aggression Conduct Problems	Anxiety Depression Somatisation	-	Hyperactivity Aggression Depression Attention Problems Atypicality Withdrawal	Adaptability Social Skills Leadership Activities of Daily Living Functional Communication

Items are included in both the parent and teacher reports that help eliminate both positively and negatively biased responses. This is known as the F Index. Scoring allows for only two answers to be omitted (or multiply scored items) by parents and teachers for each scale. If more than two answers are unable to be marked, this renders that scale unusable. This may impact on the composites scores if that scale formed part of that component (see Table 2.9).

Table 2.10 shows a summary of all the standardised quantitative measures used on this battery of tests to enable comparison. The third column shows the published test-retest correlation coefficients. This aspect of reliability was chosen as a comparable estimation of measurement error. Not all tests appear to have, for example Chronbach's alpha figures, published. These figures were used in analyses to provide disattenuated statistics where possible. This concludes the section describing the measures used in the child study of the effects of musical learning. The following section provides information on recruitment methods, participants, procedures, design, methodologies and statistical analyses used.

Table 2.10. Summary of test battery descriptors for administrative and reliability comparison

Test Name	Description	Test-retest Reliability Coefficients	Administration
Gordon's Primary Measure of Musical Aptitude	Same/different paradigm measuring tonal and rhythmic aptitude in children aged up to nine years. Composite measure is also provided. Standardisation by age per annum in the form of percentiles.	Aged 7-8 years: Tonal r = .70, Rhythm r = .73, Composite r = .76 Aged 8-9 years: Tonal r = .68, Rhythm r = .66, Composite r = .73 Gordon, (1986)	40 trials lasting ten minutes for each component administered on separate occasions, in that order.
Wechsler's Abbreviated Scale of Intelligence (1990)	Verbal (Vocabulary and Similarities) and nonverbal (Block Design and Matrix Reasoning) task based measure of '*g*' in children and adults. Provides estimates of full intelligence quota (FSIQ) as well as performance (PIQ) and verbal (VIQ) scores. Standardisation by age in three-month increments in the form of T scores.	FSIQ r=.93, PIQ r=.88, VIQ r=.92 Vocabulary r = .85, Similarities r = .86 Block Design r = .81, Matrix Reasoning r = .93 Kamphaus and Frick (2005)	30 minutes for FSIQ and 15 minutes for brief version (typically vocabulary and matrix reasoning)
Children's Memory Scale (Cohen, 1997)	Tasks chosen to focus on auditory long-term (aLTM), short-term (aSTM) and attention and concentration (A/C) in children aged five to sixteen years. These included Word List Learning (LTM), Word List Recall (STM), Numbers (digit span forwards and backwards) and Sequences (A/C). Standardisation by age per annum in the form of standardised scores.	aLTM r= .84, aSTM r = .86, A/C r = .87 Drozdick, Holdnack, Rolfhus, and Weiss (2008)	15-25 minutes to administer in total
Movement Assessment Battery for Children (2nd Edition, Henderson, Sugden & Barnett, 2007)	Range of eight tasks based on three components; manual dexterity, aiming and catching and balance. Test is available for children aged 2-16 years, divided into age bands, which are not comparable. Standardisation by age per annum in the form of standardised scores.	For this age range (aged 7-10 years) components reported as ranging between r = .73 and r = .84. Total score reported as r = .80. Henderson, Sugden & Barnett (2007).	30 minutes to administer
Behavioural Assessment System for Children (2nd Edition, Reynolds & Kamphaus, 2004)	Questionnaires regarding clinical and adaptive scales and composite scores for the self-report of children and adolescents from 6 to 24 years and their parents and teachers. Up to 170 items per questionnaire. Only the parent (PRS) and teacher (TRS) questionnaires used herein.	For scales and composite scores: TRS range mid .80s to low .90s,PRS in low .90s (Tan, 2007).	Each questionnaire takes between 15-25 minutes
Beery Visual Motor Integration (VMI), Visual Perception (VP) and Motor Coordination (MC)	Tasks require the guided and free form copying of geometric shapes (VMI), matching a geometric target from a choice of possible similar forms (VP), and tracing geometric shapes whilst staying in between double lined parameters. . Standardisation by age in three-month increments in the form of standardised scores.	VMI r = .89 VP r = .85 MC r= .86 Beery, (2004)	10-15 minutes allowed (VMI), three- timed task (VP) and 5 minute timed task (MC).

2.3 Participant Recruitment

Participants were recruited through several avenues. Networking at the Musician's Union teachers conference in October 2011 led to a connection with a peripatetic teacher who worked at a state school in the West Midlands (U.K.) specialising in performing arts. The music programme here is subsidised by charity and the local government music hub, though parents/caregivers are expected to pay £1 towards each lesson. The peripatetic music teachers are paid a professional wage by the local authority music service. A further connection from the event aforementioned included a short article in a monthly magazine 'Music World' for music teachers and musicians (see Appendix A). This article led to the offer of participation from a music school in the Channel Islands, which is a privately funded extra-curricular music school. Additional recruitment took place through conversations with the Principals, Heads of Music and teachers at two independent preparatory schools where the author works as a peripatetic teacher, and also one state funded primary schools in Sussex where children can opt to pay (directly to the peripatetic teacher) for extra-curricular music lessons within the school timetable. Teachers and parents suggested children from the same classes who were not learning a musical instrument and these participants formed the standard school music active control group. Parents and teachers and children were briefed as to the nature of the study, informed they could withdraw at anytime and consent forms were signed by parents (see Appendices B and C).

2.4 Participants and Procedure

2.4.1 Descriptives of Participants for Quantitative Study

38 children participated in the study. Table 2.11 provides descriptive data of the participants. The sample included 21 females and 17 males. The age of the children ranged from 85-103 months, or approximately seven to eight and half years old. There was an equal split between handedness between groups, though one child was able to use both hands effectively.

Table 2.11. Descriptive data of the participants by music group

Group[a]	SSM	EMT
Mean Age in Months (SD)	91.47 (4.93)	94.00 (5.95)
Gender		
Female	10	11
Male	9	8
Handedness		
Right Preference	16	16
Left Preference	2	3
Ambidextrous	1	0

[a]n=19

Participants were not randomly assigned to groups. Half (n=19) were either self or parentally selected for extracurricular music lessons amounting to >1 hour per week over and above statutory music provision, henceforth known as the Extracurricular Music Tuition (EMT) group. The remaining participants (n=19) received only statutory music group lessons of <1 hour per week and is referred to as the Standard School Music (SSM) group.

The instruments the 19 EMT children reported learning were: seven keyboard/piano, three guitar, two trumpet/horn, one drum kit, and six multiple instruments. Of these six, two were simultaneously learning piano and drums, two were learning both piano and violin, one was learning piano, violin and singing and one was learning piano and guitar.

At Time 1 (baseline) the groups were not statistically significantly different in age, equal variances assumed, $t(36) = -1.43$, $p = .16$. The groups did not differ on handedness preferences (as displayed during the Movement ABC-2) $t(36) = .83$, $p = .41$ or in the gender distribution between groups of the 21 females and 17 males X^2 (1, N=38) = 0.11, $p = .74$.

Socio-Economic Status (SES) was calculated using postcodes (see e.g. Hyndman et al., 1995; Morley et al., 2015; Noble et al., 2007). In the U.K. postcodes are allotted to 15-20 individual households and can be used to measure SES in terms of income, employment, health and disability, education, skills and training, barriers to social housing and services and the living environment, forming the Indices of Multiple Deprivation (IMD). In line with the Office of National Statistics socio-economic classification system postcodes assigned as Group AB or ABC were classified as Upper, BC1C2 classified as Middle and C1C2DE classified as Working. Postcodes from Jersey, or incomplete postcodes were replaced by a code indicating the parents' level of education and employment as an estimate SES.

Table 2.12 depicts the breakdown of SES status according to the different methods utilised. Independent samples *t* test suggested there were no significant differences between groups based on socio-economic status. Whilst no statistical differences were found between school groups and SES groups when using postcode (as described above), a significant group difference, $t(32) = -3.41$, $p = .002$ (equal variances not assumed) emerged when the parents levels of education were analysed.

Table 2.12. Socio-economic status and school type by music group

Group			Frequency	Percent
SSM	SES Level	Upper	8	42.1
		Middle	4	21.1
		Working	7	36.8
	School Type	State	7	36.8
		Independent	12	63.2
EMT	SES Level	Upper	11	57.9
		Middle	5	26.3
		Working	3	15.8
	School Type	State	7	36.8
		Independent	12	63.2

Table 2.13. Reported levels of parental education by music group

Group	O'level/GCSE	A'level/Highers	Undergraduate Degree Level	Post Graduate Degree Level
SSM	8	6	2	0
EMT	5	1	4	8

Six parents did not report their level of education achieved. Whilst doctoral level was also presented, no parent indicated this level so it has not been shown in Table 2.13, which depicts the level of parental education of the participants by music group.

Table 2.14. Parental attitudes towards musical learning by music group

Music Group		Frequency	Percent
SSM (n=16)	Essential	2	10.5
	Important	3	15.8
	A pleasant pastime	10	52.6
	Little or no value	1	5.3
EMT (n=18)	Essential	5	26.3
	Important	10	52.6
	A pleasant pastime	3	15.8

With regard to parental attitudes to musical learning, Table 2.14 indicates how the parents (by music group) responded to the question 'Do you see music learning as…' either essential, important, a pleasant pastime, or of little or no value? The EMT group parents place a higher importance on musical learning and this reached a level of statistical t (32) = 2.86, p = .008.

2.4.2 Parental Background Information Qualitative Data

In order to present a valid and reliable ecological study, it is important to explore the context of the quantitative data provided. Therefore the parental background information sheet also requested data on several other areas of interest, as now described. This qualitative data serves to illustrate the range of issues apparently typically developing children are facing in school and at home. All italicised data is reported verbatim.

Table 2.15. Qualitative responses from parents

Question	Please note any parental diagnoses, or difficulties with learning, reading, writing, vision, hearing, memory, movement or coordination	Music Group
Number of times question was not answered	21	SSM=11 EMT=10
Number of Answer simply 'No' or 'None'	12	SSM=7 EMT=5
Number of qualitative answers	5	SSM=1 EMT=4
Verbatim Answers	*"Vision";*	EMT
	"Mild dyslexia";	EMT
	"possible dyslexia but not diagnosed";	EMT
	"lazy eye, wears contact lense"	SSM
	"both parents are dyslexia (Mother diagnosed at 8, Father diagnosed at 11)"	EMT
Question	Please note if parents suffered from, were diagnosed with or suspected any psychological difficulties, for example with anxiety, lack of confidence, issues with bullying, mood changes or behavioural issues	
Number of times question was not answered	23	SSM=13 EMT=10
Number of Answer simply 'No' or 'None'	11	SSM=6 EMT=5
Number of qualitative answers		SSM=1 EMT=3

Verbatim Answers	*"stress & anxiety sometimes, but not abnormal levels"*	SSM
	"Anxiety. Mood changes. (PMT?!)"	EMT
	"Lack of confidence. Bullying as a child (aged 7-11) – mild"	EMT
	"not confident".	EMT
Question	Please note parental musical background	
Number of times question was not answered	12	SSM=8 EMT=4
Number of Answer simply 'No' or 'None'	2	SSM=2
Number of qualitative answers	24	SSM=9 EMT=15
Verbatim Answers	*"Theory of Music - Grade 2; Piano - Grade 1; Always listening to music, on a daily basis, cheers me up - memories."*	SSM
	"Piano/Recorder/Guitar as a child - basic level. Participant's Father plays guitar to a high level & has a very good ear for music."	SSM
	"Played piano, oboe and flute – all very badly!"	SSM
	"Clarinet & Saxophone for 2 years - no grades. Aged 8-11. Music used to pass time or relax."	SSM X 2 (TWINS)
	"Clarinet & Saxophone for 2 years - no grades. Aged 8-11. Music used to pass time or relax."	SEE ABOVE
	"Music is a vital part of my childhood to date. Piano Grade 3, Clarinet Grade 1, Singing Grade 6 and tried Violin."	SSM
	"Recorder, some attempts at others but generally none. Like singing. Have music on in the house."	SSM
	"Recorder. Tenner."	SSM
	"Electric guitar (basic rhythm) and listens to music daily"	SSM
	"Learned violin at school aged 8-14. Learned piano at uni and took grade 3 (+grade 5 theory). Also played recorder for as long as I can remember (not very well). Music has always been v. important to me, listening as much as playing."	EMT
	"Listened to music at home. Grade 6 French Horn – stopped at 17."	EMT
	"Enjoyed singing – part of school choir	EMT
	"Grade Guitar Aged 12"	
	"Piano lessons up to Grade 5. Everyone in the family played an instrument (some 2) and parents sang in the choir."	EMT
	"Vocal, Piano, Guitar – music plays an important part of our daily lives."	EMT
	"Played descant recorder at school"	EMT
	"No musical instruments; sing in a choir and have done so since school. Music not generally important."	EMT
	"Mother was/is musical, singing and playing piano. I played the piano (and started viola). Love to sing but not in a choir or group. Husband professional musician and	EMT

	wish our children to achieve musically where I felt I didn't."	
	"My parents and grandparents loved and encouraged music. I learned piano to Grade 5, Guitar Grade 2, percussion in school briefly (orchestra), choir at school, university and local amateur."	EMT
	"Father – self taught guitar as youth – in a band – talent but not training as a child (no money). Church choir (scholarship but not taken up) – currently takes bass lessons as an adult, sings and plays in a work band – music playing in the house a lot – general love of listening to music. Mother – recorder and clarinet to very low level – just basics, no exams (tone deaf!) But love music – wanted to be good and learn piano – but not enough money when young."	EMT
	"Violin at school and recorder. Tried saxophone and clarinet which I went back to as adult. Music in all its forms very important."	EMT
	"I had (classical) piano lessons from age 5-17 (Grade 7) and clarinet from 13-16 (Grade 5). Have spent much of my adult life going to gigs – from raves to classical to opera!!"	EMT
	"Piano – on and off since 6 years old. Choir – national and secondary school performance – singing constantly at home with Mother and siblings. Irish dancing and tin whistle – 2 years as part of school band and melodica also for 2 years as part of school band."	EMT
	"General recorder at school, Clarinet Grade 5, Classical guitar for 6 months, Grade 1 Piano, Choir at school, DJ lessons aged 30. Music is very important to get extra enjoyment in listening to and performing and creating and dancing. Also took ballroom and Latin dance lessons age 32 for 1 year."	EMT
Question	Please note if their child had any suspected or diagnosed learning difficulties, for example with reading, writing, vision, hearing, memory and/or movement and coordination	
Number of times question was not answered	15	SSM=10 EMT=5
Number of Answer simply 'No' or 'None'	13	SSM=7 EMT=6
Number of qualitative answers	10	SSM=3 EMT=7
Verbatim Answers	*"Previous hearing issues at 3 years, hearing since perfect – 100% both ears."*	SSM
	"Struggles a bit with reading and spelling	SSM
	"Some issues noted at school regarding numbers and maths"	SSM
	"Participant has a delayed speech disorder & has had a lot of speech therapy. His speech is almost up to where it should be for his age now. He sometimes seems uncoordinated, although this has improved recently."	EMT
	"Suspected dyslexia – unconfirmed."	EMT

	"Dyslexia"	EMT
	"ADD and a bit clumsy"	EMT
	"Difficulty movement of hands and coordination and above normal hearing range resulting in over sensitivity to high pitch noises."	EMT
	"Vision"	EMT
	"Participant did have a lot of ear trouble and has had 2 lots of grommets - appears to be OK now. Speech 'appears' to be behind but was monitored by a speech therapist who had no concerns."	EMT
Question	Please note if your child has any suspected, or diagnosed, psychological difficulties, for example anxiety, lack of confidence, issues with bullying, mood changes or behavioural issues,	
Number of times question was not answered	19	SSM=10 EMT=9
Number of Answer simply 'No' or 'None'	12	SSM=7 EMT=5
Number of qualitative answers	7	SSM=2 EMT=5
Verbatim Answers	*"Lacks confidence, easily bullied – follows the crowd, feelings of injust and finds it difficult to comprehend adult and child appropriate behaviour e.g. why can't I cook the dinner, drive us to school…?"*	SSM
	"Seems to lack confidence in groups"	SSM
	"I think [participant] *does seem to suffer lack of confidence, linked to the above* [speech development delay]*, but this has also improved hugely in the last year or so. He is also what I would describe as being very sensitive. Participant was assessed for Asperger's – some but not all aspects found. Finds number reasoning easier than words."*	EMT
	"Provisional diagnosis (age 4) Asperger's and ADHD"	EMT
	"Occasionally lacks confidence"	EMT
	"Participant is the youngest in his school year and can be emotionally immature."	EMT
	"Some anxiety I suspect"	EMT

2.4.3 Data Regarding Participation in Other Activities

In order to provide an ecologically valid sample data was also gathered which could account for potential effects of other in school and/or extra-curricular activities. This quasi-control data was collected regarding time spent doing physical activities, as well as leisure activities. This data compared with time spent doing musical activities.

The actual activities reported for time spend doing physical activities included: playing in the park, street dance, dance, ballet, swimming, horse riding, football, tennis, running, cricket, karate, bike riding, scooting, pogo sticking, badminton, boxing, hockey, brownies/beavers, altar serving, drama, gymnastics, tag rugby, and archery. 24 parents reported that their children took part in these activities outside school. In answer to the question ‘How did your child come to take part in these physical activities?’ There were thirteen answers of ‘1=it was their decision and initiative’, ten answers of ‘2=Parental encouragement’, one answer of ‘3=because their friends attended’, and fifteen answers of ‘4=joint decision between parents and child’.

The activities reported for creative activities and hobbies included clubs for and time spent doing Minecraft, gardening, jigsaws, computer/iPad, art, drama, engineering type games such as Meccano, board games and puzzles, textiles, arts and crafts, cookery, chess, cartoons, fencing, boys brigade, and brownies/beavers. Eighteen parents answered that these activities took place in school and 17 parents answered that the activities took place outside school. In answer to the question ‘How did your child come to take part in these creative activities and hobbies?’ there were fourteen answers of ‘1=it was their decision and initiative’, two answers of ‘2=Parental encouragement’, two answers of ‘3=because their friends attended’, and six answers of ‘4=joint decision between parents and child’. On three occasions parents answered with multiples, such as 2, 3 and 4, or indicated that each activity was chosen for a different reason.

In answer to the request for information regarding the types of musical activities the participants undertook each week, aside from practising on their instruments, answers also included choir practice, dancing, ballet, listening to music with and as a family, and singing together, for example:

“Music on at home all the time; radio, opera, musicals (knows all the words) in the car sings along.”

“[Participant] *doesn't attend dance lessons, but he loves dancing. And loves to listen to music, and does both daily.”*

Thirteen out of the nineteen participants receiving extra curricular musical tuition did so out of school time. In answer to the question ‘How did your child come to take part in these musical activities?’ there were six answers of ‘1=it was their decision and initiative’, four answers of ‘2=Parental encouragement’, one answer of ‘3=because their friends attended’, and six answers of ‘4=joint decision between parents and child’. The other two did not answer this question.

Table 2.16. Total hours of weekly activity participation as reported by parents

Music Group		Hours per Week Physical Activity	Hours per Week Musical Activity	Hours per Week Leisure Activity
SSM (n=15)	Mean (SD)	5.07 (2.28)	1.53 (1.06)	3.33 (1.54)
	Median	5.00	1.00	4.00
	Minimum	2.00	.00	.00
	Maximum	11.00	4.00	6.00
EMT (n=18)	Mean (SD)	4.94 (1.63)	3.22 (1.48)	4.06 (1.29)
	Median	5.00	3.00	4.00
	Minimum	2.00	1.00	.00
	Maximum	8.00	6.00	6.00

Table 2.17 describes the data for these activities for the SSM and EMT groups. For complete clarity, the minimum, maximum and median amount of hours are also shown. A statistically significant difference between groups was revealed for musical activity $t(31) = -3.70$, $p = .001$, but not for Leisure Activity $t(29) = -1.43$, $p = .16$ or Physical Activity $t(31) = .18$, $p = .89$.

The background information sheet was collected again at Time 2 at the end of the study in order to try to ascertain whether any changes had taken place over the year, or whether the amount of time spent doing activities had changed. The question and answers are provided in table 2.17.

Table 2.17. Qualitative responses from parents at Time 2

Question	Please note whether any significant change in circumstances have taken place during the year	Music Group
Number of times question was not answered	9	SSM=8 EMT=1
Number of Answer simply 'No' or 'None'	16	SSM=6 EMT=10
Number of qualitative answers	13	
Verbatim Answers	*"moving house"*	SSM X 2 (TWINS)
	"Mum has opened a restaurant and so has not been around as much for the children, which she reports participant has found difficult"	SSM
	"Extra anxiety, behaviour and psychological issues proving more of a challenge. Confusion/frustration/social difficulties more apparent with age."	SSM
	"Moved house in March 2014 – parents separated – moved to Dads house first to settle then Mums in May 2014. Parental care 50/50. Very amicable separation."	SSM

	"Moving to Australia in summer of 2014 – been planned and known about for a while."	EMT
	"A bit of low level bullying experienced"	EMT
	"Self and partner separating (partner is [Participant's] *Uncle)"*	EMT
	"Participant does say that certain pupils pick on her and that makes her very upset."	EMT
	"Nothing major. Big brother started secondary school. Participant has started going to sleepovers with friends. Has been on family holiday and seen different culture (Africa)"	EMT
	"Moved to temporary accommodation whilst renovating house so no piano, but borrowed a keyboard."	EMT
	"Moved house in March 2014. Participant seeing ENT specialist for enlarged adenoids. Speech and communications improving but recently discovered [participant] has double vision (insufficient convergence (close up) – right eye diplopia)"	EMT
Question	Please note whether your child has changed the amount or type of activities they do during this year	
Number of times question was not answered	10	SSM=8 EMT=2
Number of Answer simply 'No' or 'None'	12	SSM=5 EMT=7
Number of qualitative answers	16	SSM=6 EMT=10
Verbatim Answers	*"Started learning the piano"* [doesn't say when]	SSM
	"Really likes drawing and painting"	SSM
	"More physical activities 2-3 hours daily now. Trampoline in garden really upped this, also cricket and tennis lessons out of school also. More musical activities – learning drums with school now. Less interested in creative work as concentration a challenge and would prefer to be outside playing sport."	SSM
	"Increased outside, started to run as a hobby. Musical activity increased at school – she talks about it more and wants to learn the trumpet [which she did go on to do after the study ended]. *Creative hobbies increased also – art, sport and friendships"*	SSM
	"Difficulties with reading, but this has improved greatly. Still does football twice a week outside school. [Participant] *has more interest in drawing and writing than before."*	SSM
	"Started horse riding and roller disco - no other changes."	SSM
	"Not really, we bought a trampoline for the back garden so they have been playing a lot on that."	EMT
	"Continuing guitar lesson, plus loom bands and Minecraft on the iPad"	EMT
	"No diagnoses. Stopped swimming out of school at the weekend. Has started playing cricket for an out of school club. Started playing piano Oct/Nov."	EMT
	"Diagnoses of ASD, ADHD, Visual Processing Disorder, Auditory Processing Disorder, signs of dyslexia, mild	EMT

	dyspraxia. Has been more at home on the tenor horn.”	
	“Participant gets extra help from school with her learning because she is very behind her age levels. She is musically involved with the school. No other changes.”	EMT
	“Stopped singing lessons in March 2014” [Participant continued learning violin and piano]	EMT
	“Still struggling with ongoing problem of incontinence and has gone back onto medication after trying without. Has also started attending ensemble once per week (violin) whereas previously just had lessons.”	EMT
	“Dropped gymnastics (Easter) and Beavers (pre cub-scouts) but taken up ballet for 1 hour per week since Feb 1/2 term.”	EMT
	“Speech difficulties effecting making friends at school. Eyesight problems also effecting school progress. Started Brazilian football for socialisation intervention. Stopped piano as wasn't enjoying lessons but started drums in September. Also started drama in last terms of the year which helps with voice projection and role-paying and he LOVES IT!”	EMT
	“Fortnightly riding lessons (30 mins since Feb) and swimming (30 mins Fridays now) and life saving course (1 hour since April). Practising piano more and regular lessons since September 2013. Also into making loom band creations.”	EMT

When asked if participants would be happy to be contacted regarding future studies, only one parent declined. Nine parents did not answer (SSM=7, EMT=2). 28 parents indicated their permission to contact them for future studies of this nature (SSM=11, EMT=17).

2.4.4 Attrition

Initially 44 participants were recruited for this study. However, six children were excluded in total. Two children in the SSM groups were excluded due to maturation because by Time 2 they had reached the age of 10 years, which is beyond the developmental range of Gordon’s PMMA. Two participants’ parents did not respond to contact requests for Time 2 measurements. One participant was excluded as a serious hearing problem was identified. One further participant was excluded from this analysis due to a neurological condition (left sided hemiplegic cerebral palsy), which led to his scores outlying in several key areas. The data from these six participants is not included in the Time 1 descriptive statistics reported herein.

After the study was completed the researcher was informed that two participants had been formally diagnosed with attention deficit hyperactive disorder during the period of the study, one in each group. However, as the students had completed all aspects of the study, and remained in the mainstream school setting, and because of the heterogeneous nature of the sample as indicated already, they were not excluded from the analyses, except for where individual data points were more or less than 3 SD from the mean score which was the same as for all other participants.

In summary, the sample of 38 children included 21 females and 17 males. The figures reported above are the same as all figures reported subsequently (with n changing only as the result of missing data). There were no statistical differences between groups for age, sex, and type of school as a measure of SES. Similarly, there were no difference between groups regarding the amount of physical and leisure time activities but there was, as would be expected, for the amount of time spent doing musical activities. To recap, this group known as EMT (n=19) included seven keyboard/piano, three guitar, two trumpet/horn, one drum kit, and six who learned multiple instruments. Of these, two were simultaneously learning piano and drums, two piano and violin, one piano, violin and singing and one piano and guitar. The parents of the musical group were significantly more invested in their belief that music was important for their children. These parents were also significantly more highly educated that the parents of the children in the control group receiving only statutory group music lessons.

2.4.5 Procedure for Quantitative Study

In advance of testing, parents completed a background information sheet (Appendix D) in addition to the consent form. The background information sheet collected data from the parents/caregivers regarding their contact details, future contact assertion, educational levels attained and musical background, attitude to music. This form also requested information on any hearing, learning or psychological or emotional difficulties known for both the parents and child participants as indicated in the previous section. The background information sheet also collected data on activities both in and/or out of school, the amount of time spent doing musical, physical (e.g. sports/dance) and leisure (e.g. crafts/computer games) time per week both in and out of school per week and whose choice it was to do those.

The parents and teachers also completed BASC-2 Questionnaires. The results of this measure are indicated in chapter five. Any questions that the parents of participants or teachers had were discussed either in person, on the phone or via e-mail with the author.

Participants were tested at the beginning of the academic year (Time 1, September/October, 2013), and again at the end of the academic year (Time 2, June 2014).

Participants were tested individually on all tests as suggested in their respective manuals, except for the Gordon's PMMA and the Beery VMI which were possible to administer in groups. These conditions were repeated in Time 2, though due to room availability and participant illness, substitute situations were sometimes necessary. For example, different rooms, days and times of day, though the test battery remained the same.

The battery could be administered in one and half hours to two hours, and was usually administrated in one session, but occasionally more.

2.5 Research Design and Statistical Analysis

The longitudinal quasi-experimental design utilised six standardised measures as described in section 2.2 of this chapter. Music group (EMT or SSM) was the between-subjects factor and time was the within-subjects factor in the study. Independent *t* tests or one-way analysis of variance were used to establish any group differences at Time 1 (baseline). Repeated Measures Analysis of Variance (RM ANOVA) was used to observe differences over time (Main Effects) and observe any interactions between groups. All statistical tests were carried out using the Statistical Package for Social Sciences (SPSS; Version 22, IBM Corp.). Planned post hoc paired samples *t*-tests, or where the assumptions for parametric analyses were not met, Wilcoxon Signed Ranked Tests, were performed to determine change over time for each group. Due to the nature of the analysis, which incorporated multiple variables, the Bonferroni technique was used when it was necessary to correct alpha p level for multiple comparisons. This technique demands that the alpha p level of .05 is divided by the amount of comparisons undertaken. For example, for the CMS, alpha $p = .05/6$ (variables in CMS) = new alpha p level of 0.008. This is necessary in order to reduce the possibility of Type II error (Field, 2000). However, this method can also inflate the possibility of a Type I (family wise) error. Therefore, this method was used on a variable-by-variable basis within the different results section.

The size of the participant sample for the quantitative study (Total N=38) raises questions about statistical power. However, it should be noted that this sample size is comparable with that of many published studies within the field of music psychology (see e.g. Behroozmand et al., 2014; Fujioka et al., 2006; Norton et al., 2005; Overy, 2003; Schlaug et al., 2009; Williamson, Baddeley & Hitch, 2010) and the sample composition is more carefully balanced in terms of socio-economic status, sex, age and duration and type of musical training than in some studies (see e.g. Kraus et al., 2014; Lee et al., 2007; Moreno et al., 2011; Mehr, Schachner, Katz & Spelke, 2013; Rickard et al., 2010; Zendel, Willoughby & Rovet, 2013). Bearing this in mind a post-hoc power analysis was performed. For paired samples t tests, this suggested that in order to detect an effect size (*d*) of .3, with an alpha level of .01, with this sample size (n=38), there would be a critical value of t = 2.43. This would amount to a power value of .29. For these parameters, the effect size would have to reach .55 to achieve a power value above .80. However, for some calculations, the alpha p value was .05. For these parameters, with this sample, there would be a critical value of t = 1.69. This would amount to a power value of .57. To reach a power value of above .80, the effect size would need to reach .45. For bivariate correlation, to detect a significant effect, the correlation coefficient would need to be r = .71 to reach a power value of .80. For RM ANOVA, a post hoc power analysis shows that partial eta squared η^2 = .15 would be equivalent to an effect size of .42 at a power value of .80 for this sample size.

Variance in reported sample sizes is due to missing data for some variables in some measures following a decision not to input average scores in order to maintain ecological validity. 3 SD ± was deemed the cut off level for exclusion based on statistical rather than clinical norms.

2.6 Statement of Ethics

Goldsmiths Psychology Research Ethics Committee, University of London granted ethical approval for the quantitative study on 7th February 2013 and for the qualitative study on 9th August 2013. All data in this thesis has been anonymised. Written transcripts and original recordings are available on request.

Participants (adult musicians and children), and the children's parents and teachers were informed both of the nature of the research, the aims and objectives and anonymous use of results adhering to the Data Protection Act (1998). Active parental consent was required for child participants and is held on file. All participants were informed that they could withdraw at any time during the study. The author was fully trained in the test battery and has appropriate Disclosure and Barring Service (DBS) clearance and training in safeguarding children. The author collected all data and was assisted by undergraduate students (who also had DBS clearance) on two occasions (once in T1, once in T2). The work adhered to ethical standards described by the British Psychological Society. Participants, parents, teachers and schools were not remunerated for taking part in this research.

2.7 Chapter Summary

This chapter has provided a detailed description of the methods and measures used in the studies described in this thesis. Participants have been characterised, and their recruitment described. The ethics, design and statistical analysis have also been described.

The next chapter presents data from the quantitative study comparing the EMT and SSM groups of children on measures of cognitive and musical aptitude, as well as memory and their relationship to each other within the framework transfer effects related to musical instrument learning in children.

Chapter 3 – The Relationship Between Musical Aptitude, Musical Training and Cognitive Abilities

3.1 Abstract

Previous studies (e.g. Forgeard et al., 2008; Fujioka et al., 2006; Hyde et al., 2009; Moreno et al., 2011; Schellenberg, 2004) have associated musical learning with advantages in cognitive abilities such as intelligence, memory and auditory processing. These relate to potential indirect effects of musical training, theoretically conceptualised as transfer effects (Barnett & Ceci, 2002). This chapter reports one aspect of a larger overall study investigating the effects of extra-curricular musical training (EMT) in comparison to statutory school music (SSM) lessons in a group (N=38) of seven to nine year old children. To measure cognitive abilities standardised tests of intelligence and memory were used. These were Wechsler's Abbreviated Scale of Intelligence (WASI: Wechsler, 1999) and the Children's Memory Scales (CMS; Cohen, 2007). In order to establish whether musical aptitude was associated with any changes observed in the cognitive measures, the Primary Measure of Musical Audiation (PMMA; Gordon, 1986) was used. The results showed that the measures of intelligence, and musical audiation were correlated with each other but not with the measure of memory. The study provided evidence suggesting that extra-curricular musical training does not provide a significant advantage for musical audiation for children aged seven to nine years. However, the study also provided evidence that the EMT group (but not the SSM group) significantly increased IQ points over time. Specifically the vocabulary and matrix reasoning subtests increased significantly for the treatment group but not the active control. This replicates previous studies (Forgeard et al., 2008; Schellenberg, 2004). However, the findings did not show any evidence that extra-curricular musical training increases long or short term or working auditory memory.

3.2 Background on the Relationship Between Musical Aptitude, Musical Training and Cognitive Abilities

In 1974 Sergeant and Thatcher notably suggested, *"All highly intelligent people are not necessarily musical, but all highly musical people are apparently highly intelligent."* (as cited in Radocy & Boyle, 1997, p. 142). The premise of this statement is that intelligence is normally distributed, but musical ability is not. This is likely due to provision of musical training with regard to the idea of cultural capital as described by Hallam (2010), in that parents with higher educational backgrounds, and higher incomes tend to invest in their children learning musical instruments. However, the statement could also be read to suggest that there is a genetic disposition towards being musical which is innate but less common than high levels of intelligence. Gordon asserts that musical aptitude, as with other aptitude, is normally distributed. He writes, *"As there are no unintelligent persons, there are no unmusical persons"* (Gordon, 1986. p. 5). This point will be discussed in further detail in the discussion section of this chapter. At any rate for now, the relationship between musical aptitude and/or ability and intelligence has been of interest amongst academics throughout the 20th century and beyond (see e.g. Ericsson et al., 1993; Flohr, 1981; Hetland, 2000; Honing & Ploeger, 2012; Howe, Davidson & Sloboda,1998; Schellenberg, 2004; Ruthsatz et al., 2008).

In 1998 Howe, Davidson and Sloboda published their seminal paper *'Innate talents: Reality or Myth?'* setting out their thinking on the relationship between nature and nurture using music as one of their primary modes of comparison. They argued for three main points that contradicted the talent account. Firstly, they argued that there was a general and systematic lack of early signs of unusual ability in the absence of special opportunity to learn. Secondly, that there was an absence of empirical evidence of differences in ease or rate of acquisition of musical skills. Thirdly, that exceptional performances by people who appear untalented but respond well to training suggests alternative influences contribute to the phenomena of, as is relevant here, musical talent. They also noted that there is a danger of discrimination in categorising children as having (or not having) innate abilities. Overall they suggest that evidence of excellence was due to environmental differences in early experiences, opportunities, preferences, habits, training and practice. The open peer commentary published on this suggested little agreement in finding an acceptable operational definition of the notion of talent. Detterman, Gabriel and Ruthsatz suggested that Howe and colleagues' point of view amounted to *"absurd environmentalism"* (Howe et al., 1998, p. 411). They argued that the problem is that the hypothesis is attractive for three reasons: a) people want to believe they can be anything they want to be, b) we like to believe our achievements are due to our own efforts, and c) it is useful for teachers and parents to consider interventions as effective. Whilst these ideas are perhaps culturally ideologically framed, Detterman and colleagues argued that this line of thinking may also result in a situation where individuals only have themselves to blame if they are not successful.

Plomin and Deary (2015) write that it would be surprising to find behavioural traits that show no genetic influence. Plomin had responded to the original 1998 paper, and commented that *'g'* in the sense of general cognitive abilities (and measured as IQ) was estimated to be at least 48% heritable. He suggested that this shifts the focus of research from *"what is"* to *"what could be?"* (Howe et al., 1998, p. 421). He also pointed out that heritable does not mean fixed. Rather, multiple genetic systems influence abilities and complex traits, conveying probabilistic propensities rather deterministic effects. In their recent review, Plomin and Deary (2015) recount that Spearman (1904) had developed the notion of '*g*' as a general factor of intelligence, a factor found with universal statistical regularity that accounts for approximately 40% of the variance on a range of cognitive ability tests (Carroll, 1993; Jensen, 1998). The term *'g'* encompasses core skills such as problem solving, reasoning, planning comprehension of complex and abstract ideas and the ability to learn quickly and learn from experience including domains such as verbal and spatial abilities and memory (Deary, 2013; Gottfredson, 1997). Plomin and Deary (2015) highlighted five key findings regarding intelligence and heritability. Firstly, intelligence is normally distributed. Secondly, the heritability of intelligence increases linearly from ~20% in childhood, to ~40% in adolescence and up to ~80% in late adulthood. Thirdly, the term intelligence encompasses diverse cognitive abilities which correlate at around .60 genetically and ~.30 phenotypically. Intelligence is one of the most stable behavioural traits yielding a correlation of .63 in people tested aged 11 and again aged 63. The same genes affect intelligence throughout life, but account for more of the observed variance, as individuals grow older, so the affect appears stronger in adulthood than in childhood. This phenomenon is known as *genetic amplification* (Plomin, 1986). Plomin (1994) had suggested this is how genotypes become phenotypes. Briley and Tucker-Drob (2013) suggest that this is related to genotype-environment correlations because the children choose, modify and generate their environments as they develop. This is relevant to studies of the effects of musical learning as Plomin and Deary later agreed and suggested the term *"active model of selected environments"*, which they contrast to the established model of imposed environments (Plomin & Deary, 2015, p. 100). To summarise, Plomin and Deary (2015) mean in the active model that the child has more agency and control over how they spend their time and create a world which interests them, whereas in the established model of an imposed environment, the child is subject to stimuli provided by parents, teachers, schools and their community and culture thus limiting their autonomous control.

However, Gardner (1983) had suggested that rather than a general set of cognitive skills (clustered together and described as '*g*'), intelligences may be multiple and independent of each other. The specific intelligences discussed by Gardner were linguistic, logical-mathematical, spatial, bodily kinaesthetic, personal and musical. Regarding the independence of musical intelligence and empirical evidence in particular, Gardner begins his assertions by drawing together patterns of phenomena to build his argument. He suggests that composers experience musical sounds inside their minds as a general state of being. Gardner presents this auditory imagination as innate, drawing on Wagner's sentiment that 'composers make music, like cows make milk' (Gardner, 1983, p. 108). Gardner's theory regarding musical intelligence included much anecdotal evidence and also empirical evidence from studies spanning from 1923 to 1982. However, Klein (1997) writes that Gardner's theory is not adequately supported by evidence and that in fact it suffers with the same limitation as that of the general intelligence theory he criticises in that it presents only a static view of the learner's ability.

These different approaches to intelligence are mirrored by the differences in views regarding what could analogously be referred to as musicality. Honing and Ploeger (2012) discussed this in an article that considered the pitfalls and prospects of investigating the evolution of music. Honing (2011a) had hypothesised that considering 'music as cognition' is beneficial in terms of the challenges it imposes on our cognitive systems. Rather than being a product of natural selection, Honing suggests that musicality is a trait that develops without special selection, but exists as a result of exaptation (that is that it may have originally served one function but has evolved to serve a different function, Gould & Vrba, 1982). According to their definition, musicality is: "*a natural, spontaneously developing trait based on and constrained by our cognitive system, and music as a social and cultural construct based on that very musicality*" (Honing & Ploeger, 2012, p. 516).

However, there are pitfalls in Honing and Ploeger's premise, as not only is it likely that cognitive traits are polygenic, but it would also be necessary to obtain evidence that specific cognitive traits have been naturally selected. Certainly, there is evidence suggesting that specific aspects of musical ability are not directly linked to cognitive abilities in some populations. Heaton, Pring and Hermelin (1999) presented a case study of a musically untrained boy (Dominic) with Autism Spectrum Disorder (ASD) and musical splinter skills. Heaton and colleagues showed Dominic possessed exceptional music analytic skills, which had developed without formal musical tuition. As he failed to show corresponding superior visual-spatial skills the authors concluded that for him, perceptual and conceptual systems might be operating independently suggesting an ability to focus on local rather than global elements. Previous studies investigating splinter skills (that is, isolated skills which are higher than other performance scores might suggest) had revealed superior performance on visual-spatial tasks such as the Children's Embedded Figure tests (Shah & Frith, 1983) and on the Block Design test (Shah & Frith, 1993) in individuals with ASD. Heaton, Hermelin & Pring, (1999) had also shown that individuals with ASD who had not been musically trained were able to remember and identify musical pitch significantly more than matched controls. Furthermore this ability (absolute pitch) was correlated with the performance on the block design test. Whilst Heaton and colleagues (1999; and Heaton & Wallace, 2004) concluded there is robust evidence that musical savants[4] frequently demonstrate absolute pitch ability as well as superior musical memory for example, what was particularly interesting in the case study, and relevant here, is that Dominic, displayed exceptional musical skills without training. Heaton and colleagues described Dominic as a 'pseudo-savant'. He could not be described as a musical savant as for this he would have to demonstrate extraordinary abilities both with a musical instrument and also with regard to musical language. However, Dominic had only received minimal musical tuition and his ability was consummate with that level. In contrast his pitch memory was not subject to substantial decay, as would normally be the case and he could discriminate between small pitch intervals and disembed specific unlabelled tones that did not violate the harmonic structure or melodic contour (which is very difficult even for highly trained musicians). Interestingly this auditory disembedding ability did not match his visual skills (measured by block design test) suggesting a specific ability to process local musical qualities. This is what led the authors to suggest that for Dominic, different perceptual and conceptual systems were able to operate independently. However, Miller (1989) documented the case of Eddie, a visually impaired child with ASD and language deficits who displayed highly competent musical skills prior to any musical training. Offering an alternative view for typically developing individuals, Ericsson wrote in response to Howe et al. (1998) that deliberate practice could modify or circumvent basic capacities. He suggested there are qualitative differences between everyday skill acquisition and expert performance resulting from sustained effort. These differences include anatomical changes that support

[4] Musical savants are individuals with extraordinary musical talent which co-occur with autism spectrum conditions (Heaton, Hermelin & Pring, 1999; Miller, 1998)

specific motor skills and domain-specific-memory skills serving to increase long-term crystalised knowledge. This would enable predictive perceptual cues which could aid the initiation of actions and processes earlier than less skilled performers for example.

Two papers using subsets of the Swedish twin cohort focused on the relationship between cognitive and musical discrimination abilities and musical practice and ability (Mosing et al., 2014a and Mosing et al., 2014b). The first (‘*Practice Does Not Make Perfect’*) presents evidence that the propensity to practice music is between 40-70% heritable and furthermore suggests that music practice does not causally influence music ability. This conclusion was drawn on the basis of the evidence drawn from the twin comparisons, i.e. that if one twin practised a lot more music than the other, it did not make a significant difference to their auditory discrimination ability. In the discussion section, the authors do acknowledge that auditory discrimination is only one aspect of musical ability.

The second paper *(‘Genetic Pleiotropy Explains Associations between Musical Auditory Discrimination and Intelligence’*) describes a correlation between the Swedish Musical Discrimination Tests (SMDT) and Vienna Matrices (similar to Raven’s Matrices) test (Formann & Piswanger, 1979). The good fit model was a two-factor model whereby one underlying shared genetic factor explained the covariance between the IQ task and the musical discrimination tasks and a second underlying genetic factor explained variance only for the discrimination tasks. The authors suggest that the effect is due to genetic pleiotropy. According to Plomin and Dreary (2015) the genetic principle of pleiotropy, whereby each gene affects multiple traits, predicts that generalist genes will have effects that create genetic correlations in structural and functional neural networks and ultimately in behaviours. In other words, it will be difficult to identify specific relationships between genes, training effects and domain specific or domain general observable behaviours. The SMDT consists of three tests, Melody, Rhythm and Pitch and is designed to be a quick and available (online) measure of musical ability operationalised as discrimination ability for auditory musical stimuli in the atomistic tradition.

Ullén et al., (2014) attempted to understand the different contributions of musical training and innate musical ability by evaluating the SMDT using analyses based on 6881 participants, 711 of whom were identical twins and 651 who were non-identical twins. The total sample comprised of adults between 27 and 54 years old, with almost 60% being female. Data was also collected on their musical education, historical training and present musical activity. Quantitative genetic analysis was used to examine genetic and environmental contributions to each skill. The results indicated that musical training had an effect on scores as individuals with musical education, as well as individuals who played an instrument scored higher than those who had not on the SMDT. The total number of hours spent training was correlated with each test (Melody = .24-.27; Rhythm = 14-.17; Pitch = .23-.28). Sex had a small effect on Pitch, with females scoring slightly lower than males ($p < .001$). Age had a significant effect on Rhythm and Pitch, with increasing age decreasing discrimination abilities. The analyses showed a moderate genetic influence on scores with heritability estimates of 59% for Melody, 50% for Rhythm and 40% for Pitch with the remaining variance shared by unique environmental influences. This suggests that over a life-span musical learning does influence musical aptitude, but that aspects of musicality may be innate and/or have a genetic component. However the test is administered online and only measures perceptual aspects of musicality. This test (and others) therefore measures only a small range of musical skills and/or abilities. In contrast, Herholz & Zatorre (2012) have proposed that, *"playing music involves several sensory systems and the motor system and makes demands on a wide variety of higher-order cognitive processes" (*Herholz & Zatorre, 2012, p. 486). Therefore the current study aims to investigate how the first year of musical instrumental learning impacts on separately testable yet potentially related and integrated skills. It provides an opportunity to study the development of skills during the first year of learning a musical instrument in order to determine whether these are related, co-develop in a contiguous way, or are directly interconnected. For example, changes in cognitive abilities are often reported as overall rather than specific effects (such as changes in IQ points). In some instances post-training outcomes have been attributed to factors such as improved memory, or the musical training is subsequently described as additional schooling, yet these aspects were not specifically tested in the studies (e.g. Schellenberg, 2004). Jaschke and colleagues (2013) recently commented on the need to *"gain deeper insight concerning the nature of musical learning"* (p. 8) in psychological studies. In order to support this, it seems appropriate to move away from umbrella concepts of intelligence and musicality and adopt a finer grained, or modal approach to the study of musical learning. This is especially important when considering the notion of transfer effects and subsequent attributions between musical learning and cognitive abilities. Therefore, the next section considers the intricacies of musical aptitude testing.

3.3 Aptitude Testing

3.3.1 Musical Aptitude

The literature on musical capabilities generally adopts either an omnibus or an atomistic approach. The omnibus approach is similar to the way in which *'g'* is used to describe a general intelligence in that it describes a general unitary musical trait (Brandler & Rammsayer, 2003). Alternatively, the atomistic approach considers separate musical skills in a similar way to which vocabulary, or nonverbal reasoning and visual-spatial skills can be measured discretely (Law & Zentner, 2012). The Atomistic approach is based on the belief that musical capability is multidimensional and includes a range of independent skills. Seashore and Gordon are known for their atomistic approaches, though Gordon believed musical ability to be distinct from intelligence whereas Seashore did not (Gordon, 1986; Seashore, 1919; Shuter-Dyson & Gabriel, 1981).

The choice of musical aptitude assessment was motivated by the need to be sensitive to maturational changes and be appropriate for use with the age group of the participants in the study. The Seashore Measures of Musical Talents (Seashore et al., 1960) is valid only from US 4th grade (UK equivalence Year 5, aged nine to ten years) and so was not suitable. The Wing Musical Aptitude Test (1948, 1981) and The Bentley Measure of Musical Abilities Test (1966) were also rejected as both also incorporate aspects that focus on training and acquired musical knowledge. Although the Bentley measure was designed for children aged between seven and eight years up to 14 years old, the test includes a section on chord analysis. This therefore assumes some acquired knowledge that is specific to musical learning, rather than measuring aptitude per se. The Wing test also includes a chord analysis section and was consequently similarly excluded. Gordon's Primary Measure of Musical Audiation (PMMA; Gordon, 1986) was chosen because the PMMA was designed for use with five to nine year old children.

Gordon theorised that a combination of innate capacities and early musical experiences encapsulated musical potential. In the manual for the PMMA he explains that although aptitude is *a "measure of one's potential to learn, and achievement is a measure of what one has learned… the two concepts (aptitude and achievement) are not mutually exclusive"* (Gordon, 1986, p. 3). He appeared to believe that the stabilization of musical aptitude occurs at around nine years old due to a change in the quality and quantity of enculturation and training. He writes that if these continued to increase, the level of musical aptitude would *"undoubtedly rise"* (Gordon, 1986, p. 5). However, Gordon does contradict himself. For example, whilst explaining that one could not reach a higher level of musical aptitude than that with which one was born (Gordon, 1986, p. 4), a few pages later he suggests that after the age of nine *"Nevertheless, a young child's audiation skill can and should be continually developed"* (Gordon, 1986, p. 9). These inconsistencies are confusing but appear overall to convey that Gordon believes there is a sensitive period for learning (up until the age of nine years) during which one could maximise one's musical potential.

Gordon criticised aptitude tests that rely upon pitch discrimination suggesting they have 'negative validity' because the results can only predict who will not profit from musical instruction (Gordon, 1986, p. 6.). Instead Gordon suggests the PMMA is valid because the basis of the test utilises *"categorical perception and audiation of patterns to evoke embodied musical meaning"*(Gordon, 1986, p. 10). This point necessitates a short description of precisely what Gordon means by the term audiation. Gordon writes that,

"Need dictated the coining of the verb to audiate[5]. Audiation takes place when one hears and feels music through recall or creativity, the sound not being physically present except when one is audiating whilst also aurally perceiving music that is being performed by others or that one is performing himself" (Gordon, 1986, p. 8).

If it is possible to measure what Gordon describes as informal musical achievement, and no associations between this measure and the other cognitive measures are shown, it would suggest that there are aspects of musical aptitude that develop separately from other aspects of cognition. Gordon believed the PMMA was a valid test of audiation because correlations between the PMMA [6] academic achievement and intelligence tests were low (*r*= <.36). Gordon suggests this demonstrates concurrent validity as the PMMA measures musical factors rather than general academic factors Gordon, 1986). According to Radocy & Boyle (1997, p. 151) agree that the low correlations between the PMMA, academic achievement and intelligence suggest that the test is measuring some other aspect of musicality, perhaps the musical intelligence that Gardner suggests is independent of '*g*'. However, note that the term audiation is contentious. Shuter-Dyson (in Deutsch, 1982, p.405) suggests that whilst some musical aptitude tests do show associations with measures of intelligence, the PMMA has been shown to have only low correlations, for example with the Lorge-Thorndike Intelligence Tests the correlation with the PMMA (for Grade 3, aged 7-8 U.K.) are between .19 and .30.

The next section considers the relationship between music and cognitive aptitude, beginning with meta-analyses conducted by Hetland (2000).

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[5] Underlining added by thesis author to replicate Gordon's original emphasis
[6] These were identified as the Stanford Achievement Test and Lorge Thorndike Intelligence Tests in the PMMA Manual, (Gordon, 1986, pp. 107-109).

3.3.2 The Effect of Musical Learning on Cognitive Aptitude or Ability

Hetland's review considers 15 independent experimental studies (701 participants) and was carried out in order to separate the distinct effects of passive musical listening (the so-called 'Mozart Effect') from active participation in musical instruction. These studies tested the hypothesis that learning to make music enhances spatial reasoning, as an extra-musical effect in pre- and elementary school students.

The first analysis included children aged three to twelve years who had been learning music for between six weeks and two years. This analysis included measures of spatial-temporal ability that relied on mental rotation without a visual or physical model, for example the Object Assembly subtest of the Wechsler Preschool and Primary Scale of Intelligence-Revised (Wechsler, 1989). Other tests of spatial-temporal ability, for example, Kaufman's Assessment Battery for Children (Kaufman & Kaufman, 1983) and McCarthy's Scales of Children's Abilities; Puzzle Solving (McCarthy, 1972) were also included. According to Hetland (2000) the results of his meta-analysis showed *"that active music instruction lasting two years or less leads to dramatic improvements in performance on spatial-temporal measures"* (p. 203). He remarks that the effect size across studies is remarkably consistent (r = .37, equivalent d = .79) but suggests that the low reliability of the measures used[7] means that the results should be interpreted with caution. It appears Hetland is referring to the use of the discrete analysis of subtest data rather than the use of composite standardised scores. Hetland noted that the effect was stronger with younger children (aged three to five years; r = .44) than for older children (aged six to twelve years; r = .27). Hetland found that musical learning has an equal effect on spatial-temporal ability for both low and high socio-economic status (SES) groups and that the length of programme (of musical instruction) did not seem to affect the results. He further noted that one-to-one music lessons might lead to stronger spatial skills, but that group instruction was also effective. Similarly, musical notation learning also contributed to performance but was not essential for improvements on tasks of spatial-temporal ability. This is important because good performance on the Wechsler Object Assembly subtest (which the majority of studies used) relies on an ability to assemble coherently whole pictures from elements of the pictures (like a jigsaw). Some researchers

[7] Here Hetland refers to his first analysis of 15 studies. He describes the measures specifically as spatial-temporal tasks requiring mental rotation, "and/or multiple solution steps for two or three-dimensional figures in the absence of a physical model" (Hetland, 2000, p. 183). These were measured in 9 studies using the Objects Assembly subtest of the WPPSI-R, the STAR-EP in two studies, the McCarthy Scales of Children's Abilities – Puzzle Solving in one study, the Kaufman Assessment Battery for Children (Magic Window) in one study, the Developing Cognitive Abilities Test (Spatial subtests) in one study and finally the WRAMA-Matching subtest in one further study.

have suggested the mechanism underpinning far transfer effect reflects the learning of musical notation (Rauscher & Zupan, 2000) and/or the proximity of the brain regions responsible for music and spatial processing (Leng & Shaw, 1991; Shaw, 2000). Finally Hetland reported that his meta-analysis failed to reveal effects of parental involvement or type of instrument learned.

The second analysis included five studies (694 participants) using Raven's Standard Progressive Matrices (RSPM; Raven, 1976). These tasks require the individual to fill in a matrix by figuring out how best to complete the pattern. They are regarded as measures of non-verbal intelligence rather than of spatial-temporal ability, which is why Hetland separated them for his analyses. This meta-analysis shows *"in striking contrast"* (Hetland, 2000, p. 218) to the first analysis, that music instruction does not lead to improvement on non-verbal intelligence as measured using RSPM (median r = .06, equivalent d = .11).

The third analysis included eight studies (655 participants) with *"more loosely defined"* (Hetland, 2000, p. 219) concepts of spatial abilities and included aspects of memory, visualisation and perception as a result of using tests such as the Stanford-Binet Bead Memory task (Thorndike, Hagen & Sattler, 1986), which requires spatial memory. Hetland reported that the results strongly suggested an effect of music instruction of other types of spatial tasks (median r = .31, equivalent d = .66).

Overall, Hetland's meta-analyses provides strong evidence that music instruction increases some, but not all types of spatial ability and does not improve logical thinking associated with general non-verbal intelligence measured by RSPM. Hetland regards this as a *"solid finding"* and states that the *"effect cannot be explained away by a Hawthorne effect, nonequivalence of experimental groups, experimenter bias, or study quality"* (Hetland, 2000, p. 220). These meta-analyses formed the basis of The Handbook of Research and Policy in Art Education (Hetland & Winner, 2004).

Ruthsatz and colleagues (2008) challenged Hetland's report, suggesting there was evidence of a positive association between musical ability and general intelligence. They cited Lynn and Gaults' 1986 study, which showed a significant positive correlation between Wing's Standardized Tests of Musical Intelligence (Wing, 1968) and Spearman's g (as measured using Raven's Progressive Matrices) in 93 children aged nine to eleven years. Lynn and Gault (1986) reported positive correlations for g and chord analysis (r = .27), pitch change (r = .40), and pitch memory (r = .37). Ruthsatz and colleagues also cited a review of 65 independent studies by Shuter (1968) that showed a correlation between general intelligence and musical achievement of .35. Ruthsatz and colleagues (2008) claimed that the slightly older, higher-level child musicians in their study provided evidence of "*significantly higher mean levels on innate characteristics such as general intelligence and music audiation, in addition to higher levels of accumulated practice*" (Ruthsatz et al., 2008, p. 330). They used the Raven's tests and Gordon's Advanced Measures of Music Audiation (Gordon, 1989) as well as a questionnaire measuring practice times and found a significant relationship between those three independent variables. This led them to posit what they describe as a multi-factor view of the acquisition of skills underpinning musical expertise. However, their sample of 178 high school band members does not include a control comparison group. Nevertheless, they summarise their argument by recounting Seashore's (1919) quote:

> *"It is possible for a person, strong in other capacities, but with relatively low intellectual power, to assume fairly important roles in music within restricted fields of activity; but the great musician is always a person of great intellect".*
>
> (Ruthsatz et al., 2008, p. 331)

Whilst this serves to illustrate one particular standpoint or view of the debate, there are several studies that have investigated changes in IQ scores in children that are the same age as the participants in this study. The first of these (Costa-Giomi, 1999) was a longitudinal study following 117 nine-year-old children over a period of three years. The study utilised random allocation of instrumental teaching in its design, although the recruitment process specified that the sample only included children and families who had never learned a musical instrument before and did not have a piano in the home. The ethical agenda of the study also specified a criteria that family income was lower than $40,000 (Canadian)[8]. Only 78 children completed all the cognitive abilities tests, which included five standardised tests. These were described as Level E of the Developing Cognitive Abilities Tests (Wick, 1990), the tonal and rhythmic audiation tests of the Musical Aptitude Profile (Gordon, 1965; 1988), the fine motor subtests of the Bruinicks-Oseretsky Test of Motor Proficiency (Bruinicks & Oseretsky 1978), the language and mathematics subtests Level 14 of the Canadian Achievement Test (CAT2; 1992), and the long form of the Coopersmith Self-Esteem Inventories (Coopersmith, 1981). Measures were taken before the programme of musical learning began and at the end of the first, second and third years of instruction. Instruction involved individual weekly lessons (30

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[8] The ethical reasoning was based on a study by Duke et al., (1997), which found that children in the US learning piano were from a privileged environment. Specifically they found 80% Caucasian, 84% lived at home with both parents, 70% were female and only 18% had a family income under $40,000 USD.

minutes for the first two years and 45 minutes in the final year) either during lunchtime or after school based on a traditional curriculum including basic techniques and both popular and classical repertoires. Analyses were carried out on the *"total cognitive abilities score"* (Costa-Giomi, 1999, p. 203). No rationale is given for this although analyses were carried out on what is described as *"verbal, quantitative and spatial"* (Costa-Giomi, 1999, p. 204) aspects of the tests. After two years of piano training, children in this active group showed improved general cognitive abilities and spatial abilities with a small effect size (d = .2) in comparison to the no-treatment control group. However, no differences between groups were found following the third year, suggesting any inferred advantage might have been temporary. Costa-Giomi explains the conflicting evidence (between years) by proposing that *"the positive effects of the treatment were dependent upon children's dedication to learning piano"* (Costa-Giomi, 1999, p. 208) which she deduced from qualitative progress reports produced by the teachers. She also explains this evidence led her to believe that there was an initial enthusiasm for the project which may have waned, especially as participants reached puberty. Although she suggests that hormonal changes may have influenced the results from the adolescents, unfortunately no biological data (such as testosterone which has been suggested is related to artistic talent, see Hassler et al., 1985; Hassler, 1992) were taken. Furthermore, no analyses investigating differences between sexes were undertaken.

Building on this earlier research, Schellenberg proposed that the combination of different experiences music lesson provides could have *"collateral benefits that extend to non-musical areas of cognition"* (Schellenberg, 2004, p. 511). In his study 132 participants were randomly allocated into (1) standard keyboard, (2) Kodàly voice, (3) drama or (4) no lesson groups. Six year old children were selected because *"music and drama instructors consider children of this age to be sufficiently mature for formal lessons, and because plasticity declines in older children"* (Schellenberg, 2004, p. 512). Schellenberg cites the acquisition of perfect pitch before the age of seven as his primary justification for this observation. Participants were recruited via an advert in the local community newspaper offering free arts lessons and then randomly allocated group assignment. Lessons were taught for a period of 36 weeks, facilitated by a number of certified music and drama teachers associated with the Royal Conservatory of Music in Toronto. This ensured group sizes of no more than six children per group.

The measures used were Wechsler's Intelligence Scale for Children (WISC-III, Wechsler, 1991), Kaufman Test of Educational Achievement (K-TEA: Kaufman & Kaufman, 1985), and the Parent Rating Scale of the Behavioural Assessment System for

Children (BASC[9], Reynolds & Kamphaus, 1992). The WISC-III provided a full-scale IQ score and four index scores including verbal comprehension, perceptual organisation, freedom from distractibility and processing speed. The twelve subtests used were picture completion, information, coding, similarities, picture arrangement, arithmetic, block design, vocabulary, object assembly, comprehension, symbol search and digit span. The K-TEA comprised of five subtests, mathematical applications, reading decoding, spelling, reading comprehension and mathematical computation.

Schellenberg reported finding *"relatively modest but widespread intellectual benefits from taking music lessons"* (Schellenberg, 2004, p. 513) with an average increase of 7 IQ points (SD 8.3) for the musical training group (MT) in comparison with an increase of 4.3 (SD 7.3) IQ points for the control groups. The increase for the MT group is reported as being significantly larger than that of the control group with an effect size between small and medium (d = .35). The description of analyses included a justification for increasing power by collapsing the data from both the musical training (Kodàly voice and keyboard) and control (drama or no extra lesson) groups. According to Schellenberg the groups showed similar levels of IQ increase and this justified the collapse of the data from the groups.

Schellenberg also reports that some index scores (freedom from distractibility and processing speed) showed higher increases than others (verbal comprehension and perceptual organization) and that these increases were significantly larger for the MT group than for the control group. Similarly, for all but two of the twelve subtests (arithmetic and information), larger increases were reported for the MT group in comparison to the control group, though these data are not reported specifically. In the discussion section of this paper and in a later paper (2006), Schellenberg argues that whilst the results from his 2004 study did provide evidence for a far transfer effect, methodological limitations in the study meant that effects from other extra-curricular activities could not be fully ruled out. He suggests that extra-curricular activities (such as chess), which requires focused attention, memorisation, and the progressive mastery of a technical skill, essentially functions as extra schooling or intellectual enrichment (Ceci & Williams, 1997). In a personal communication, that took place between this author and Dr. Schellenberg at the International Conference for Music Perception and Cognition (2012), Schellenberg reiterated his belief that the results from his studies reflected the socio-economic advantage of the participants, who were recruited via a network of highly educated academics (see also Corrigall & Schellenberg, 2015). For this reason, great care

[9] The BASC-2 will be discussed in Chapter Five as it forms part of the battery of tests used in this study.

was taken to ensure that the children in the current study were drawn from a range of schools and that SES was as balanced as possible within the sample. Furthermore, data on the children's extra-curricular activities, such as sports clubs, hobbies and arts and crafts as well as music were collected in order to control for these potential confounds.

It is unfortunate that that the original Schellenberg study did not include a measure of musical aptitude. However, questions concerning whether pre-existing differences might potentially afford an advantage for musical learning, and consequently affect training effects, were addressed by Norton and colleagues in 2005. In a cross-sectional design, these authors studied 70 children aged between five and seven years using structural magnetic resonance imaging scans. They compared participants at baseline who were about to start learning either stringed instruments or piano, with a group of children who only studied music in class lessons. The behavioural measures probed cognitive, motor and auditory skills using object assembly, block design, vocabulary, Gordon's PMMA (Gordon, 1986), Raven's Matrices (Raven, 1976a and b; 1998) and an auditory analysis test developed by Rosner and Simon (1971). This auditory analysis test required children to repeat back 40 words that had a missing syllable. For example, the child was asked to say smell without the 'm' or cowboy without the boy. Children also completed a right and left finger-tapping test (Peters & Durding, 1979) where they were asked to make as many taps possible in 20 seconds. Of the 70 children recruited, 39 were about to begin individual extracurricular music lessons (30 minutes per week) on either a keyboard or a stringed instrument in addition to their classroom based group music lessons. The remaining 31 children would receive the classroom based group music lessons only. The first aim of this study by Norton and colleagues (2005) was to investigate whether any pre-existing differences were observable in the brain structures of the participating children, bearing in mind their intention regarding music lessons. Searches based on previous evidence regarding neural adaptations associated with musical training found no voxel-by-voxel differences between white or grey matter concentrations in the brain. No pre-existing differences were found between the participants and they were therefore considered as a typically developing group of children. Initial analyses showed that the musical training group participants were slightly older and also had a higher reported mean SES. Following the musical training period, the results showed that age significantly affected performance with higher scores observed on all outcomes except the object assembly and block design scores. SES appeared to only affect the vocabulary tests where higher scores were observed in the higher SES group. The oldest children in the instrumental group were then removed from further analyses to create an age-matched sample. SES remained a factor but was controlled for in analyses though neither ANOVA nor ANCOVAs subsequently revealed any significant difference between groups. After correcting for multiple comparisons, only the Raven's Matrices and Auditory Analysis test were correlated with Gordon's PMMA. However the authors only reported the composite score so the relationship between specific cognitive and musical variables are not specified. No other correlations were found between performances on the cognitive, behavioural or auditory measures. As this study was published in 2005, it was not included in the meta-analysis performed by Hetland in 2000.

Forgeard et al. (2008) studied 59 children aged between eight and eleven years old, divided into three experimental groups. The first group included 21 children who had received a minimum of three years musical instruction on a mixture of instruments. All the children in this group received instruction in reading musical notation. The second group of 20 children had learned via the Suzuki method. This way of teaching and learning emphasises playing 'by ear' initially and musical notation reading is only introduced at later stages. The third group of 18 children received only the statutory music class lessons (which all participants also received). This group was classed as an active control group. Initial analyses revealed that the children in the instrumental groups were older than the children in the control groups so this factor was co-varied in the analyses. However, no differences were revealed between groups for SES or sex, or between outcomes for the two different types of instrumental groups. Therefore the two musical learning groups were collapsed into one instrumental group for further analyses. The outcome measures used in the study included Gordon's Intermediate Measure of Musical Aptitude (IMMA; Gordon, 1986) as well as other melodic and rhythmic discrimination tasks and Rosner & Simons' (1971), auditory analysis task, motor learning task (as used in Norton et al., 2005) and cognitive tasks such as block design and object assembly from WISC-III (Wechsler, 1991) and Raven's progressive matrices (1976a). The findings showed that the instrumental group outperformed the control group on two of the near transfer tasks, specifically the left and right hand motor tapping task and the tonal component of the IMMA. Similarly, the collapsed instrumental group outperformed the active control group on the three of the 'distantly associated' (far transfer) tasks. These were the tests of vocabulary (WISC-III; Wechsler, 1991) and Raven's standard matrices (Raven, 1976a) and advanced matrices (Raven, Raven & Court, 1998). However, the instrumental and control groups did not differ on measures of rhythm discrimination, object assembly, block design or Raven's coloured matrices (Raven, 1976b), nor on the measure of auditory analysis.

In order to determine the effects of training duration, a series of multiple regressions were carried out where the control group were entered as zero weeks training.

The results provided a model whereby, when controlling for age, training duration could predict the outcome for motor learning with the left and right hands, for Gordon's IMMA tonal tests and the melodic discrimination test as measure of near transfer. The model could also predict the outcomes for vocabulary (partial $r^2 = .09$, $p = .02$) and Raven's advanced progressive matrices (having removed one outlier whose scored 2 SD below mean on all the Raven's tests) as significant for Raven's coloured (partial $r^2 = .13$, $p = .01$), standard (partial $r^2 = .10$, $p = .02$) and advanced (partial $r^2 = .12$, $p = .01$) as far transfer outcomes. Forgeard and colleagues had criticised research that suggests an effect of far transfer when no measure of near transfer, for example, in the parent domain, has been included. Their study was the first to provide evidence of a relationship between the two.

Whilst the Forgeard and colleagues' study provided evidence regarding the inter-related development of cognitive and behavioural skills due to musical learning, these results were reported as being due to the effects of three years of training on two types of musical instrument (strings and keyboards) in a cross-sectional rather than longitudinal study. However, Hyde et al., (2009) reported the results of a longitudinal study in which structural brain changes that correlated with improvement in musically relevant motor and auditory skills after only 15 months of musical training. Their sample comprised of fifteen children who were beginning extra-curricular keyboard lesson and sixteen children who were receiving typical statutory music lessons. The children were all right-handed and aged around six years old at the beginning of the study. A control group of 16 children of matched age did not receive individual music lessons but did take part in group music classes, consisting of singing and drumming, at school. A series of behavioural tests including the WISC-III (Wechsler, 1991), the Raven's progressive matrices (coloured and standard, Raven, 1976a), and an auditory analysis test (Rosner & Simon, 1971) and sMRI scans were taken pre and post musical training. Age and SES were co-varied in analyses as the instrumental group scored slightly higher on both factors, though sex was equally distributed. Results for measures included in the 'near transfer' battery showed that the instrument group outperformed the control group on measures of right hand motor performance (a similar trend $p = .06$ was found for left hand) and on the non-standardised melodic and rhythmic discrimination test (described as similar to Gordon's PMMA), though only a composite result is reported. However, no differences over time were found for the 'far transfer effects' as measured using object assembly, block design, vocabulary, or Raven's Matrices. Associating the behavioural measures with neural adaptations, changes in the motor areas of the right precentral gyrus and corpus callosum were predicted by left hand motor test improvement scores. Changes in the right hemispheric auditory area were predicted by improvements in the melodic/rhythmic discrimination test. These results were taken to support previous findings (Norton et al., 2005; Schlaug et al., 2005) showing that such brain changes are more likely to be the result of training than determined by any pre-existing differences in the participants' brains.

Mehr et al., (2013) focused on a group of four-year-old children (N=29). They questioned the validity of claims regarding a positive effect of musical training on cognition based on the five randomised controlled trials (RCTs) published, suggesting a publishing bias. Therefore, in an RCT design study they compared musical or visual based training with a non-treatment control group in which the participants received 45 minutes of parent-accompanied lessons a week for a period of six weeks. In the music classes the lessons were based on typical pre-school music activities such as dancing to music and included parents singing lullabies to their children. In the arts classes, the parents and children worked on crafts projects together. At baseline, children were tested on receptive vocabulary. After the training period, the children were tested on two types of spatial reasoning (a navigation tests and a visual form analysis test), numerical discrimination and receptive vocabulary. The reason given for this is the short experimental period, which might incur practice effects with the other measures. The only effect reported as significant was a positive effect of the visual based training on the tasks. However a second RCT failed to replicate these findings, leading the authors to suggest that pre-school music education may not increase spatial, linguistic or numerical skills as measured in their study. Whilst acknowledging the brevity of their training period, they suggested this might not be a factor because results reported in previous RCT studies suggested duration of learning did not automatically lead to a larger effect. They suggest instead that any transfer effect may occur in steps of progression rather than in a simple linear trajectory.

Regarding training intensity, they suggested that at an early age children may find the intensity of more typical training aversive, and that the relationship between *"intensity and cognitive transfer remains unclear"* (Mehr et al., 2013, p. 7). With regard to direct effects of training, they suggest that their communications with parents provides indirect evidence that *"that the music lessons had their intended effect"* (Mehr et al., 2013, p. 8). Finally, with regard to the notion of sleeper effects, that is the possibility of a delayed rather than immediate effect, they suggested that this should be addressed in future studies. Having indicated a publication bias in favour of positive results for music training to cognitive transfer effect, the authors suggested that their negative findings help to balance this. They echo the view of Hetland & Winner (1999) who claimed that the primary benefits of music education should be self-evident, and by implication not reliant upon cognitive transfer effects, but that continued instruction *"will likely thrive for its intrinsic value"* (Mehr et al., 2013, p. 8).

In spite of the potentially different developmental stages of the participants involved in each study, these findings suggest that it is possible to design research examining how behavioural changes might be related to multimodal sensorimotor integration as a result of learning to play a musical instrument. It was essential for this study to choose measures that would be both efficient to administer yet comparable to other studies testing near and far transfer effects as outcomes of musical instrument learning. As the review of literature presented in this chapter demonstrates there is conflicting evidence regarding improvements on the Raven's matrices tests. As Wechsler's Abbreviated Scales of Intelligence (WASI; Wechsler, 1999) includes a block design and vocabulary test as well as the matrix reasoning test (that is similar to the Raven's) it was particularly suitable for use in the study. Furthermore, the WASI allows for three levels of analyses; the first level omnibus known as the full four factor FSIQ, the second level for fluid or performance (P) IQ and for crystalised or Verbal (V) IQ and the subtest level, specifically vocabulary (verbal, crystalised intelligence), similarities (semantic processing, crystalised intelligence), matrix reasoning (nonverbal fluid intelligence), block design (spatial ability, fluid intelligence).

However, the WASI does not specifically provide measures of memory. As the following section describes, certain types of memory (such as auditory working memory) have been associated with improvements due to musical learning. Therefore subtests from the Children's Memory Scale (CMS; Cohen, 1997) were included in the battery of measures in order to be able to identify whether these changes in auditory memory co-occur with the other cognitive changes as the evidence discussed in the next section suggests.

3.3.3 Effects of Musical Learning Studies on Memory

Within the context of this study it is necessary to review aspects of memory associated with learning. This is important because it may be that any observed increases in intelligence, may be related to auditory memory. Working memory especially is complex because (like musical ability and intelligence) it is thought to be partly heritable, forms some of the variance in *g* within the construct of intelligence, and also appears to be trainable (Kane, Hambrick & Conway, 2005; Oberauer et al., 2005; Shipstead, Redick & Engle, 2012). With regard to musical training, specific aspects of auditory WM, such as the posited phonological loop (Baddeley, 2012), may be important with regards to the underlying mechanisms of transfer between domains. Whilst relevant models of memory were outlined in chapter one, empirical studies with specific relevance to musical training will be reviewed in the following section. In particular, distinctions between short-term memory (STM) and working memory (WM) will be reviewed as this is a complex area in which the terminology is important when interpreting findings relating to musical learning (and potentially transfer effects).

To begin with, Ho et al. (2003) did find an advantage for musicians for auditory STM. Their study of 90 male right-handed participants aged six-15 years (mean age, 10 years) included both cross-sectional and longitudinal investigations. The first cross-sectional analysis was undertaken because the musically trained group had already participated in the schools band and orchestra programme for between one and five years (Mean = 2.6 years). Ho and colleagues found no difference between the groups in their initial overall IQ (Hong Kong WISC, utilising the picture completion and block design subtests for PIQ and vocabulary and digit span subtest for VIQ). Comparison between music training groups revealed a significant difference between groups in verbal (STM) but not visual memory scores, with the musically trained group outperforming the control group with an average 20% more auditory retention. The second study was longitudinal and followed a smaller sample of the same group and tested the participants one year later. The results showed that verbal memory performance had stabilised in children who had discontinued music lessons. In contrast, the verbal memory performance increased in those who had either continued or subsequently started music lessons.

Further studies also suggest musical training provides an advantage in auditory STM. This has been attributed to an enriched acoustic environments as this has been seen to sharpen the tuning of auditory neurons in young and old animals (Engineer et al., 2004). Fujioka and colleagues (2006) investigated whether the same effect might be found in humans by studying children learning the violin using the Suzuki method, which focuses on aural learning as previously described. Using the functional neuroimaging technique, magnetoencephalography (MEG) which can locate when and where in the brain a sound is processed, the study examined six participants who were four to six year olds and who had one year of violin training using the Suzuki method. Fujioka and colleagues were interested in the effects of musical training on the development of auditory cortical-evoked fields (AEF). These are collections of neurons (approximately 50,000; Okada, 1983), which synchronise in response to stimuli. MEG can pick up activity in the pyramidal cells in the sulci, which are perpendicular to the cortical surface (unlike the gyri). MEG measures changes in event related potentials (ERP), known as signatures. Fujioka and colleagues found an association between the ERP signatures in the AEF and verbal memory ability after only four months of musical training. The active music group, together with six age-matched controls who were not given any musical training were measured four times using MEG. Two types of stimuli were used in the experimental design; the pitch of A4 tone produced by the down-stroke of a bow on a violin on the open A string (fundamental frequency of 440 Hz) lasting 850 ms, and a 500 ms noise burst. The results suggested that changes in the AEF field reflected *"specialized and effective"* cortical networks developing over the course a one year (Fujioka et al., 2006 p. 2604). For the behavioural measures, a musical discrimination tests and the digit span tests from the WISC-III were used. No significant differences were observed between groups at the initial time point. Whilst both groups increased performance on both tests, the positive change was statistically significant for the musically trained group only. However, there is a complication when using digit span tests to measure memory effects in children.

The use and separation (or aggregation) of forwards (FDS) and backwards (BDS) digit tests is important in studies investigating training effects on children's memory. FDS is considered a measure of auditory STM in both adults and children. BDS however has been shown to place a heavier load onto the WM of children, but not adults (St. Clair-Thompson, 2010). Recent studies have suggested this may be due to differing developmental trajectories of STM and WM (Harris et al., 2011).

In the Fujioka et al., (2006) study unfortunately the specifics of the digit span test were neither described nor results reported so it remains to be understood as to whether the musical training affected short term or working memory, or both in this case. In fact, only raw scores were used on both tests due to the lack of availability of standardised scores for this age group. Therefore, the changes reported in the study might not be reliable (especially considering the small sample size) and cannot be confidently attributed to musical training. Whilst the aim of this study was not specifically to investigate which types of memory might be affected by musical training, Lee et al., (2007) reported results from two experiments comparing the effects of musical training and mental-abacus training specifically on WM in typically developing children.

Lee and colleagues addressed the hypothesis that different types of training would affect the different auditory and visual domains and therefore different aspects of WM would be influenced (see Alloway, Gathercole & Pickering, 2006). The study used five measures to test WM: forwards and backwards digit span tests (FDS and BDS respectively); a non-word span (which included nine nonsense words instead of digits); an operation span (based on an approach developed by Turner and Engle (1989), requiring participants to speak an operation string. In this operation string test, participants were show an example such as this: "*9/3+5=8? D*". They were required to answer out loud either 'yes' or 'no' if the answer was correct (in this case 'yes', and then state and remember the letter associated (in this case, the letter D). They also included a simple spatial span test, which required participants to remember an object and location of that object within a grid of cells, and finally a complex spatial span based on an approach reported by Hegarty, Shah and Miyake (2004), which essentially added a mathematical operation to be remembered to the simple spatial span described earlier.

The first cross-sectional study included 32 children (mean age, 12.5 years) half were randomly selected to train in mental abacus exercises for 1.5 hours twice per week for at least one year. The remaining 16 formed a control group who did not receive any training. None of these participants had undertaken musical training. The results showed the mental abacus training group outperformed (on speed and accuracy) the controls on the mental calculation tests and on the simple spatial span tests, but not the FDS, BDS, non-word span, operation span or for the complex spatial span tests. The authors suggested that the increases occurred because the training enhanced the participants' ability to store visual-spatial information in their mind, but that this effect did not affect their auditory WM capacity.

The second study examined the effect of musical training on WM capacity and whether there were differences between adults (n = 40, mean age = 22 years) and children (n = 40, mean age = 12 years). Using the same series of tests, the primary aim of this study was to observe any advantage of musical training specific to auditory memory. The results for the FDS and non-word span tests (proposed as measuring phonological storage), showed that the adults performed better than the children, and that the musically trained (MT) groups performed better than the non-trained groups. For the BDS and operation span tests (proposed as measures of the central executive component of memory) and for the visual–spatial storage tasks, the musically trained child group performed better than the untrained child group, but no difference was found between the adult groups, although they performed better than the children. The musically untrained children scored the lowest on all measures. However, as the level of musical training was determined only by a 10-item tone recognition test, the use of the term 'trained' is somewhat misleading. No data was gathered regarding duration or type musical training undertaken and no account was made for the possibility of absolute pitch perception. Whilst no statistics were provided suggesting any differences between age groups, the authors reported that the MT group scored 9.3 out of 10 (children) and 9.5 out of 10 (adults) in comparison to the untrained group (0.1 out of 10 for children and 0.8 out of 10 for adults). These scores imply that the MT group scored highly on the time recognition test, whilst the control group scored poorly.

This has implications because the authors claimed that the degree of musical training had effects on phonological memory and further argued that the effects of musical training on central executive and visual-spatial skills were *"more obvious for children than for adults"* (Lee et al., 2007, p. 342). Lee and colleagues supported their claims following a series of two (adults vs. children) by two (trained vs. untrained) ANOVAs, in which the following results were revealed. There was a significant main effect of training and age for FDS and the non-word span test (measuring phonological memory), though the interaction was not significant. Post-hoc tests revealed statistically significant results that the adults performed better than the children, and the musically trained groups better than the un-trained groups. However, for the BDS and operation span tests (measuring the performance of the central executive), there was a significant effect of training and age and the interaction was also significant. Post-hoc tests revealed that the children's untrained group had scored lower than all the other three groups (all *p*s < .01). For the spatial span tests, both object only and location only, there was a significant effect of training and age and the interaction was also significant and again the untrained children scored lower than the other three groups (all *p*s < .01).

Whilst Lee and colleagues design considered types of memory more carefully than controlling for the musical training effects, with a slightly younger group of children, (eight to nine year olds, N = 142) Rickard et al., (2010) evaluated the effects of musical learning in the form of an intervention over a two and a half to three year training period.

The intensive strings programme included 41 female and 41 male students with a mean age of eight years. The age matched control group consisted of 37 female and 31 males. Intensive music training was provided in the form of a one-hour per week classroom based strings programme in five different schools. All participants also had one hour of standard general music provision per week. The participating schools committed to purchasing the instruments (violins, violas and cellos) and allocated instruments to the students, rather than allowing the students to make a choice about musical activity. One year into the programme a further active control group, who received juggling lessons was recruited. This juggling intervention lasted for one year only. The battery of measures included the verbal memory measures from the Children's Memory Scale (Cohen, 1997). This included the verbal learning trials of word-pairs, immediate memory, delayed recall, delayed recognition and forwards digit span tasks.

The results from the memory tests revealed significant test-time by group effects for verbal learning, verbal immediate recall and visual perception, although the significance alpha level was not adjusted for multiple comparisons. Unfortunately the means for each group are only reported in diagrammatic figures (Rickard et al., 2010, Figure 1, p. 43), which do not provide sufficient information for a re-analysis by this author. Post hoc analyses showed that the music group significantly improved scores on the verbal learning and verbal recall tests after the first year. However, the control group performed better than the music group on immediate verbal recall after the second year. From the second to third year, the digit span scores increased significantly more in the music-training group than in the control group. However, it was not explicit whether the statistic reported (p = .04) had been corrected for multiple comparisons. The authors report that these group differences remained stable even when controlling for the effects of age and school. They also claimed this was the case in spite of parent-reported limited compliance with practice in the music-training group over the duration of the programme. No significant changes were found for any of the measures for the active control juggling over the one year of the intervention. The authors suggested that group administration of the CMS might have reduced its sensitivity. They had received confirmation from Cohen that group administration of these tasks was possible, though it seems unlikely that written as opposed to oral response would not have complications and call into question the legitimacy of standardising those scores. They also noted that larger class sizes may have served to limit levels of individual teacher/child interactions and limited the development of critical musicianship skills. Specifically they mentioned problems with intonation, posture and excessive time spent tuning, which reduced overall practice time. However, the students receiving the music-training were tested for progress in musical skills such as being able to clap a beat, read and repeat simple rhythms, and echo and sight-read simple melodies. The mean scores of these tests improved significantly from 39.88 initially to a post-programme mean of 56.61.

In summary, Rickard and colleagues posit that their programme *"may have developed acquisition and short-term working memory capacity rather than long-term consolidation"* (Rickard et al., 2010, p. 44,) and suggest the evidence they provide concurs with the proposal of Jakobson, Cuddy and Kilgour (2003) that musical learning enhances auditory temporal processing abilities, a proposal which is described as consistent with structural changes observed in neuroimaging studies (see e.g. Münte et al., 2002; Schlaug et al., 1995).

In a similar study, Roden, Kreutz and Bongard (2012) investigated a school-based programme that included a music training (MT) group as well as two control groups, an extra natural science training group and a no training control. The mean age of the participants was seven years (37 males, 36 females). The MT group (maximum of five per learning group) received weekly 45-minute lessons on guitar, violin cello, flute, trumpet, clarinet and drums over eighteen months. Fluid intelligence was tested using a German translation of Cattell's Culture Free Intelligence test (Cattell, 1961; Weiß, 2006) This included four subtests; series, classifications, matrices and typologies that according to Weiß correlate highly with '*g*' (.83). Verbal memory was tested using a German adaptation of Rey's Auditory Verbal Learning test (Rey, 1941) which included verbal recall of word lists, delayed recall of the same word lists and verbal recognition of words on the same word list.

The participants completed the tests three times over a period of 18 months. Repeated measures ANCOVA analysis revealed time by group effects for verbal learning, verbal delayed recall and for verbal recognition but not for visual[10] memory. Post-hoc analyses, with alpha level adjusted for multiple comparisons, showed that the MT group significantly improved their performance over time for all the verbal but not the visual tests. Their active control (natural science group) improved on verbal delayed recall only, and only between Time 1 and Time 2. The non-active control group significantly increased performance on verbal learning from Time 1 to Time 2, and from Time 2 to Time 3. They also significantly increased their scores on verbal delayed recall, but only for Time 2 to Time 3. Overall, for the verbal tests, the MT group outperformed both the active and passive control groups, which the authors interpreted as suggesting that musically trained children developed more efficient STM and LTM strategies compared to their control peers groups. However, the children were not randomly allocated to the intervention groups and compliance to practice demands was described by the authors of the study as not only inconsistent but also poorly reported by the parents of the participants. Furthermore, the children's pre-test musical knowledge was not adequately screened meaning an effect of pre-existing differences cannot be ruled out. In spite of the quasi-experimental nature of the study, Roden and colleagues claimed that the larger than expected effect sizes, the large sample size, and inclusion of two control groups suggests a robust effect showing that musical training positively impacts on auditory memory. They conclude that the temporal nature of the auditory framework and the strategy of chunking through musical learning strengthens WM and that these effects may transfer from the musical to the linguistic domain.

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[10] In the paper itself, the authors write 'verbal memory' though they must mean visual memory as they have just reported the verbal memory statistics and they do not report any separate visual memory statistics.

As can be ascertained clearly from a review of these studies so far, ensuring the design adequately considers the nature and length of musical training, and the type of memory tested and measure utilised is complicated and difficult to achieve. In a different type of paradigm, Moreno et al. (2011) demonstrated an effect of specific musical skills training (from computerised programmes) on the executive function of children. She suggests that this type if training has a global transfer effect, which includes both memory and perception.

In the study, two groups of 32 children aged between four and six years received either visuospatial art and design skills (active control) or listening skills based on rhythm, pitch, melody, voice, and musical concepts as well as other cognitive, perceptual and motor skills (music training group). This musical training took place for five days per week for four weeks for 45 minutes per session. The measures included Wechsler's Pre-school and Primary Scale of Intelligence (WPPSI-III; Wechsler, 2002) from which the vocabulary and block design subtests were used alongside a go/no go paradigm test of executive function. The rationale for this was originally based upon Green and Bavelier's (2008) work suggesting the N2/P3 ERP components are involved in inhibitory processing. Specifically it is a measure of functional plasticity focusing on observations of enhanced N2 and decreased P3 amplitude as previous research had demonstrated an effect of musical training on this relationship (Moreno et al., 2009).

The N2/P2/P3 a and b complex are a group of co-occurring ERP signatures which are measured using electroencephalography (EEG) in research. The N2 (or N200) component is often studied in language research. It is a negative peak occurring 200-350 ms post stimulus and is thought to reflect the temporal processing of phonological stimuli. The P2 (or P200) is a positive ERP signature associated with higher-order processing in language, attention and memory, comparing sensory inputs with stored memory. The P3 (or P300) is a positive peak that is thought to relate to novelty processing and attention. The P3b is thought to be related to improbable events and is often used to investigate cognitive workload (Bear, Connors and Paradiso, 2001). No differences were found between groups at the baseline, the analysis of the post-training data revealed significant three-way interactions between group, session and test (verbal vs. spatial). For the measures of intelligence, the vocabulary subtest was the only measure to show statistically significantly increased scores, and this was only reported for the musical training group. For the go no/go accuracy index, the musical training group outperformed the visual-arts group following the training period. There was no difference between groups for the N2/P3 complex but there was for the P2, which showed significantly larger peak amplitudes post training in the music group but not the visual group. This suggests enhanced higher-order perceptual processing ability as a result of the musical training leading the authors to suggest a transfer effect to executive function as the task required high levels of concentration, attention and memorisation. The results were reported as demonstrating broad transfer between musical-listening skills and high-level cognitive skills and brain plasticity associated with executive function. The authors suggested that, as their results provide evidence that increases in verbal performance can be independent of spatial skills, their findings further supports the link between music and language development. This is important as it returns to the focus of evaluating musical learning to the notion of transfer effects.

In this regard, Slater et al., 2014 and Kraus et al., (2014) recently looked at the effects of music training on cognitive and auditory abilities and related literacy skills in a longitudinal study of seven to ten year old bilingual children from low-income homes in Los Angeles, U.S. The children were randomly assigned to training and control groups. The intervention programme provided by the already established Harmony Project[11] was quite extensive with children typically participating in four to five hours of musical enrichment per week over the year. Converging evidence suggests that music-based interventions positively impacts on reading problems (see e.g. Bhide & Goswami, 2013; Overy, 2000 & 2003). This study in particular was initiated in response to the 2011 National Endowment of Arts survey (Rabkin & Hedberg, 2011), which reported that the percentage of 18 year olds who reported having received any kind of music instruction in their childhood (either at school or privately) fell from 53% in 1982 to 36% in 2008. The impetus for the study came from the observed 'Matthew Effect'[12] (Stanovich, 1986) which describes the compounded disadvantage (of low socioeconomic status and early school failure) with further disadvantages experienced by individuals in bilingual communities where the languages spoken in the home and in school is different (Goldstein, 2004).

The Slater et al. (2014) study included three standardised measures of literacy. These included: for oral reading speed, the Test Of Reading Word Efficiency (TOWRE; Torgesen, Wagner & Rashotte, 1999), for silent reading speed, the Test Of Silent Word Reading Fluency (TOSWRF: Mather et al., 2004) and for phonological processing, the

[11] In this case a free music education and enrichment program provided for underserved children in Los Angeles, USA rather than the In Harmony Project in the UK, which is associated with the successful El Sistema program creating orchestral musical learning opportunities in disadvantaged areas in Venezuela.

[12] The Matthew effect is usually associated with reading. It refers to a passage from the gospel of Matthew (XXV: 29) and has been co-opted to suggest that individuals who have early educational advantages (a reciprocal relation between opportunity, reward and motivation) will be able to utilise these experiences to efficiently benefit from new educational experiences.

Comprehensive Test of Phonological Processing (CTOPP: Wagner, Torgesen & Rashotte, 1999). A measure of IQ was established using the block design and similarities subtests from the WASI (Wechsler, 1999). 19 children formed the music training (MT) group, whilst 19 children remained on the waiting list forming the control group. The mean age of the groups was not significantly different (both seven years of age). IQ was tested only at baseline, at which time the groups did not differ. All children had acquired English by the age of two years. The groups were not sex balanced with 13 girls in each (vs. six boys). In the MT group, children initially enrolled into group musicianship and recorder classes for one hour twice per week. Depending on instrument availability and participant readiness (assessed by the teacher) children then progressed to instrumental training classes typically amounting to 4-5 hours of classes per week (three bass, two cello, eight trumpet, one viola). Five remained in the group classes. Initially the groups did not differ on the measures. After one year, a modest effect of group membership on a composite reading score was found. Post-hoc analyses revealed the MT group reading scores were in line with standardised scores for their ages, whereas the control groups' scores had declined over the year. Specific test analyses revealed that whilst phonological awareness and phonological memory did not change significantly in either group, rapid naming performance improved significantly for the MT group.

The Kraus et al. (2014) study investigated a slightly older cohort (mean age 8.25 years) of 44 children that was more evenly sex balanced. The training group undertook a similar process of training as described above for Slater et al. (2014). Measurements were taken in the July of 2011, 2012 and 2013. Hearing ability was within normal ranges for all participants. The focus of this study was to investigate whether musical training improved auditory brain stem response. After two years of musical training, a distinction between groups the MT group showed a significant improvement in the differentiation between the 'ba' and 'ga' sounds, whilst the control group did not. After the first year, both groups had shown moderate ability to distinguish between the consonant sounds. Kraus and colleagues suggest this is evidence of transfer from musical training to language processing as the enhanced skill influenced automatic auditory processing.

The range of studies included here demonstrates different approaches to understanding memory and learning as they all focus on discrete aspects of these connected phenomena. They have been included in order to understand how researchers have attempting to variously segregate visual and auditory memory, short, working and long-term memory and the effects of musical training on them. This section has extensively reviewed the literature exploring the impact of musical learning on musical aptitude, cognitive aptitude and aspects of memory. These three factors are based on psychological constructs all of which include some heritable and some trainable aspects. The aim of the current study was to attempt to provide a holistic perspective in order to understand interrelationships between musical and cognitive abilities, how these might co-develop within the framework of transfer effects. The following section clearly states the aims and hypothesis of this study.

3.4 Aims, Hypothesis and Research Design

The motivation for this study was to clarify some specific research questions within a broader research concept that has associated musicality with intelligence. Therefore, the research questions addressed in this chapter are as follows: Firstly, Gordon asserts (and Radocy and Boyce agree), that the Primary Measure of Musical Aptitude is uncorrelated with a range of cognitive abilities (see section 3.3.1). Therefore, this study explores whether this holds 30 years on. Secondly, this study considers whether musical training effects this measure of musical aptitude in children under nine, i.e. before the age that Gordon asserts musical aptitude stabilises. Thirdly, this study attempts to replicate Schellenberg's findings regarding the effects musical training and cognitive increases within an ecologically valid study design. The fourth research question addresses whether or not any findings regarding the effects of musical training on cognitive abilities are isolated or associated with changes in measures of other activities undertaken over the same period? Finally, the study explores whether any effect of musical training on cognitive abilities can be extended from measures of IQ to also include measures of memory concurrent with measuring changes in musical aptitude? The hypotheses listed below address these questions specifically following a short description of the measures and design.

The test battery included tests of musical aptitude (PMMA; Gordon, 1986), of intelligence, or cognitive aptitude (WASI; Wechsler, 1999), and of memory (CMS; Cohen, 2007). The effects of music learning on visual-motor skills and of fine and gross motor skills are addressed in chapter four and on socio-emotional behaviour in chapter five. An overall hypothesis for the quantitative studies in this thesis is that children receiving extra-curricular music tuition (EMT) for one academic year would obtain higher scores on measures of cognitive, behavioural and socio-emotional skills than children who only received statutory class music lessons (SSM). The study aimed to inbuild protection against previously noted quasi-experimental confounds. The design addressed this providing a sample with an equal sex balance and which was socio-economically balanced by including a mixture of charitably subsidised and parentally provided extra-curricular music lessons. The sample was drawn form a range of areas within the U.K. Together these factors offer an ecologically valid comparison to randomised control trials in the field of music education effect studies.

The first hypothesis for the study in this chapter is that the PMMA (Gordon, 1986) will not be correlated with WASI (Wechsler, 1999) (H_1).

The second hypothesis is based on Gordon's theory that musical aptitude does not stabilise until the age of nine years and is a result of a combination of innate ability and an enriched musical environment (Gordon, 1986). Here the opportunity arises to compare whether extra-curricular musical training has more of an effect on musical audiation than statutory school music. Therefore, H_2 predicts that the EMT group will increase their scores (absolute gain) significantly more than the SSM group on the PMMA from T1 to T2 as a result of their musical training.

The third hypothesis is motivated by the results from Schellenberg's (2004) study and states that the EMT group will outperform the SSM group on the overall measure of intelligence as measured in IQ points by the WASI. Furthermore, based on previous evidence (Forgeard et al., 2008), the specific hypotheses related to the subtests of the WASI was that the EMT group would outperform the SSM group on both vocabulary and matrix reasoning but not on similarities or block design (H_3).

In relation to research question four, this pre/post study enables testing a hypothesis that it is musical, rather than physical or leisure activity that drives observed changes (H_4). This hypothesis is possible to test because data on the amount of hours per week the children spend doing all three types of activity was gathered from parents.

Finally, in relation to research question five the Children's Memory Scale was included in the battery in order to specifically investigate whether extra-curricular musical training in the first year has an effect over and above statutory school music lessons on measures of auditory memory (H_5).

3.5 Methods, Measures and Participants

This study took place over one academic year with the first time point occurring in September 2013 and the second round of observations recorded in June 2014. Chapter two provides a full description of all measures, procedures and descriptive analyses of the sample. The between groups factor was the amount of musical activity and the within groups factor was time.

3.6 Results

3.6.1 Preliminary Analysis

Descriptive analyses, *t* tests, Repeated Measures Analysis of Variance (RM ANOVA), bivariate correlations and multiple regressions were carried out using SPSS statistical software (Version 20; IBM Inc, 2013). No missing values were imputed hence the variability in reported sample size. This decision was taken to best reflect the ecological validity of the study, whilst acknowledging that imputation of missing value averages was also possible.

Tests of normality (agreement between Kolmogorov-Smirnov and Shapiro-Wilk as well as looking at histogram charts) for the distribution of each factor were also considered in order to proceed with parametric analyses. These revealed some outlying scores (±3SD) affecting variance in the SSM group. These data points were treated as follows:

For the variable of PMMA Raw Tonal, removing an outlier score resolved the issue and so analysis of the group mean and SD for Time 1 were recalculated.

For WASI vocabulary, removing the outlying score did not equalise the distribution of scores satisfactorily. Therefore, the data point remained and Wilcoxon Signed-Rank Tests (WSRT) non-parametric equivalence was used (sample split by music group) instead of repeated measures analysis of variance (RM ANOVA).

For the CMS variables of Word List Recall (C-WLR) and Digits Total (C-DT), equal variance could not be assumed for the SSM at Time 1. No outliers were found for these, only a slight positive (leftwards) skew for C-DT. As there were no significant differences between groups, these factors were included in the parametric analyses that follow.

No significant differences between groups (using independent *t* tests) at Time 1 were found for Gordon's PMMA, or for the WASI Full Scale IQ, second level factors of Performance IQ (PIQ) and Verbal IQ (VIQ) and for third level subtests of similarities, block design and matrix reasoning. Tables 3.1, 3.2 and 3.3 show the mean statistics for each variable at Time 1. The maximum raw score possible for each component of the PMMA is 40, and thus the composite, 80.

Table 3.1. Mean Group Scores at Time 1 for the Primary Measure of Musical Aptitude (Gordon, 1986)

Test	Group	n	Mean	Std. Dev.	Min.	Max.
Tonal Raw Score (/40)	SSM	18	32.72	2.38	30	37
	EMT	19	34.47	3.55	27	40
Tonal Percentile	SSM	19	51.68	19.90	9	87
	EMT	19	64.37	22.98	20	99
Rhythm Raw Score (/40)	SSM	19	28.58	3.83	20	34
	EMT	19	29.63	4.45	20	35
Rhythm Percentile	SSM	19	52.68	21.82	8	86
	EMT	19	57.42	25.63	7	86
Composite Raw Score (/80)	SSM	19	60.79	5.43	48	70
	EMT	19	64.11	6.81	47	74
Composite Percentile	SSM	19	52.47	18.48	18	88
	EMT	19	61.74	22.81	16	97

Table 3.2. Mean Group IQ and Percentiles at Time 1 for Wechsler's Abbreviated Scale of Intelligence (Wechsler, 1999)

Test	Group	n	Mean	Std. Dev.	Min.	Max.
WASI Full 4 IQ Points	SSM	18	103.83	11.71	88	123
	EMT	19	108.84	15.39	74	133
WASI Percentile	SSM	18	57.17	25.92	21	94
	EMT	19	67.53	28.58	4	99

Table 3.3. Mean Group Scores at Time 1 for Wechsler's Abbreviated Scale of Intelligence (Wechsler, 1999), and the Children's Memory Scales (Cohen, 1997)

Test (Standardised Scores)	Group	n	Mean	Std. Dev.	Min.	Max.
WASI (W) Full 4	SSM	18	208.33	25.55	173	248
	EMT	19	213.05	36.65	135	265
W–VIQ	SSM	18	107.22	15.54	87	137
	EMT	19	114.47	20.20	67	146
W–PIQ	SSM	18	101.11	19.16	70	133
	EMT	19	103.11	18.52	68	138
W–Vocabulary	SSM	18	50.33	6.84	42	66
	EMT	19	52.95	15.46	12	76
W–Block Design	SSM	18	50.94	9.99	36	73
	EMT	19	51.68	11.65	36	78
W–Similarities	SSM	18	56.89	11.11	42	78
	EMT	19	61.95	10.33	32	74
W–Matrix Reasoning	SSM	18	50.17	11.36	33	69
	EMT	19	51.58	10.23	31	67
CMS Word List Learning	SSM	19	10.32	2.91	5	15
	EMT	19	9.11	3.40	4	17
CMS Word List Recall	SSM	19	12.37	3.04	8	17
	EMT	19	10.89	2.69	6	16
CMS Digits Forwards	SSM	19	11.26	2.79	7	18
	EMT	19	10.53	3.20	5	18
CMS Digits Backwards	SSM	19	10.11	2.71	7	15
	EMT	19	9.32	2.16	5	13
CMS Digits Total	SSM	19	11.05	2.66	8	17
	EMT	19	10.42	3.00	5	15
CMS Sequences	SSM	19	10.00	2.21	6	13
	EMT	19	10.53	3.55	4	16

3.6.2 Principal Analysis

3.6.2.1 Pearson Bivariate Correlations

All p values are reported as one tailed in line with the specific hypotheses (see section 3.4).

For the WASI Full Four (T Scores) and Gordon's PMMA Composite (Percentiles) at Time 1, the two measures were significantly correlated $r = .36$, $p = .01$. However, at Time 2 they were not $r = .10$, $p = .28$. As the research question related to the relationship between the two measures over time the correlation analysis was carried out on the difference in scores over time (pre-post, standardised). This result showed a positive significant correlation between the two measures $r = .28$, $p = .05$.

This result was disattenuated using the following equation (Osbourne, 2003)

$$Tr = r_{xy} \frac{r_{xy}}{\sqrt{r_{xx} r_{yy}}}$$

The lowest estimate of reliability coefficients (see Table 2.10) were used to calculate the true correlation statistic, $Tr = .34$.

Further analysis was undertaken for the different levels of the WASI and the PMMA but no further significant relationships (that remained once alpha p was corrected for multiple comparisons) were found.

3.6.2.2 Wilcoxon Signed Rank Test (WSRT)

Using split file command (by Music Group) for WASI vocabulary subtest WSRT revealed a significant change over time for the EMT group, $Z = -2.18$, $p = .03$, confirmed with paired samples t tests $t(18) = -2.31$, $p = .03$. These statistics do not remain statistically significant when corrected for multiple comparisons when all four WASI subtests are compared (αp .05/4=.0125). The WASI vocabulary standardised group mean statistics are presented in Table 3.6.

3.6.2.3 Group comparisons using RM ANOVA and paired sample *t* tests

Table 3.4 shows the mean group raw and percentile scores and standard deviations for Gordon's PMMA.

3.6.2.3a PMMA Tonal Raw Score Results

For the tonal raw score, there was a main effect of time $F(1, 34) = 8.10$, $p < .01$, ŋ2 = .19 but no statistically significant interaction between groups. Planned post-hoc analysis revealed the SSM group had improved performance significantly over time $t(17)$ -2.98, $p = .01$, 13Cohen's $d = -.7$, but the EMT group had not ($p = .16$, $d = -.4$).

3.6.2.3b PMMA Tonal Percentile Score Results

Similar results were revealed for the variable of the PMMA percentile for the tonal component with a main effect of time $F(1, 35) = 10.40$, $p < .01$, $ŋ^2 = .23$ but no interaction between groups. The mean shift in percentiles for SSM (n=19) was from 51.68 (SD

[13] Cohen's d can be found for paired samples t tests by dividing the mean of the group different (T1-T2) by the standard deviation of the difference (Cohen, 1988).

19.90) to 67.84 (SD 15.88) which was significant $t(18) = -3.17$, $p = .01$, $d = -.7$ and for EMT (n=18), 64.37 (SD 23.38) to 73.89 (SD 20.62) which was not significant ($p = .15$, d = -.4).

Table 3.4. Gordon's Primary Measure of Musical Aptitude Mean Group Raw and Percentile Scores and Standard Deviations at Time 1 and Time 2

PMMA	Group[a]	Mean T1	SD T1	Mean T2	SD T2
Composite Raw	SSM	60.79	5.43	66.59	3.36
	EMT	64.50	6.78	68.22	4.75
Composite Percentile	SSM	52.47	18.48	73.32	12.01
	EMT	61.71	22.81	77.17	18.46
Tonal Raw	SSM	32.72	2.35	34.39	2.20
	EMT	34.61	3.60	35.89	3.05
Tonal Percentile	SSM	51.68	19.90	67.84	15.88
	EMT	64.37	22.98	73.89	20.62
Rhythm Raw	SSM	28.58	3.83	32.11	2.51
	EMT	29.89	4.43	32.33	3.01
Rhythm Percentile	SSM	52.68	21.82	73.05	14.31
	EMT	57.42	25.63	72.72	17.73

[a]SSM n=19, [b]EMT n=18

3.6.2.3c PMMA Rhythm Raw Score Results

The rhythm component analysis also revealed a main effect of time $F(1, 35) = 16.17$, $p < .01$, $\eta^2 = .32$ but no interaction between groups. Planned post-hoc analyses revealed both groups had significantly improved performance over time SSM $t(18)$ -3.70, $p < .01$, $d = -.9$ and EMT $t(17)$ -2.13, $p = .048$ (d = -.5). However, only the SSM group result remains statistically significant after correcting for multiple comparisons of the three variables tonal, rhythm and composite according to the Bonferroni method (αp .05/3 = .016).

3.6.2.3d PMMA Rhythm Percentile Score Results

A significant overall main effect of time was revealed for rhythm percentile scores $F(1, 35) = 16.54$, $p < .01$, $\eta^2 = .32$ but again, no interaction between groups. The mean shift in percentiles for the SSM group was from 52.68 (SD 21.82) to 73.05 (SD 14.31). This was significant $t(18)$ -3.82, $p < .01$, $d = -.9$. For the EMT group the shift in percentile scores was also significant initially $t(17)$ -2.13, $p = .048$ ($d = -.5$) from 57.42 (SD 25.63) to 72.72 (SD 17.73). However, only the SSM group result remains statistically significant after correcting for multiple comparisons of the three variables tonal, rhythm and composite according to the Bonferroni method (αp .05/3 = .016).

3.6.2.3e PMMA Composite Raw Score Results

Finally, for the PMMA composite (which is the summation of the tonal and rhythmic scores), a main effect of time was found for the raw scores $F(1, 35) = 27.96$, $p < .01$, $\eta^2 = .44$ though no interaction between groups was revealed. Planned post-hoc analyses revealed both groups had significantly improved performance over time SSM $t(18) = -4.56$, $p < .01$, $d = -1$ and EMT $t(17) = -2.93$, $p < .01$, $d = -.7$

3.6.2.3f PMMA Composite Percentile Score Results

Similar results were found for the composite percentiles, $F(1, 35) = 29.94$, $p < .01$, $\eta^2 = .46$ with no interactions between groups. The mean shift in overall percentiles for PMMA for SSM (n=19) was from 52.47 (SD 18.48) to 73.32 (SD 12.91) and for EMT (n=18), 61.71 (SD 22.81) to 77.17 (SD 18.46). Planned post-hoc analyses revealed both groups had significantly improved performance over time SSM $t(18) = -4.76$, $p < .01$, $d = -1$ and EMT $t(17) = -3.03$, $p < .01$, $d = -.7$. Figure 3.1 illustrates the pre and post mean group scores for Gordon's PMMA.

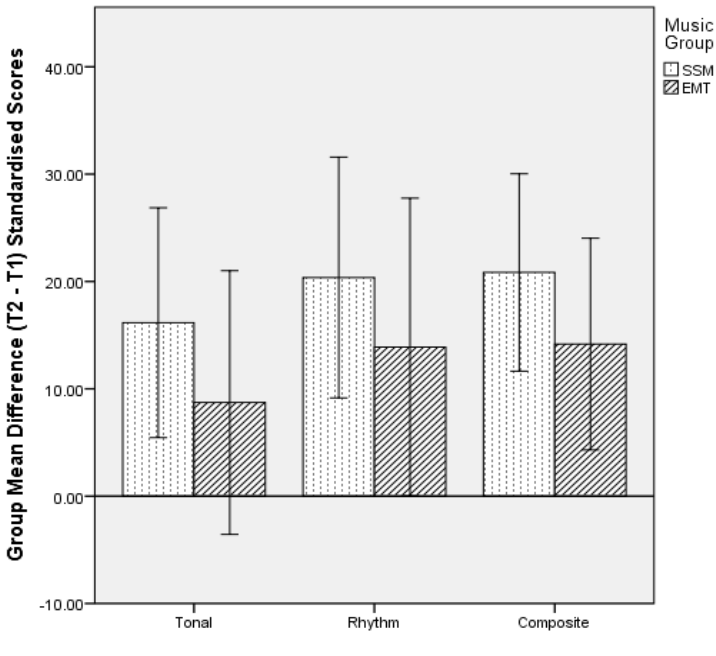


Figure 3.1. Bar Chart illustrating differences between T1 and T2 for Gordon's Primary Measure of Musical Aptitude. (Error bars represent 95% confidence intervals).

3.6.2.3g WASI IQ and T Score Results

The mean group scores for the full four factor WASI IQ points and the mean groups scores for the WASI T scores for all WASI IQ and T scores analysed are shown in Table 3.5 and illustrated in Figure 3.2.

RM ANOVA revealed a main effect of time $F(1, 35) = 5.67$, $p = .02$, $\eta^2 = .14$ for WASI IQ points but no interaction was revealed between groups. Planned post-hoc analyses revealed a significant increase in IQ points for EMT only $t(18) = -2.83$, $p = .01$, a mean change of 6.95 points in comparison to the SSM which improved by .17 points on average (see in Table 3.5). The effect size of this change for the EMT group was $d = -.7$ (SSM $d = -.02$).

Table 3.5. Mean Group IQ and T Scores at Time 1 and Time 2 for Wechsler's Abbreviated Scale of Intelligence (Wechsler, 1999)

WASI Measures	Group^{ab}	Mean T1	SD T1	Mean T2	SD T2
IQ Points	SSM	103.83	11.71	104.00	9.02
	EMT	108.84	15.39	115.79	14.69
FSIQ T Score	SSM	208.33	25.55	209.00	20.48
	EMT	213.05	36.65	226.79	38.03
VIQ	SSM	107.22	15.54	109.39	14.31
	EMT	114.89	20.20	122.37	18.17
PIQ	SSM	101.11	19.16	100.17	12.50
	EMT	103.42	18.52	109.16	15.83
Vocabulary	SSM	50.33	6.84	53.94	10.37
	EMT	52.95	15.46	60.42	12.05
Similarities	SSM	56.17	11.36	56.00	5.66
	EMT	61.58	10.23	61.95	9.82
Matrix Reasoning	SSM	50.89	11.08	52.78	7.67
	EMT	51.79	10.01	56.42	8.29
Block Design	SSM	50.94	9.99	47.39	8.2
	EMT	51.68	11.65	52.74	8.68

^{a}SSM n=18, ^{b}EMT n=19

For the WASI T scores, RM ANOVA revealed that overall there was no main effect of time for the FSIQ and no interaction between groups. For VIQ there was non-significant main effect of time $F(1, 35) = 3.89$, $p = .057$. RM ANOVA results for PIQ showed no statistically significant differences between groups or over time, although planned post-hoc analyses revealed that the EMT group improved their performance on this measure significantly $t(18) = -2.57$, $p = .02$, $d = -.6$ and this effect remained significant when corrected for multiple comparisons at this level (WASI PIQ and VIQ $\alpha p.05/2 = .025$).

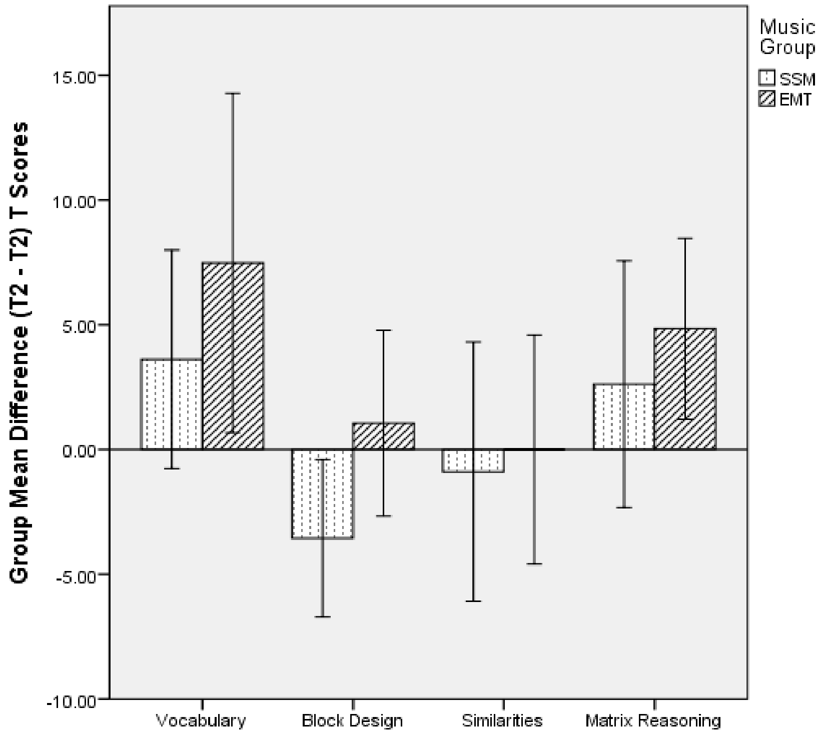


Figure 3.2. Bar Chart illustrating differences between T1 and T2 for Wechsler's Abbreviated Scale of Intelligence (Wechsler, 1999). (Error bars represent 95% confidence intervals).

For the third level subtest analyses, each factor was analysed independently. No significant changes over time, or group differences, were revealed for the factors of similarities or block design, although, a near significant interaction occurred with the latter $F(1, 35) = 3.09$, $p = .056$.

To reiterate for vocabulary, WSRT revealed a significant change for the EMT group over time $Z = -2.18$, $p = .03$. As calculations for Cohen's *d* requires normal distribution within groups, an estimate of effect size can be revealed for WSRT by dividing the *Z* by the square root of the n (Rosenthal, 1994). In this case the effect size for the change over time for the EMT group is -.5. This effect was confirmed with a paired samples *t* test for the EMT group, $t(18) = -2.31$, $p = .03$, $d = -.5$. However, although the result does not remain significant when corrected for multiple comparisons ($\alpha p.05/4 = .0125$) although this is borderline.

For matrix reasoning, a significant main effect of time was revealed $F(1, 35) = 6.67$, $p = .01$, $\eta^2 = .16$. The increase in performance was revealed to be significant for EMT group only with a planned post-hoc *t* test $t(18) = -2.81$, $p = .01$, $d = .-.6$. This result just remains significant when correcting for multiple comparisons (WASI subtests $\alpha p.05/4 = .013$).

3.6.2.3h Children's Memory Scale Results

For the CMS there are no different levels for comparison. Therefore, αp.05/6 = .008. Table 3.6 and Figure 3.3 show the pre and post mean group standardised scores for each of the components.

Table 3.6. Mean Group Standardised Scores at Time 1 and Time 2 for the Children's Memory Scale (Cohen, 1997)

CMS Task:	Group[a]	Mean T1	SD T1	Mean T2	SD T2
Word List Learning	SSM	10.32	2.91	11.05	3.21
	EMT	9.11	3.40	10.63	3.22
Word List Recall	SSM	12.37	3.04	11.37	2.67
	EMT	10.89	2.69	11.37	2.83
Digits Forward	SSM	11.26	2.79	12.32	2.69
	EMT	10.53	3.20	11.58	3.15
Digits Backwards	SSM	10.11	2.71	10.74	2.66
	EMT	9.32	2.16	10.16	2.99
Digits Total	SSM	11.05	2.66	12.16	2.70
	EMT	10.42	2.97	11.37	3.24
Sequences	SSM	10.00	2.21	12.37	2.14
	EMT	10.53	3.55	12.89	3.75

[a]n=19

RM ANOVA revealed a trend towards significance for Word List Learning $F(1, 36) = 3.77$, $p = .06$ but no effect for Word List Recall. For DSF, a strong main effect of time was found $F(1, 36) = 6.12$, $p = .02$, $\eta^2 = .15$ but not for DSB. For Digits Total (a combination of both scores) a significant main effect of time was found $F(1, 36) = 6.41$, $p = .02$, $\eta^2 = .15$. For Sequences, a significant main effect of time was found $F(1, 36) = 41.52$, $p < .01$, $\eta^2 = .54$ but Levene's test of homogeneity of variance for both Time 1 and Time 2 was significant. There were no interactions for any of the tasks. Table 3.6 displays the group means for each CMS variable at Time 1 and Time 2.

Planned post-hoc analyses (paired samples *t* tests) revealed improved performance over time for SSM for Digits Total $t(18) = -2.26$, $p = .04$, $d = -.5$ and Sequences $t(18) = -4.51$, $p < .01$, $d = -1$ and for EMT for Sequences $t(18) = -4.61$, $p < .01$, $d = -1$. The figures for Sequences were checked using a non-parametric equivalent (due to the issues with normality as described with Levene's tests earlier). WSRT test confirmed the increased performance over time for Sequences for SSM $Z = -3.02$, $p < .01$, *effect size = -.7* and for the EMT group $Z = -3.28$, $p < .01$, *effect size = -.8*.

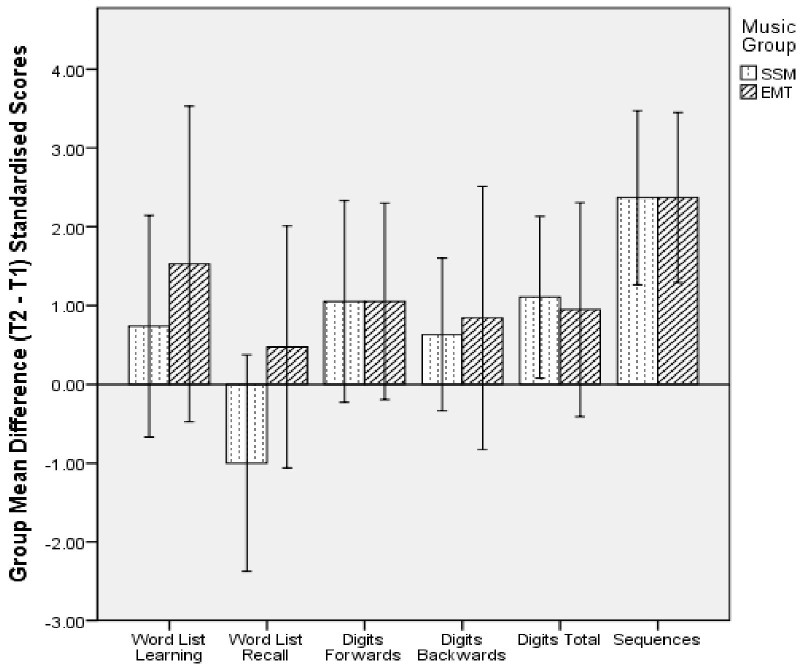


Figure 3.3. Bar Chart illustrating differences between T1 and T2 for the Children's Memory Scale (Cohen, 1997). (Error bars represent 95% confidence intervals).

3.6.3 Exploratory Analysis

Multiple regressions were carried out using the global scores of both cognitive aptitude (WASI Full Four IQ) and musical aptitude (Gordon's PMMA Composite) as outcomes, based on the hypothesis that one might influence the other and that each measure tested has been variably described as either a near or far transfer effect of learning music. No significant model was found to explain the unique variance of each predictor with either the WASI FSIQ or Gordon's PMMA as the outcomes variables. The number of reported hours of weekly Musical activity was not predictive of Gordon's PMMA score composite or of WASI IQ score. Similarly, the numbers of hours weekly for Physical and Leisure activities did not predict the PMMA or WASI composites.

3.7 Discussion

One of the aims of this thesis is to determine whether the acquisition of skills during the first year of learning a musical instrument would affect the outcome of measures of cognitive, behavioural and emotional abilities conceptually and operationally described as near and/or far transfer effects of musical learning.

The hypotheses for the study described in this chapter specifically relate to five research questions. The first asked if it is possible to have a test of musicality that is not associated with a range of cognitive abilities? The hypothesis (H_1) for this states that Gordon's PMMA (tonal, rhythmic and composite) should not be correlated with WASI, as measured on either general level of IQ or for specific aspects of intelligence described as crystalised or fluid using the subtests of vocabulary and similarities for the former and block design and matrix reasoning for the latter. The results reveal that musical audiation, as measured by Gordon's PMMA (composite), is significantly correlated with intelligence, as measured by the WASI either at a general level of IQ. Once these statistics were disattenuated (for measurement error) the magnitude of the correlation increased (from r = .28 to r = .34). However, this does not reach the post-hoc power analysis level required (r = .71) to achieve 80% power. Yet these results do support other findings that Gordon's PMMA is positively associated (at a low magnitude) with the concept of '*g*'. Shuter-Dyson (in Deutsch, 1982, p.405) found the PMMA to be associated with the Lorge-Thorndike Intelligence Tests with correlations between .19 and .30. Lynn and Gault (1986) also found a that Raven's Standard Progressive Matrices were associated with various measures of musical aptitude ranging from r = .43 -.61. However, the musical tests they used were drawn from Wing's Standardised Tests of Musical Intelligence (Wing, 1968). Wing developed these measures on a framework that links musical ability with intelligence (as the name suggests) and is based on knowledge and perceptual abilities. Nevertheless, these findings strengthen suggestions that musical audiation (a combination of innate ability and acculturated knowledge) acquired before the age of nine is positively associated with intelligence as measured using the construct of *g*.

The second research question asked whether it was possible to have a measure of musicality that was not affected by musical training? According to Gordon's theories, musical audiation develops as a result of an enriched musical environment and does not stabilise until the age of nine years. Gordon did not specifically state whether it is trainable or not, but with this study the opportunity arose to compare whether the absolute scores of the EMT group increased more than those of the SSM group. If so, this would suggest that more time spent learning musical instruments has a positive effect on musical audiation. However, as both groups increased their scores significantly on the overall composite (and to a level congruent with 80% power based on the post-hoc power analysis), the results suggest that extra-curricular music training does not necessarily significantly influence Gordon's PMMA scores over time at this age group. This is supported further as only the SSM group increased their scores significantly on the component of tonal and rhythm separately with a larger effect size than the EMT group scores. Whilst the EMT group scored higher on all PMMA scores at baseline, their scores were not significantly higher than the SSM scores. Whilst one explanation of this could be that ceiling effects prevented the EMT scores from increasing at Time 2 relative to Time 1, observation of the histograms for both groups at both pre and post suggest this was not the case. Unfortunately it is not possible to compare this finding with an older sample as the PMMA changes to the IMMA at the age of nine, and is not directly comparable. Gordon suggests that children's musical aptitude stabilises around the age of nine so it remains a possibility that this is why the scores of children in the SSM group essentially caught up with the scores of the children in the EMT group. The Mosing et al., (2014a) study of the Swedish Twin cohort suggested that musical training did not causally influence performance on auditory discrimination tests with heritability factors of 59% for Melody and 50% for Rhythm. As discussed later in this section, it may be that Gordon's PMMA relies on a paradigm (same/different) which taps into auditory discrimination rather than measuring what he asserts is 'audiation' and that further problematises interpretation of the results.

In Flohr's (1981) study, five year old children were randomly assigned to one of three groups: Music groups 1 and 2 received music instruction for 25 minutes twice per week for 12 weeks. Music 1 included an element of improvisation that Music 2 did not. The third group was a no training control group. Flohr's groups scored differently on the PMMA at the outset (the music groups scored higher) so the pre-test scores were co-varied in the analyses, which used the raw composite scores. The control group's scores did not differ significantly over time. As the analyses showed the two music groups increased their scores even when the pre-test scores were co-varied, Flohr suggested that musical training did increase musical audiation. Whilst it is frustrating that neither the tonal or rhythm scores are reported, this evidence is in line with other studies suggesting the effect of musical training is stronger in younger children than older children (Schlaug et al., 2005), perhaps due to differences in neural developmental trajectories (Giedd & Rapoport, 2010). Whilst according to Schellenberg's (2011) theory of self-selection it may not be surprising that those children with a higher musical aptitude took extra music lessons, it is perhaps of interest that this advantage was essentially negated as the children receiving statutory music lessons group caught up over the year with both groups ending up in the high percentile range.

The third hypotheses predicted that the EMT group would outperform the SSM group on the overall measure of intelligence as measured in IQ points by the WASI as was reported by Schellenberg (2004) findings. The results in this study directly replicated Schellenberg's for the EMT group, but not for the control group. Schellenberg reported a seven IQ point increase for his musical group and a four IQ point increase for his control group. The results of this study showed a seven IQ point increase for the EMT group but less than one point increase for the SSM control group. However, a 7-point change is less than half of one standard deviation. Whilst the effect size for this change overall (IQ) was very small ($\eta^2 = .14$), the effect size for the specific test (matrix reasoning) for the EMT group was large ($d = -.6$). Furthermore, the critical t value ($t = 2.43$) for an alpha p value of .01 from the post hoc power analysis (<.8) indicates this finding is robust. Furthermore, as no differences were found at Time 1 for either of these factors for age, gender or schools (acting as a proxy for SES) and for SES as inferred by a combination of postcode and parental education levels (analysed as a coded variable, see chapter two) this suggests the in-building of heterogeneity to the research design has been an effective solution against threats to internal validity consummate with quasi-experimental conditions (Mitchell & Jolley, 2012).

Continuing with the WASI, analysis of the FSIQ did not reveal any main effect of time or interaction and neither did the VIQ and PIQ with RM ANOVAs. However, planned post-hoc analyses revealed that the EMT group had significantly increased performance on the PIQ over time. PIQ is a combination score of block design and matrix reasoning that measures fluid intelligence. These subtests are discussed in the following section.

For vocabulary, (analysed using a non-parametric equivalent) a statistically significant main effect of time and a significant increase for the EMT group only was revealed. No main effects of time or interactions were found for similarities and block design, though planned post-hoc analyses revealed a statistically significant decrease in performance on block design for the SSM group, which just fell short of statistical significance in terms of group interaction.

Block design is a measure of fluid intelligence associated specifically with visual-spatial abilities and fine motor skills. A decrease in block design for the SSM group suggest that for this group, performance on visual-spatial and fine motor skills were below the level of typical development for this age group. In comparison, the EMT group scores increased, though not significantly (see Figure 3.2). This suggests the development of these skills was typical in the EMT group. Because both visual-spatial abilities and fine motor skills were tested independently of intelligence (see chapter four), it will be possible to evaluate if one of the factors in particular was being affected in the SSM group over the academic year tested. It is likely that it will be the fine motor skills rather than the visual-spatial factor as, if we compare the block design subtest with the other measure of fluid intelligence, the matrix reasoning subtest, this also includes visual-spatial reasoning and both groups increased their performance on this test, though only the EMT group significantly so. For matrix reasoning, a main effect of time but no interaction between groups was revealed. Post-hoc analysis showed the EMT group increasing performance significantly over time.

One other factor differs between block design and matrix reasoning: that of time pressure. Block design has to be completed within a time limit. This means that decisions have to be made quickly. Whilst Bamberger suggests (in McPherson, 2006, p. 69) it is important not to underplay anomalies such as this, it is difficult to understand why the SSM group performance decreased over time. Two studies reviewed herein, Rickard et al., (2010) and Slater et al., (2014), reported a decrease in one of their chosen measures for their control groups; the former with regard to visual perception (but not visual memory) and the latter with regard to reading skills. This suggests there may be other unknown reasons for the decrease in the SSM group performance that are unrelated to the nature of their musical learning. In conclusion with regard to H_3, this study did replicate the increase in IQ points previously found in Schellenberg (2004). Furthermore, these results also support the findings of Forgeard et al. (2008) and Hyde et al. (2009) regarding the positive effect of musical learning on vocabulary and a measure of fluid intelligence. However, unlike Norton et al. (2005) no correlation was found between PMMA and the WASI, an equivalent test to Raven’s Matrices that they used.

One more point regarding the significance of the findings presented here, specifically concerning PIQ and matrix reasoning, is that this advantage is apparent after only one year of training (amounting to approximately 14 hours on average over the duration of one academic year per participant). Although one other study (Gromko & Poorman, 1998) reported an effect for PIQ after seven months of singing and playing song bells in pre-schoolers, but that statistical analyses was performed on raw scores and were therefore not age-adjusted.

Finally, in relation to research question five, the CMS was used to determine whether EMT in the first year has an effect over and above SSM lessons on measures of auditory memory. According to the CMS (Cohen, 1997), learning and memory are the ability to acquire (new) information, retain and access (stored) information and incorporate the ability to direct and sustain attention/concentration (CMS Manual, Cohen, 1997, p. 11). The Word List subtests of the CMS are divided into Word List Learning (four trials), and Word List Recall, which required the participant to recall the original list (of unrelated words) after a distracter word list has been presented. The results suggested a trend toward improvement in performance for both groups over time for Word List Learning, ostensibly a simple span measure of auditory STM. For Word List Recall, which requires some consolidation to long-term memory (following a distractor list of different words) there were no statistically significant findings. Figure 3.3 illustrated the differing directions between groups regarding long-term memory consolidation. For the SSM group there was a reduction in performance, whereas the EMT group slightly increased their scores. However these findings were not statistically significant. Whilst the results from this study suggest that musical learning is not affecting memory during the first year of learning, it is important that this appears to be equally true of both STM and WM. Further exploration of the effect of musical instrument learning and types of memory (possibly using more thorough *n*-back tasks) will be necessary for future research. St. Clair-Thompson suggests that the strategy of reporting combined forwards/backwards span scores is *"only tenable if they are tapping the same cognitive process"* (St. Clair-Thompson, 2013, p. 294). This advice followed a neuroimaging study suggesting functional differences for DSF and DSB by Li et al., (2012) in a combined structural and functional data from a large group (N=299) of healthy young adults. The results revealed four critical areas for verbal working memory, suggesting a link between the auditory phonological loop and salience network. The voxel based morphometry analyses revealed positive correlations between DSB scores and the grey matter volumes in the right anterior and right posterior superior temporal gyrus, the left inferior frontal gyrus and the left Rolandic operculum. Similarly, there was a positive correlation between BDS scores and resting-state functional connectivity within the salience network, between the right anterior superior temporal gyrus, the dorsal anterior cingulate cortex and the right fronto-insular cortex. Unfortunately Li and colleagues did not control for a factor of musical learning in this study and the participants were Chinese speakers, a language associated with an advantage in pitch processing that exceeded those of musicians (Chandrasekaran et al., 2009). However, it did demonstrate that DSB recruits both the phonological perception and storage, and the sub-vocal rehearsal system of the auditory STM system, which might be important for future studies.

A separate measure, the Sequences task of the CMS requires participants to repeat back a set of semantically grouped either numbers or words (such as the days of the week forwards and backwards under timed conditions) under timed conditions. This task assesses the ability to mentally manipulate and sequence auditory/verbal information as quickly as possible, thereby *"placing a heavy demand"* on WM (Cohen, 1997, p. 151). In the current study, both groups made robust improvements in these areas. When reporting this finding to the participants' teachers, none were surprised as the focus during that year (based on the Key Stage 2 Curriculum in the U.K.) was on learning sequences, with specific practice, for example, on learning the months of the year. This would be congruent with Klingberg's (2010) view. He suggests that early experimental methods were very material specific and resulted in a fixed view of memory capacity based on Miller's magical number seven (Miller, 1956). Klingberg reframes WM as the functioning of top-down processing (for central-executive or attentional-control) stating that this voluntary allocation of selective attention relies not only on the parietal and prefrontal cortex, but also on the overlap in activation between them. Furthermore, retention of an internal representation of a salient location, and directing and maintaining attention towards that location, may require mechanisms of sustained neural activity that he suggests may be difficult or impossible to separate at the neuronal level.

Whilst within the field of auditory memory, evidence of an auditory short and long-term advantage for musicians appears to be growing, evidence regarding a working memory advantage for musicians remains inconclusive (Baddeley, 2012; Bartlett & Dowling, 1981; Cuddy & Lyons, 1981; Halpern, Bartlett & Dowling, 1995; Hickok et al., 2003; Schulze et al., 2011). Many reasons have been suggested for this. For example, difficulties in controlling for cultural bias inherent with some participant groups (Morrison, Demorest & Stambaugh, 2008), differences in the criterion for musicianship across studies (Berti et al., 2006; Müllensiefen et al., 2014; Pechmann & Mohr, 1992), and important nuances within stimuli, such as the psychoacoustic and temporal properties of timbre contributing to the listeners' sensitivity have all been highlighted (see Halpern & Müllensiefen, 2008). However, Alloway and colleagues found that developmental trajectories did not differ across childhood in a study designed to ascertain whether verbal and visual STM and WM capacity are separable in children aged between four and six years old. They suggest a three-factor model whereby *"related but separable constructs representing measures of verbal and visuospatial storage and a third factor representing the shared variance"* (Alloway, Gathercole & Pickering, 2006, p. 1712). This supports a domain-general mechanism. The findings are compatible with the Baddeley (2000) model of the central executive being responsible for controlling resources and monitoring information processing. In summary, the study described in this chapter does not provide evidence of any effect of increased musical training on STM, LTM or WM capacity as measured by the CMS. It could be that an effect was present in the pre-attentive stage of auditory discrimination, but our study did not include behavioural brain stem measures.

The finding of an association between Gordon's PMMA and WASI replicates previous studies. Shuter (1968) reviewed 65 studies and found a positive correlation between musical aptitude and intelligence tests of .35. The disattenuated correlation coefficient found herein agreed with this (r = .34). This suggests that this sample size was adequate to replicate previous findings. It also adds weight to speculation regarding Gordon's notion of audiation. Gordon suggests the term audiation is the key to understanding how individuals (in this case children) think musically. That is, that the listener responds to auditory impressions immediately and intuitively. He reasoned that in the PMMA tests there is not enough time between hearings to commit the phrase to memory (Gordon, 1986, p. 8). However, this supposition does not appear to have taken into account ideas regarding working memory, in particular Baddeley's phonological loop. This model of memory suggests that some form of subvocal rehearsal is utilised. The evidence of which has relied upon the notion of articulator suppression in that attempting to block the ability to subvocally rehearse the sound, the ability to recall it is decreased (Baddeley et al., 1984). In order to test whether or not the PMMA utilises 'audiation' or whether the children were able to subvocally rehearse (as was apparent vocally in some students, see chapter six), an experimental paradigm could be devised using music rather than words to adapt Baddeley and colleagues 1984 research. Indeed, this finding suggests there is further research to be done regarding what musicality actually means in addition to superior auditory skills, especially with regard to the connection with fluid intelligence and working memory.

3.8 Limitations

There are several limitations to this study. One problem encountered that should be considered for future studies, is that it is rather difficult to test large groups of children using the PMMA. This is because there is a tendency for some of them to repeat the example stimuli by singing it back to help them remember it, even when they are asked not to do this. Once one begins, others have a tendency to join in, leading to an atmosphere not entirely conducive to controlled testing. Furthermore, whilst attrition rates were low with only three participants failing to complete the measures at Time 2, the conditions for testing did occasionally change between Time 1 and Time 2. Time 2 occurred at the end of the school year and students were very tired and facing the demands of extra-curricular summer activities (such as sports day) and end of year school tests. This meant that some participants were testing in their home rather than at their school, or vice versa.

However, in spite of *"Battling spuriousness by accounting for, rather than controlling for, non treatment factors."* (Michell & Jolley, 2012, p. 444), and the small sample size in the study, the results presented are nevertheless similar to comparable studies (see e.g. Fujioka et al. 2006; Hyde et al., 2009; Lee et al., 2007; Norton et al., 2005; Slater et al., 2014). Recent reviews regarding the affects of musical training concur that both short-term learning and long-term training/expertise strongly support a model of experience-based meta-plasticity (Herholz & Zatorre, 2012; Schlaug, 2015). Several models of learning related to common processing, such as the Trion model (Leng, Shaw & Wright, 1990), the Summation model (Rauscher & Zupan, 2000), and/or MNESIS (Eustache & Desgranges, 2008) model have been suggested specifically in regard to musical learning. However, all these models require evidence of overlaps between domains with regard to transfer. Whilst not explicitly concerned with musical learning, Johnson (2011) suggests a domain-general framework based on interactive specialisation, which may be more appropriate. However, Forgeard and colleagues (2008) surmise that no measures of far transfer can be attributed to musical learning unless a measure of near transfer is included. Therefore chapter four investigated measures of fine and gross motor abilities alongside visual-motor integration in order to ascertain whether the musical learning undertaken by these participants directly affected measures of these behavioural abilities conceptualised 'near transfer' effects.

3.9 Chapter Summary

This chapter investigated the effect of musical learning on musical aptitude, intelligence and memory. A correlation was found between the measure of musical audiation and the measure of intelligence. No significant effect of extra musical training was revealed over time for musical aptitude relative to a lesser amount of musical enrichment. This may suggests a naturalistic developmental trajectory between the ages of seven and nine, although the evidence presented here is not conclusive. In contrast, the EMT group IQ score increased significantly, whereas the SSM group score did not. The matrix reasoning and vocabulary subtests, replicating previous studies, drove this effect. No effect of musical training was found on any of the measures of memory, though both groups did significantly increase their performance on a subtest measuring focused attention.

Chapter 4 – Measuring Near Transfer Effects Potentially Associated with Musical Learning

4.1 Abstract

This chapter focuses on the concept of near transfer measures from musical learning to other fine and gross motor and visual motor integration, visual perceptive and motor coordination skills. Klingberg (2010) suggested that relying upon a direct measurement of musical skill amounts to a positive bias and does not test for near transfer of ability. For example, testing the ability to read music using written music only provides evidence that one direct aspect of learning had been achieved. Whereas testing visual perception, or visual motor integration for example enables assumptions to be made that the skill extends abilities within or beyond the same domain; that it is transferable from one specific skill to another stimuli or response mode. As the sample of children in this study were learning a range of instruments (from singing to drumming to violin and/or piano, see chapter two) the focus here was on the near transfer of acquired skills using two measures; the Movement Assessment Battery for Children (MABC-2; Henderson, Sugden & Barnett, 2007) and the Beery Visual Motor Integration (Beery, 2004). The Beery had previously been used in music studies, showing a positive affect for musical training, but the MABC-2 had not. The longitudinal study utilised a quasi-experimental design in which 19 seven to nine year old children who were receiving extra-curricular musical training (EMT) were compared with 19 children who were receiving statutory group music lessons (SSM). Over one academic year, whilst both groups improved on the composite measure of Aiming and Catching from the MABC-2, a significant advantage was found for the EMT group in comparison to the SSM control group. This finding suggested that extracurricular musical learning in the first year increased hand-eye coordination, applied timing and velocity control more than group music lessons. The Beery tests did not reveal any differences between the two groups and neither did any of the other factors of the MABC-2.

4.2 Introduction

This chapter explores measures of musical learning associated with motor and visual skills, and the integration of these described as motor-visual skills. Evidence pertaining to the understanding of how musical instrument learning affects the acquisition of these skills in children has been described as inadequate (McPherson, 2005). Consequently, the literature reviewed begins with a short but broad look at these skills as developed in adults in order to help situate the children's studies in context within the framework of near transfer.

4.2.1 Background to the Effects of Musical Learning on Motor Abilities

The coupling between musical perception and action has been argued to be a function of rhythm associated with the evolutionary embedding of motor actions mirrored in others (Llinas & Ribary, 2001). Rhythm is known to have a powerful entraining effect (Molinari et al., 2003), which also appears to engage the mirror neuron system (Gallese et al., 1996) and cerebellum (Sakai et al., 1999). Whilst this example is descriptive of a general action-perception coupling, the skills specifically associated with musical learning are difficult and complex as Altenmüller & Schneider (2008) describe:

> *"Performing music at a professional level is probably the most demanding of human accomplishments. Making music requires the integration of multimodal sensory and motor information and precise monitoring of the performance via auditory feedback."* (Altenmüller & Schneider, 2008, p. 332)

Musical instrument learning has been described as a process of optimisation, which requires the planning, organisation and execution of complex motor sequences (Penhume & Steele, 2012). This process relies on the simultaneous coordination and control of movements from multiple body parts. The feedback/feedforward loops rely in turn on the integration of the auditory, visual and tactile receptors. This afferent nervous system information is often generally described as proprioception. However, Sherrington (1906) explored several different aspects of this in detail. *Proprioception* specifically refers to muscular, tendon and articular (joint) sensitivity; *exteroception* refers to afferent information regarding the mouth, eyes and skin; and *interoception* refers to information gathered from internal organs, such as the inner ear for balance. These may be useful terms regarding the specificities of musical training as musical playing relies on a constant dynamic monitoring mode, or feedback loop which supports the notion of neural meta-plasticity (Schlaug et al., 2010; Zatorre et al., 2007).

Multiple brain regions in both hemispheres and neural networks have been associated with structural and functional changes either due to, or concomitant with, musical training. Karni et al., (1995) reported increased representation (enlargement of the hand area) in the Primary Motor Cortex (PMC, or M1) in adults. In comparison to a non-training group, the training group improved (speed and accuracy) to an optimal level after three weeks, though only on the specific finger movement sequence (in comparison to novel sequences). Associated activity-dependent changes were observed in M1 and the effect remained for several months after training was discontinued. However, this study did not report controlling for previous musical experience in the six male participants. Schlaug et al. (1995) did find evidence that violin and piano players, who had begun learning their instruments before the age of seven had a larger anterior area of the corpus callosum (CC; the white matter tract connecting the hemispheres). Subsequent research suggested that this adaptation in the CC enables increased independence between hands (Lee, Chen & Schlaug, 2002; Oztürk et al., 2008; Ridding et al., 2000). Furthermore, increased grey matter volume in left inferior frontal gyrus in the prefrontal cortex, which is known to inhibit inappropriate motor responses in musicians compared with non-musicians has been observed (Mahncke et al., 2006; Sluming et al., 2002; Swick, Ashley & Turken, 2008). The depth of the central sulcus, which is an indicator of the size of PMC, also appears to be larger in musicians than non-musicians and is more pronounced in the right hemisphere, possibly as a result of training demands on both the preferred and non-dominant hands associated with the musical learning (Amunts et al., 1997; Bangert & Altenmüller, 2003; Lotze et al., 2003; Schlaug, 2001). Specific neural adaptations to specific instruments have been shown (see e.g. Bangert et al., 2006; Elbert et al., 1995; Pantev et al., Ragert et al., 2004). Furthermore, the age of onset and amount of time spent learning a musical instrument is positively correlated with measures of grey matter volume in PMC, premotor area (PMA), the superior parietal lobe and left cerebellum (Amunts et al., 1997; Gaser & Schlaug, 2003; Grodd et al., 2001; Hutchinson, 2003). Herholtz and Zatorre (2012) suggest that co-activation of subcortical structures such as the basal ganglia, and limbic systems may account for associated pleasurable reward effects. As the area encompasses the fronto-tempero-parietal region, the overlap might result in a *"hearing-doing or seeing-doing"* network (Wan & Schlaug, 2010, p. 567).

Differences between musicians and non-musicians have also been observed using behavioural measures. At a basic level, the tapping rates of the index finger in both hands have been shown to be faster in musicians than non-musicians (Jänke, Schlaug &

Steinmetz, 1997). In adults, bi-manual tapping tasks which are similar to piano playing have revealed very different patterns of activation in professional musicians (piano players) and non-musicians (Jänke et al., 2001), which alongside other studies has led researchers to suggest that levels of automation contribute to efficiency in motor movement (Koeneke et al., 2004; Lang et al., 1990). Findings have also extended to the process of internal or 'mental training' in musicians whereby the PMC, supplementary motor area (SMA) and cerebellum were co-activated when musicians (in comparison to non-musicians) were asked to simply imagine playing their musical instrument during a functional magnetic resonance imaging experiment (Kuhtz-Buschbeck et al., 2003).

Functional changes associated with musicianship have been demonstrated using Diffuser Tension Imaging (DTI). Although evidence is currently mixed regarding levels of fractional anisotropy (FA) in the internal capsule[14], there seems to be agreement regarding higher levels of FA in the CC and superior longitudinal fasciculus which correlates positively with the number of practice hours recorded in childhood (see e.g. Bengtsson et al., 2005; Imfield et al., 2009; Schmithorst & Wilke, 2002). Recently, between-group differences in diffusivity in the cortico-spinal tract suggest that practice-induced myelination contributes to changes in white matter tracts (Rüber, Lindenberg & Schlaug, 2013).

Positive effects associated with musical learning and motor movement have been exploited in neurological therapies such as Melodic Intonation Therapy (MIT) for aphasic stroke patients and Auditory-Motor Mapping Training (AMMT) for children with Autism Spectrum Disorder (Schlaug et al., 2015). Auditory-motor coupling has also been utilised therapeutically to help people with Parkinson's disease[15] manage their symptoms (Baumann et al., 2007; Grahn & Rowe, 2009; Thaut, McIntosh & Hoemberg, 2014).

In summary, it is clear that learning to play a musical instrument leads to structural and functional changes in the brain. These changes not only lead to instrument specific adaptations, but also to an effect of automaticity enabling efficiency (in turn promoting performance ability) and also increasing inhibition of inappropriate movements enabling independence of actions (thereby increasing technical function).

[14] FA is thought to reflect fibre density, axonal diameter, and myelination in white matter (Basser, Mattiello, & LeBihan, 1994). FA is used to measure of the microstructural status of white matter. Levels of diffusivity can be obtained as a reflection of fibre density. Where 0 density = isotropic, either unrestricted or equally restricted in all directions, a value of 1 = diffusion occurs only along one axis and is fully restricted along all other directions.

[15] PD patients suffering cognitive, speech and communication as well as motor skill difficulties, depression and memory dysfunction due to neural decay in the substantia nigra resulting in reduced dopamine production.

However, these studies are of adults, in the main (rather arbitrarily) comparing musicians and non-musicians. The effect seems to be associated with early learning, but what of children. How do these enhanced motor functions develop? The next section considers the evidence with regard to children in particular.

4.2.2 Motor Skills and Musical Learning - Children's Studies

Gilbert (1980) presented a study describing the characteristics of motor music skills development in three to six year old children. She cited previous works showing evidence that music education affects the developmental trajectory for rhythmic ability (Groves, 1969; Smoll, 1974; 1975), and for perceptual ability (Pflederer & Sechrest, 1968), whereby ability increased with age. Furthermore, Elrod (1972) found that a specifically structured musical skills programme enhanced perceptual-motor development in a group of *"educable mentally retarded children"* (Gilbert, 1980, p. 168). However, Bond (1959) had found no evidence of an association between rhythm perception and motor performance. These equivocal findings led Gilbert to study 808 children aged three to six years using the Motoric Music Skills Test (MMST). In the absence of any test suitable examining motor skills in relation to musical skills, Gilbert devised this 44-item measure that incorporated theoretically and empirically discriminated aspects of performance. The factors tested were described as 1) Motor Pattern Coordination, 2) Eye-Hand Coordination, 3) Speed of Movement, 4) Range of Movement, and 5) Compound Factors. The results of the MMST showed overall improvements in performance in line with chronological age. Sex differences emerged in the study with girls performing at significantly higher levels than boys. However race, community size and previous musical instruction experience did not appear to be significantly related to performance on the test. Gilbert claimed that performance on the motor pattern coordination task (unfortunately it is not explained what this task involves) developed in an *"all-or-nothing"* manner (Gilbert, 1980, p. 169). However, the reported score variance suggests improvement on the task occurs incrementally. Aged three, mean variance was 48.8, at four this drops to 29.8, at five this drops again to 15.25 and finally aged six the mean variance reported between scores reaches 5.1. However, Gilbert explained that at the youngest ages performance scores were mostly either extremely high, or low with only a few moderate scores. Hand-eye coordination scores seemed initially to improve incrementally with age although further analyses showed a similar irregular pattern of increase and decrease. Whilst the speed as a measure and an overall compound factor displayed a similar pattern to hand-eye coordination, the range of movement subtest appeared to show a step increase between the ages, suggesting four years old as the optimal age of acquisition of the hand-eye coordination task as measured using the MMST.

However, the Gilbert sample was younger than those tested in the current study and the study was also cross-sectional, attempting to establish a set of standardised scores representing typical development. In a longitudinal study Costa-Giomi (1999; 2005) found evidence that nine-year-old children (N=117) trained on the piano (in comparison to those who were not) increased their performance in measures of motor proficiency after two years. However, this effect was not observed in the third year, at which point the groups did not differ. The study was a randomised control trial but with a specific hypothesis regarding the advantage of socio-economic status with regard to the effects of musical learning. Therefore the participants recruited specifically focused on children who had a family income lower than approximately £22,000, did not have a piano in the home and had no prior musical training. The project duration was three years and 78 children of the original 117 completed all of a range of cognitive abilities tests (described in chapter three). The motor skills assessment used the fine motor skills subtest of the Bruininks-Oseretsky Test of Motor Proficiency (1978). However, the results of the motor skills assessment are not specifically reported in either the 1999, or the 2005 publications, which focused instead on the cognitive abilities tests, attainment and self-esteem.

Norton et al., (2005) report a baseline cross-sectional study (from the start of a longitudinal piece of research), which utilised both magnetic resonance imagining (MRI) and behavioural tasks in children who were due to begin learning to play the piano. They found no pre-existing differences in finger-tapping ability in preferred and non-dominant hands in the overall sample of 71 five to seven year old children. In another study utilising both MRI scanning and behavioural tasks, Forgeard et al., (2008) found that the musically trained group of children outperformed the control group (of non-musically children) in both right and left hand motor learning tasks following 15 months of weekly piano lessons. The finger tapping paradigm requires children to use their index finger to tap the spacebar of a computer keyboard as many times as possible in 20 seconds. This task is performed twice with each hand, beginning with their dominant hand and the scores are averaged (Peters & Durding, 1978; 1979). This suggested advantage of musical learning could be considered as a 'near transfer' task in these studies as the children were learning piano. The results were not only predicted by duration of training but also associated with evidence of early adaptation observed in the pre-central gyrus, CC and in Heschl's Gyrus. Hyde et al., (2009) found further evidence of the effect of musical training on behavioural tasks. They used a four-finger motor sequencing task as a measure of procedural learning. In comparison to a group of non-musically trained children (16 six year olds), a musically trained group (15 six years olds, receiving half hour weekly piano lessons) significantly outperformed the non-trained group with their right hand performance, and outperformed the non-trained group at levels approaching significance (p = .06) with the left hand. The neural adaptations correlated with the motor tapping task occurred in the mid body of CC, an area Wahl et al. (2007) have shown connects primary sensorimotor cortices.

A recent study measuring temporal unevenness during scale practice in 30 children aged between eight and seventeen years who played piano for at least nine months suggested that years and frequency of practice were positively associated with evenness of finger movements. However, parental involvement in the child's practice and greater enjoyment of practice were two environmental factors also positively associated with temporal evenness (Spector et al., 2014).

As this review of the literature suggests, there is a paucity of evidence regarding musical training in children and of near transfer of associated motor skills. The following section will review a second measure of associated behavioural skills, visual motor integration.

4.2.3 Visual Perceptual Skills Associated with Musical Learning

Visual perception has been defined as *"the interpretation of visual stimuli, the intermediate step between simple visual sensation and cognition"* (Beery, 2004, p. 10). With regard to musical learning, the potential effects of musical notation reading, and the similar but separable skill of sight-reading, must be considered. Musical sight-reading requires accuracy under the addition pressure of speed whilst musical notation reading is important in the process of learning repertoire.

Musical notation reading has been associated with an increased ability to understand that particular visual-spatial shapes are associated with particular sounds and/or musical actions (Jänke, 2006). This is not to say that other musical skills, for example the ability to learn pieces 'by ear' and 'off by heart', are not also exigencies of musical learning that require some visual aspects. The musician must be aware of the precise placement of fingers, for example on a fret board, during performance. However, these aspects are considered in the following section, which incorporates literature on the human mirror neuron system as another way of learning via the integration of visual-motor systems.

Separation of visual and auditory modalities is experimentally challenging. However, increased audio-visual integration in the brain stem and increased behavioural cortical response and behavioural sensitivities to audio-visual asynchronies has been found in adult musicians (Lee & Noppeney, 2011; Musacchia et al., 2007). In adults, these skills can be separated and assessed as visual-spatial skills and visual-spatial-temporal skills. The rationale for the belief that musical training affects the spatial aspect of the visual modality (Schlaug et al., 2005) rests on the concept that music notation is spatial and musical notation learning therefore enhances spatial reasoning. Courtney et al. (1996) demonstrated that the neural systems for faces and for spatial location are functionally segregated (in working memory), with different areas recruited in both extra striate and frontal cortices for processing the two types of visual information. At any rate, musical notation reading has been correlated with differences in grey matter volume and activation response associated with the superior and inferior temporal cortex in visual-spatial processing tests (Gaser & Schlaug, 2003), and activation in the parietal cortex was also present even when musical notation was simply being observed rather than being played by musicians (Stewart et al., 2003).

McPherson (2005) identified the development of differing strategies at different stages of musical learning in children. Although his study focuses on mental strategies of children (N=157) aged seven to nine years when first learning a musical instrument, he also administered several behavioural measures. These were sub-grouped into five factors; performing rehearsed music, sight-reading, playing from memory, playing by ear and improvising. His evidence, based on the mean improvement rate over the three years, suggests that over the first year of learning, the greatest improvement was in the children's ability to play from memory, whilst during the second to third years the greatest improvement was for playing rehearsed music. Indeed for his sample, the pattern of development suggested that levels of sight-reading actually decreased in the first year and did not develop until the third year of learning, during which time their ability to play from memory deteriorated. Values were corrected for multiple comparisons although large 'within group' differences were also reported. Investigating this, he found that children who showed initial poor performance compared to their peers maintained this pattern over time, perhaps suggesting pre-existing differences. However, this effect was stronger for the visual skills (performing rehearsed music and sight-reading) than for aural skills of playing by ear, from memory and for improvising.

Whilst it could be argued that evidence of musical learning affecting performance on tests such as the Object Assembly (Hetland, 2000; Rauscher et al., 1997), Raven's Matrices or matrix reasoning tests (Forgeard et al., 2008; Hyde et al., 2009; Schlaug et al., 2005 and chapter three) provides evidence for increases in visual cognitive abilities, performance on these tests also reflects fluid intelligence. These results may therefore have alternative explanations, such as domain general rather than specific transfer effects.

4.2.4 Visual-Motor Integration Skills Associated with Musical Learning

There is empirical evidence pertaining to the integration of visual and motor skills following music training. Orsmond & Miller (1999) tested a group of 58 musically trained children (ranging in age from 44 to 88 months, or three and half to seven years old). They reported significant improvements on the on the Beery VMI over an experimental period of four months. The authors describe this effect as accelerated development due to an enriched environment, rather than using the term near transfer. There was also a significant interaction between group, sex and duration of learning for this measure. The authors suggested that an earlier study by Hurwitz et al. (1975) reporting a significant increase on the Beery VMI in response to musical training, could not claim any level of causality as it was cross-sectional and involved learning via the Kodály method which does not require musical notation reading. They suggested that the effect observed in Hurwitz and colleagues' study occurred as a result intense parental involvement, known to be an important factor contributing to musical achievement in children (Sloboda & Howe, 1991). However, it should be noted that the training group included in the Orsmond & Miller study learned via the Suzuki method, which, like the Kodály method, does not use musical notation in the early stages and also includes a high reliance on parental inclusion.

More recent research suggests the human mirror neuron system situated in the pre and supplementary motor areas, inferior parietal cortex and the arcuate fasciculus (a white matter fibre bundle bidirectionally connecting the caudal temporal cortex and inferior parietal cortex to locations in the frontal lobe) is implicated in the musical training 'advantage' (Kristeva et al., 2003; Lahav, Saltzman, & Schlaug, 2007; Overy & Molnar-Szakacs, 2009). Schlaug et al., (2005) suggest that this may not be solely due to sight and performance mirror neurons, but also incorporates auditory-visual mirror neurons, which, as musical learning proceeds develops the action-sound-mappings.

Watanabe et al. (2007) report a behavioural study investigating the effects of early musical training on motor skills. In this, participants copied a temporally complex rhythmic tapping sequence. The pattern consisted of long and short sequences with differing inter-onset times. The study was specifically designed to compare the effects of early training with long-term training. The two groups of adult musicians were divided on the basis of training before seven years old (early training; ET) or after seven (late training; LT). The mean age of the ET group was 5.9 years. They had 14.8 years of experience, formal training for 7.7 years and currently practised for 11.8 hour per week (n=15, mean age 22.1 years, 9 women, 6 men). The LT group, whose average age was 27.5 years, started training at 11.4 years, had 13.7 years of experience. 6.3 years of formal training and currently practised for 13.4 hours per week (n=14, 8 women, 6 men). A no training control comparison group had less than three years of musical training (n=10, 5 women, 5 men, mean age 26.2 years). Both musical groups improved in accuracy of reproduction over the five days of training, and there was no significant interaction between groups. When compared to non-musicians, only the ET group improved overall across the days. For the performance measure of 'per cent asynchrony response' however, there was a significant interaction between groups whereby the ET group performed better than LT across the five days. On this aspect, both groups performed better than the non-musician control group. The authors suggest these results indicate that enriched multimodal experiences during a sensitive period for learning results in preferential enhancement of cerebellar circuits. However, they acknowledge that a genetic component cannot be ruled out and neither can an enriched early environmental interaction, nor the effects of current practice being undertaken by musicians. A second control group of musicians who were currently not practising would have been a helpful addition to this study.

4.3 Hypotheses and Research Design

Klingberg (2010) evaluated transfer as quantifiable on three levels: either within the same domain but transferred to another stimuli or response mode (i.e. near, discrete or specific transfer), across domains from one construct to another (i.e. far, distant or global transfer), and thirdly transferred from specific skill or ability to everyday behaviour, which he describes as the ultimate goal of interventions. Within music and education psychology, and when exploring the potential impact of musical learning, the terms 'near' and 'far' have commonly been used to describe domain specific and domain global transfer of skills. Conceptually and methodologically it is important to be able separate priming which occurs during encoding and time-on-task effects from the concept of near transfer in order to be able to identify which specific skills might contribute either therapeutically and/or educationally. Therefore, the measures chosen for this study specifically do not test musical ability, but remain within the same domain. As Table 4.1 illustrates, each measure is matched with either a specific or range of skill/s recruited and developed over time in order to facilitate playing a musical instrument.

Table 4.1. Subtest Functions and Hypothesised Near Transfer Effects of Musical Instrument Learning with regard to the Movement Assessment Battery for Children (2nd Edition, Henderson, Sugden & Barnett, 2007)

Test	Sub Tests	Task Requirement	Examples of potential 'near' transfer of skills	Domains implicated
MABC-2 Manual Dexterity	Task1: Placing pegs in a board Task2: Threading Lace Task3: Drawing a Trail	Fine motor control, especially digit dexterity, but also proprio- and extero- ceptive awareness	Fret/note finger positioning, posture, hand-eye coordination, application of correct pressure	Fine motor and visual-spatial and visual-spatial-temporal skills and sequential learning
MABC-2 Aiming & Catching	Task1: Throwing and catching with one or two hands Task2: Throwing a beanbag onto a target on a mat	Gross and fine motor, speed of movement, and hand/eye coordination. These incorporate proprio-, extero and intero-ceptive awareness	Percussion, bowing, marching/dancing, dynamic force exertion	Spatial demands, movement planning (direction), target judgement, velocity absorption, dynamic force generation, hand-eye coordination
MABC-2 Balance	Task1: Balance board Task2: Walking Heel-to-Toe forwards Task3: Hopping	Control in relation to other body parts including head, eyes, and muscular tension. These incorporate the three types of ceptive awareness	All multiple limb instruments, performance command	Compensatory action/reaction based on feedback (counterbalancing to maintain equilibrium)
Beery Visual Motor Integration	Copying geometric shapes	Visual development and fine motor skills	Reading musical notation and translating shape to sound-action coupling	Hand-eye coordination
Beery Visual Perception	Identify the correct matching geometric shape	Fine-grained visual development	Understanding values of musical notation	Visual-spatial congruence
Beery Motor Coordination	Drawing geometric shapes within outline	Visual development and fine motor skills	Grasp precision, dexterity and attention	Hand-eye coordination, focus, grasp and pressure

The research question pertinent specifically to this aspect of the children's study related to whether extra-curricular musical training (EMT) provided either an accelerated learning trajectory or differential learning pattern in comparison to statutory school music (SSM) for fine motor skills, and motor visual integration skills. However, with reference to McPherson's observation regarding the lack of learning via musical notation in the first year, it was not predicted that there would be any difference between musical learning groups during the experimental period for visual perception.

Changes in gross motor skills associated with musical learning have not been tested before. The recruitment process did not provide enough participants to group according to instrument, therefore only a general prediction could be made regarding musical learning and gross motor skills with regard to near transfer. Specifically regarding the measures and task used herein, the use of the MABC-2 is novel within the field. Direct comparison with the finger-tapping paradigm would have been invalid due to the mixed instruments learned by the participants in the EMT group. Furthermore there is lack of standardised comparative data for finger-tapping tasks, whereas the MABC-2 incorporates multiple fine and gross motor tasks and is age standardised so was suitable for testing group differences in the study. It is also possible that other physical or leisure activities that children take part in, as well as musical training may impact upon these measures. Therefore, the hours per week spent doing these activities as reported by parents were compared to the hours per week musical activity reported by parents in order to try to specify causality of any changes evident over the experimental period.

Whilst the literature regarding musical training induced changes in visual perception is also limited, several studies have used the Beery test of Visual Motor Integration (B-VMI). Results have suggested an advantage for musically trained groups. Therefore, the B-VMI and the new supplementary measures of visual perception (B–VP) and motor coordination (B–MC), which had not yet been reported in music studies, were also administered.

The specific hypotheses (following on from chapter three, H_1-H_5) were that:

H_6 – The EMT group will perform significantly better than the SSM group on measures of fine and gross motor skills over time as measured using the MABC-2

H_7 – The EMT group will perform significantly better than the SSM group on measures of visual-motor integration and motor coordination as measured using the Beery VMI and MC

H_8 – There will be no differences between groups over time for the Beery VP

H_9 – Performance on the MABC-2 and Beery VMI and MC will be correlated

H_{10} – Musical activity, rather than physical or leisure activities will show change over time in the outcome measures of the MABC-2 and Beery VMI and MC

As detailed in the literature review, sex has been shown to be a differentiating variable for motor skills. Gilbert (1980) had found that girls performed better than boys on the three motor music skills subtests which showed significant increase over time. These were Motor Pattern Coordination, Eye-Hand Coordination and Compound factors. The boys showed high mean scores on the subtests in which scores had not increased significantly. These were Speed and Range. Orsmond & Miller (1999) found what they describe as a gender effect in their study. However, these appear to be related to score performance differences between the boys and girls for the music discrimination test. This led to the sex of the children being co-varied in the study and so no specific differences are reported for the Beery VMI, which is the measure of specific interest in this study. With regard to the separate yet related issue of gender, McPherson, Davidson and Faulkner (2012) suggest that gender is not often highlighted as a key issue, except for with regard to identity and personality. For example, Faulkner (2010) found that girls were more likely than boys to carry on practising an instrument even when they were not enjoying it. These aspects of gender, as opposed to sex, and personality, will be considered in greater detail in chapter seven and eight. Therefore, based on the limited nature of the literature, sex was added to the analyses with no specific prediction. It may have been possible to speculate that girls would outperform boys in the EMT group due to their extra musical training. However, without knowing exactly what Gilbert's MMST entailed exactly, it was deemed as worthy of further investigation without firm prediction. The cognitive measures used in chapter three were also included in the analysis in order to explore whether any correlations could be found between the measures indicating a link between near and far transfers.

4.4 Methods, Measures and Participants

This study is based on the same participants and was undertaken at the same time as the study reported in chapter three. All factors are the same as were presented in chapter two. To follow are the results of the measures of the MABC-2 and Beery tests.

These were also analysed using the same statistical techniques that were utilised in chapter three.

4.5 Results

4.5.1 Preliminary Analysis

In order to establish whether assumptions necessary for parametric analyses were violated, observations of histogram charts and agreement between Kolmogorov-Smirnov (KS) and Shapiro-Wilk (SW) tests were considered to check whether normal distribution of variance within groups was present for the variables at Time1. When these conditions, or the relevant test conditions such as Levene's Test of Equality of Variance (Levene's), or Box's Test of Sphericity were not met, non-parametric equivalent tests were used. Where multiple comparisons were made, Bonferroni corrections were used to provide a new level of alpha *p*, except for when reporting composite factors such as the MABC-2 Total score, as these form part of the *a priori* hypotheses. All further reported statistics should be regarded as Sphericity assumed unless otherwise stated. For all charts, error bars depict standard deviations. One asterisk (*) denotes statistically significant change over time based on planned post-hoc analyses, and two (**) denote statistical significance after correcting for multiple comparisons.

For the Beery tests, there were no issues regarding normality of score distribution or differences between groups at Time 1 for either the B–VMI or the B–VP. However, for the B–MC both KS (p = .03) and SW (p = .01) were significant as well as Levene's Test (p = .01) for subsequent RM ANOVA. Removal of one outlier did not satisfactorily resolve the issue (KS and SW p = .05) and Levene's test remained significant. Therefore, the non-parametric equivalent for RM ANOVA, the Wilcoxon Signed Rank Test (WSRT) was used to analyses B–MC. Independent *t* tests did not reveal any significant differences between groups for the three Beery measures (all $p > .35$) at Time 1.

For the MABC-2, KS and SW values were non-significant for all measures. However, an independent *t* test between groups at Time 1 was significant (p = .03) for Aiming & Catching. Inspection of the data showed that participant 8's score dropped from 18 at Time 1 to nine at Time 2 suggesting an issue of attention rather than ability. Removal of this outlier resolved the issue regarding equal variance. However, the *t* tests value for this variable remained close to significance (p = .05). Therefore, both the parametric RM ANOVA and non-parametric equivalent WSRT statistics are reported in the following section. The *t* test values between groups at Time 1 for the remaining variables of MABC-2 Total, Manual Dexterity (MD) and Balance were all non significant (all $p >$ .49).

Table 4.2. Group Mean Standardised Scores at Time 1 for the Movement Assessment Battery for Children (2nd Edition, Henderson, Sugden & Barnett, 2007), and the Beery Visual Motor Integration, Visual Perception and Motor Coordination tests (Beery, 2004)

T Scores	Group	Mean	Std. Deviation	Minimum	Maximum
MABC Total	SSM[a]	9.53	2.68	5	17
	EMT[b]	9.26	1.94	5	13
MABC Manual Dexterity	SSM	8.53	3.27	3	15
	EMT	9.05	2.66	5	15
MABC Aiming & Catching	SSM	9.67	2.83	5	15
	EMT	8.11	1.82	4	12
MABC Balance	SSM	10.37	2.06	6	15
	EMT	10.84	2.09	6	15
Beery	SSM	101.95	12.92	68	121
Visual Motor Integration	EMT	105.95	13.01	76	131
Beery	SSM	99.11	16.34	60	120
Visual Perception	EMT	103.11	14.67	75	126
Beery	SSM	87.42	6.41	70	95
Motor Coordination	EMT	90.63	13.53	62	113

[ab] n=19

Table 4.2 provides descriptive statistics for the MABC-2 and Beery standardised scores at Time 1.

4.5.2 Principal Analysis

4.5.2a Bivariate Correlations

Bivariate correlation analyses were carried out between the WASI, PMMA and CMS from chapter three and the MABC-2 and Beery at Time 1, Time 2 and on the difference between these pre and post scores. These analyses were two-tailed for the MABC-2 as this measure has not previously been used in musical learning studies and one-tailed for the Beery which has been previously used.

Firstly at Time 1, a significant correlation was found between PMMA composite (percentile) and the MABC-2 Total score. The raw correlation (r = .37, p = .03) was attenuated for measurement error and the true r = .47 is therefore reported. However, this does not reach an 80% power level (according to post-hoc power analysis) and furthermore correlational analysis on the Time 2 and the difference between pre and post scores did not reveal any significant relationship between these two measures.

Component level analysis of rhythm and tonal (from the PMMA) and manual dexterity (MD), balance (BAL) and aiming and catching (A&C; from the MABC-2) revealed some significant relationships in spite of correcting for multiple comparisons which resulted in a lower alpha *p* value (*p*.05/5=.02). The raw value for the PMMA tonal component and MD was $r = .39$, $p = .02$, for BAL, $r = .38$, $p = .02$ and A&C was non significant ($p > .2$). For the PMMA rhythm component and PD, only BAL was significant ($r = .44$, $p < .01$) but MD and A&C were non significant ($p > .2$ and .8 respectively). The disattenuated statistics at Time 1 revealed true correlation coefficients as so: PMMA Composite and MABC-2 Total $r = .47$, MD and Tonal $r = .55$, BAL and Tonal $r = .74$ and Rhythm and BAL $r = .60$. However, for the Time 2 and difference between pre and post scores, there were no significant correlations between composites or components of the PMMA and the MABC-2.

For the PMMA and the Beery, at Time 1 the PMMA Composite and VP were significantly correlated $r = .47$, $p < .01$, attenuated $r = .58$. The tonal component was also significantly correlated $r = .46$, $p < .01$, attenuated $r = .56$. The rhythm component was also significantly correlated $r = .32$, $p = .05$, attenuated $r = .41$.However, this does not remain significant once corrected for multiple comparisons. At Time 2 and for the difference between pre and post scores, there were no significant correlations between composites or components of the PMMA and the Beery VMI, VP and MC.

4.5.2b Non-parametric Wilcoxon Signed Ranked Test (WSRT)

For the two variables for which non-parametric equivalents were utilised, the MABC-2 Aiming & Catching (A&C) component and the Beery MC factor, data was analysed using split file command (by Music Group) and WSRT. No significant effects were found for either component, though a trend towards significance alpha level was found for the EMT group for the A&C component of the MABC-2 only ($Z = -1.82$, $p = .07$).

4.5.2c RM ANOVA and Paired t tests

The group means and standard deviations for the MABC-2 and Beery variables at Time 1 and Time 2 are provided in Table 4.3. Figure 4.1 depicts the MABC-2 composites and Figure 4.2 represents the subtest tasks for both groups at both times.

Table 4.3. Group Mean Standardised Scores for Time 1 and Time 2 for Movement Assessment Battery for Children (2nd Edition, Henderson, Sugden & Barnett, 2007) and the Beery Visual Motor Integration, Visual Perception and Motor Coordination tests (Beery, 2004)

Measure	Group	N T1	Mean Time 1	Std. Deviation T1	N T2	Mean Time 2	Std. Deviation T2
MABC Total	SSM	19	9.53	2.67	19	10.26	2.45
	EMT	19	9.26	1.94	19	10.47	2.30
MABC Manual	SSM	19	8.53	3.27	19	9.26	3.45
Dexterity	EMT	19	9.05	2.66	19	9.32	2.85
MABC Aiming	SSM	18	9.67	2.83	18	10.44	2.75
and Catching	EMT	19	10.16	2.59	19	10.84	2.09
MABC Balance	SSM	19	10.37	2.06	19	11.58	2.80
	EMT	19	10.84	2.09	19	11.37	2.67
Beery Visual	SSM	19	101.95	12.92	19	98.74	7.44
Motor Integration	EMT	19	105.95	13.01	17	104.24	14.67
Beery Visual	SSM	19	99.11	16.34	17	96.94	17.96
Perception	EMT	19	103.11	15.47	14	99.86	12.02
Beery Motor	SSM	19	87.42	6.41	18	86.33	12.52
Coordination	EMT	19	90.63	13.53	18	91.11	16.31

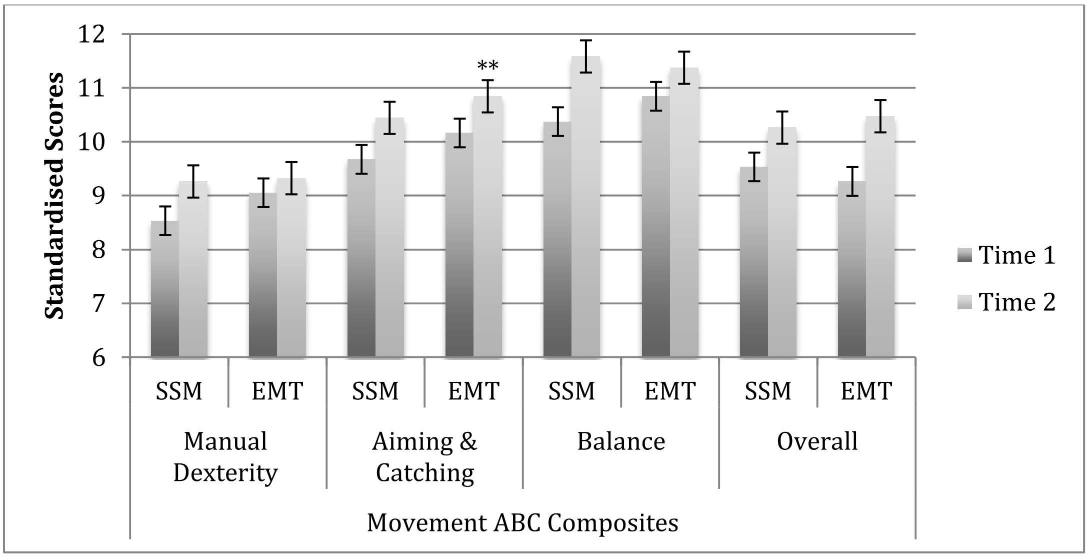


Figure 4.1. Bar Chart of Group Mean Scores for the composites of the Movement Assessment Battery for Children (2nd Edition, Henderson, Sugden & Barnett, 2007)

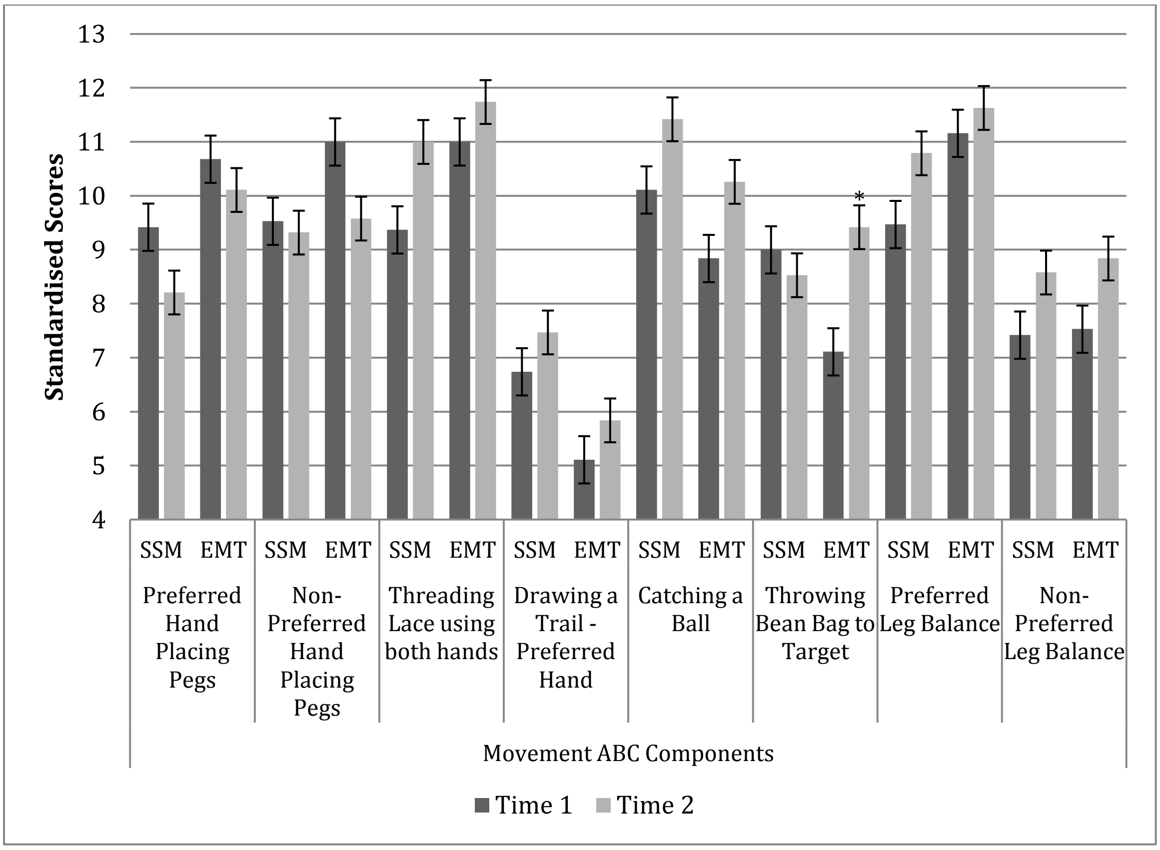


Figure 4.2. Bar Chart of Group Mean Scores for the Tasks of the Movement Assessment Battery for Children (2nd Edition, Henderson, Sugden & Barnett, 2007)

For the MABC-2, RM ANOVA analysis revealed a significant main effect of time but no interaction between groups for the Total composite score $F(1, 36) = 5.05$, $p = .03$, $\eta^2 = .12$. As this is the primary composite score for the measure, it is reported as significant without correction. No interactions were found between groups. Planned post-hoc analysis paired samples *t* test using split file command did not reveal any significant difference between groups for MABC-2 Total score.

For the second level of composite factors (A&C, MD and Balance) there was a main effect of time, significant even when corrected for multiple comparisons, for the A&C composite $F(1, 35) = 8.94$, $p < .01$, $\eta^2 = .20$ but no interaction between groups. Planned post-hoc analyses revealed a significantly increased performance for the EMT group for A&C $t(18) = -3.51$, $p < .01$, $d = .8$. The SSM group also increased performance to a near statistically significant level $t(17) = -2.08$, $p = .053$, $d = .2$. See Figure 4.1.

The composite of Balance, RM ANOVA analyses suggested that the main effect of time showed a trend towards significance level for ($p = .066$) but there was no interaction between groups ($p > .4$). Paired sample *t* tests did not reveal a significant advantage of one group over the other for the Balance composite although the SSM group approached significance level (EMT p > .4, SSM $p = .07$).

Manual Dexterity did not show any significant main effects of time or interaction between groups (all $p > .2$).

Table 4.4. Group Mean Scores for the Subtest Tasks at Time 1 and Time 2 for the Movement Assessment Battery for Children (2nd Edition, Henderson, Sugden & Barnett, 2007)

Measure	Group[a]	Mean T1	SD T1	Mean T2	SD T2
Preferred Hand Placing Pegs	SSM	9.42	2.91	8.2	3.58
Standardised Scores	EMT	10.68	2.73	10.11	2.28
Preferred Hand Placing Pegs –	SSM	31.87	5.49	30.90	5.80
Timed[b]	EMT	28.72	4.34	27.95	4.18
Non-Preferred Hand Placing	SSM	9.53	2.57	9.32	2.69
Pegs Standardised Scores	EMT	11.00	2.05	9.58	2.27
Non-Preferred Hand Placing	SSM	36.70	6.37	33.59	5.57
Pegs – Timed[b]	EMT	32.20	3.95	33.64	5.03
Threading Lace using both hands	SSM	9.3	3.39	11.47	3.06
Standardised Scores	EMT	11.00	3.02	11.74	2.56
Threading Lace using both hands	SSM	32.89	9.80	24.39	7.13
–Timed[b]	EMT	27.48	7.07	23.47	5.80
Drawing A Trail Standardised	SSM	6.74	4.08	7.47	4.17
Scores	EMT	5.11	3.23	5.84	3.37
Throwing and Catching A Ball	SSM[b]	10.11	2.08	11.42	2.69
Standardised Scores	EMT	8.84	1.71	10.26	3.25
Throwing a Bean Bag to Target	SSM	9.00	3.32	8.53	3.19
Standardised Scores	EMT	7.11	2.16	9.42	3.13
Best Leg Balance Board	SSM	9.47	3.19	10.79	4.17
Standardised Score	EMT	11.16	2.91	11.63	2.89
Best Leg Balance Board –	SSM	13.44	8.20	20.69	11.57
Timed[b]	EMT	17.26	8.83	20.06	9.06
Non-Preferred Leg Balance	SSM	7.42	2.69	8.58	4.27
Board Standardised Score	EMT	7.53	3.41	8.84	3.45
Non-Preferred Leg Balance	SSM	7.12	5.27	13.09	10.63
Board – Timed[b]	EMT	8.69	7.62	14.50	9.95

[a]Both groups n=19, Time 1 and Time 2, except SSM which was n=18, Time 1 only
[b]Average over two trials in seconds

Regarding the task level of the MABC-2, no significant main effects of time or interactions were found for any of standardised scores for the MD components, which included pegboard, sewing and drawing a trail. Table 4.4 and Figure 4.2 present data for the individual variables measured using the MABC-2. Two variables are not included (hopping using each leg along 5 mats and walking along a straight line toe to toe) as all participants achieved the ceiling score on these tests.

For the individual tasks of the A&C composite, one outlier caused Levene's test to be significant for the 'ball throwing and catching' (ball) tasks. This data point was subsequently removed. The statistic remained significant at $F(1, 35) = 8.11$, $p < .01$, $\eta^2 = .19$ revealed a main effect of time for this task but no interaction between groups. Planned post-hoc analyses showed both groups improved performance to near statistically significant levels SSM: $t(17) = -2.08$, $p = .05$, $d = .49$ EMT: $t(18) = -1.97$, $p = .07$, $d = .45$.

For the 'bean bag throwing to target' (beanbag) component, no main effect of time was found, but a significant interaction between groups was revealed $F(1, 36) = 4.88$, $p = .03$, $\eta^2 = .12$ although this effect disappears when corrected for multiple comparisons ($\alpha p = .05/13 = .003$).

The direction of change for groups was different with SSM reducing their performance score, whilst EMT improved their performance on this task (see Figure 4.2). Further analyses revealed a significant increase in performance for EMT for the 'beanbag' factor $t(18) = -2.78$, $p = .01$, $d = .64$. However this does not remain significant when correct for multiple comparisons. The decrease in performance on this task for SSM was not significant ($p > .6$)

Due to the borderline distribution of variances within groups at Time 1 for this component (A&C), analysis of the tasks was repeated with WSRT using the split file command to compare groups. This analysis revealed a significant effect for the EMT group for 'beanbag' performance over time $Z = -2.45$, $p = .01$. The statistic for 'ball' was not significant $Z = -1.82$, $p = .07$. For the SSM group, the effect over time on performance for the 'ball' task was significant $Z = -2.06$, $p = .04$, but not for the 'bean bag' ($p > .79$). These statistics do not remain significant once corrected for multiple comparisons.

For the Balance tasks, analyses of the balance board best leg and other leg did not reveal a main effect of time or interactions for the standardised scores (*ps* > .8).

Recalling that WSRT was used for Beery MC and no significant results were found, RM ANOVA and paired samples *t* tests were used to analyse the other two components, Beery VMI and Beery VP. No significant effects over time were found. Similarly, planned post-hoc analyses revealed no significant change over time for either group on any of the Beery measures in either direction.

Analyses were repeated with sex as well as music group as independent variables. There were 10 females in the SSM group and 11 in the EMT group. There were nine males in the SSM group and eight in the EMT group. No significant differences of sex effect was found between sex or music group for any of the variables at Time 1 except for the MABC-2 A&C and B-MC. Due to lack of normal distribution between scores within groups at Time 1, a WRST non-parametric analysis was used for B–MC. No significant differences between group or sex were found for the B-MC. For MABC-2 A&C, WRST analysis revealed a significant effect for male participants $Z = -2.33$, $p = .02$, but not for females ($p = .12$) for MABC-2 A&C. However, when split by sex and music group using an independent samples t test on the difference between pre and post measures (Time 2 – Time1), the effect did not remain. That is there were no significant differences between the EMT and SSM group for males. For the remaining variables, parametric analyses (RM ANOVA) were used. There was a near significant main effect of time for females for MABC-2 Total scores, $F(1, 19) = 4.32$, $p = .05$ but no interaction between groups (both SSM and EMT improved performance). There was no effect for males for the MABC-2 Total.

Continuing with the analyses of sex for the second level components, MD, A&C and Balance, no significant effects were found for manual dexterity or balance factors. For A&C Box's statistic was significant ($p = .03$) confirming the issue with homogeneity of variance for this second level factor for males only. Therefore parametric analysis could not be used.

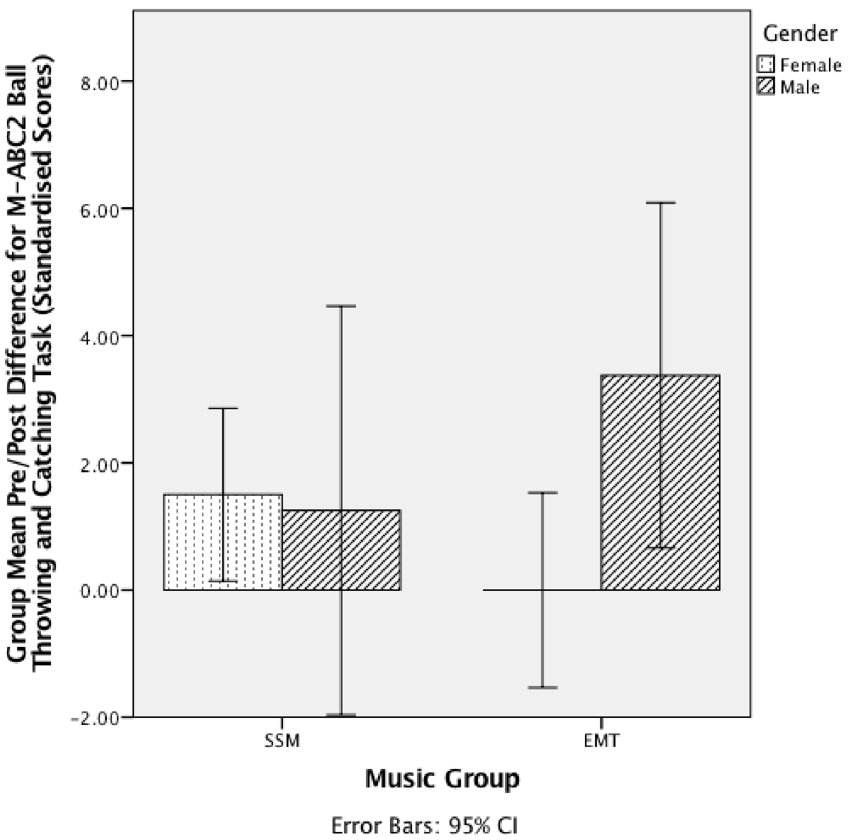


Figure 4.3. Change Over Time for Males for the Ball Throwing and Catching Task of the Movement Assessment Battery for Children (2nd Edition, Henderson, Sugden & Barnett, 2007)

The third level variables for this factor were also analysed. This revealed that males significantly improved their performance in ball-throwing and catching task over time $F(1, 35) = 9.98$, $p < .01$, $\eta^2 = .22$ but not on the beanbag task. Figure 4.3 depicts the difference between pre and post scores for male and female children in the ball-throwing task. Error bars represent 95% confidence intervals. There was no significant change for females.

No effect was found for sex for the Beery VMI, or VP, or for MABC-2 Manual Dexterity or Balance components.

Bivariate correlation analyses (Pearson's) carried out on the score difference (Time 2 - Time 1) within MABC-2 revealed significant positive associations between the Total score and MD ($r = .76$, $p < .01$), A&C ($r = .50$, $p = .01$), Balance ($r = .44$, $p = .01$) as would be expected. Between the second level variables, MD and Balance were significantly positively associated ($r = .38$, $p = .02$) but MD was not associated with A&C

and neither was A&C associated with Balance. MABC-2 third level tasks ‘bean bag’ and ‘ball’ were not correlated ($p > .6$)

Within Beery, neither VMI and VP, nor VP and MC were significantly associated, although VMI and MC were ($r = .41$, $p = .014$).

The MABC-2 Total and the three Beery factors were not significant significantly correlated. MABC-2 MD and Beery VMI were significantly negatively associated $r = -.35$, $p = .03$. MABC-2 MD was not correlated with Beery VP and Beery MC. MABC-2 A&C and Balance were not associated with any of the Beery factors.

4.5.3 Exploratory Analyses

Multiple regression analyses was carried out using MABC-2 Total, MD, Balance, A&C, ‘bean bag’ and ‘ball’ differences (Time 2-Time 1) as outcome variables and parent reported hours spent weekly doing and musical, physical and leisure activities. No significant models were found.

As with chapter three, exploratory analyses were carried out using the amount of hours per week reported for Musical, Physical and Leisure activities by parents. However, the violations of assumptions required for parametric analysis remained and so these results are not reported.

4.6 Discussion

This chapter investigated performance on behavioural measures of fine and gross motor and visual-motor skills in children with different levels of musical enrichment. Reflecting Forgeard and colleagues’ (2008) suggestion that, as a matter of deductive logic, the notion of far transfer effects necessitates the establishment of near transfer effects, the work presented in this chapter was focused on testing near transfer effects. In order explore the assumption that the acquisition of a domain specific skill is directly linked to more distant or global skills, measures of near transfer must be distinct from the skills being specifically trained (Klingberg, 2010). For example, testing a novice pianist on a piece of music that they have been practising only provides information about how well they have learned that piece. In contrast, the novice pianist’s performance on finger tapping exercises provides information on near transfer of the fine motor control skills developed during musical practice. Rather than using tapping paradigms which would could only inform our understanding of near transfer from instrument learning focusing on finger training (perhaps appropriate for piano training), tests that assessed potential changes in gross and fine motor skills, in visual perception and visual-motor integration, and in motor co-ordination over time where used in the study. The tests were the MABC-2 (Henderson, Sugden & Barnett, 2007) and the Beery VMI, VP and MC (Beery, 2004).

The MABC-2 is a standardised test used to evaluate motor skills in children and adolescents. The measure assesses sensorimotor functioning and motor coordination; specifically focusing on gross motor ability (e.g. jumping, catching), fine motor ability (e.g. drawing, writing) and motor coordination. The test yields a global score (MABC-2 Total) and three component scores, the Manual Dexterity (MD), Balance and Aiming and Catching (A&C). The Beery is designed to assess the extent to which individuals aged between two and eighteen years can integrate their visual and motor abilities (hand-eye coordination). It includes three tests, but there is no overall score for the Beery.

The research question pertinent specifically to this chapter of the children's study related to whether EMT provided either an accelerated learning trajectory or differential learning patterns in comparison to SSM for fine motor skills, and motor visual integration skills. Changes in gross motor skills associated with musical learning have not been tested before. The use of the MABC-2 is novel within the field.

Regarding the first hypothesis in this chapter (H_6), which predicted that the EMT group would perform significantly better than the SSM group on measures of fine and gross motor skills over time as measured using the MABC-2, the analysis of the data for the MABC-2 Total overall measure of motor ability, revealed a main effect of time, with both groups improving over time. There was no significant difference between SSM and EMT groups. For the second level composite measures of the MABC-2, significant differences over time and between groups emerged only for the A&C composite, although a trend towards significance was observed for the Balance composite. For the A&C composite, a significant main effect of time was observed and planned post-hoc analyses revealed a significant improvement in the EMT group. The improvement in the SSM group approached significance level.

The composite scores were made up of several tasks, which are subsequently described as third level tasks. The A&C composite included two third level tasks, throwing a beanbag onto a target and throwing and catching a ball. The MD composite included pegboard, sewing and drawing a trail tasks. The Balance component included balancing on a board, hopping and walking along a marked line.

The analysis of the data from the task level for A&C showed that the EMT group outperformed the SSM group on the 'bean bag' task of the A&C at the second time point. This statistic reached the criteria for a power level of 80% based on a post hoc power analysis. This task required participants to throw a bean bag onto a marked target across a distance of approximately two metres, requiring hand-eye coordination and judgement regarding velocity, distance and target focus. Whilst the SSM group decreased their performance scores on this task over points one and two, the magnitude of this decrease was not significant. Regard the ball throwing and catching tasks, there was a main effect of time but no interaction. Planned post-hoc analysis revealed a trend towards significance level in both groups, although this was stronger in the SSM group. As the data for this test were not normally distributed, this was also analysed using non-parametric tests. These revealed that the EMT group improved beanbag throwing over time, whilst SSM group showed no increase in performance on that task. In contrast, the SSM group improved on ball throwing and catching over time whilst no change was observed for the EMT group.

The analysis of the data from the Manual Dexterity component, which included pegboard, sewing, drawing a trail tasks, failed to reveal any differences between groups or over time. Regarding the task analyses for the Balance component, as ceiling level performance for the tasks of hopping on each leg and walking along a straight line were achieved by participants, these tasks were not analysed. Although planned post-hoc analyses did reveal significant statistical differences between groups for both the 'best leg' and 'other leg' balance board tasks, these statistics related to the number of seconds rather than the standardised scores that were not significant. However, the difference between groups regarding their leg preferences demonstrated different patterns. Leg preference was coded as ipsi-lateral when they chose the same side leg as their preferred hand (i.e. if they were right-handed and chose their right leg as their best leg); contra-lateral if they chose the opposite leg to their preferred hand (i.e. right-handed but left-legged, or 'goofy' colloquially). Some participants began by choosing their same-sided leg as hand but then changed as they found their contra-lateral leg gave them a longer balance time, or higher score. These were coded as 'Changed'. For the SSM participants, seven were ipsi-lateral, four were contra-lateral and eight changed preference, meaning 12 ended up as contralateral. For the EMT participants, two were ipsi-lateral, eight contralateral initially and nine changed, meaning that 17 ended up using contralateral limbs for their hand and leg preferences. These patterns should be noted in any future studies attempting to understand effects of musical learning on gross motor abilities.

In summary, whilst the overall analysis of the MABC-2 data showed a significant improvement over time for both groups, the second level composite of Aiming and Catching suggests there were differences between groups. The analysis of the data from the tasks revealed a difference between groups for ball throwing and catching and beanbag throwing onto a marked target. The EMT group outperformed the SSM group on the beanbag task and the SSM group outperformed the EMT group on the ball task. Similarities between these tasks include an understanding of velocity and focused attention, whilst differences between the tasks centre on reaction in order to receive/catch the ball. In Forgeard et al., (2008) and Hyde et al., (2009), a direct effect of piano training on finger tapping and sequences was observed over a slightly longer experimental period. Whilst direct comparison with the finger-tapping paradigm would be invalid due to the mixed instruments learned by the participants in the EMT group, it is noted that no fine motor skills effects were observed in our music-training group. To summarise with regard to H_6, in this study the EMT group did perform significantly better than the SSM group on measures of gross, but not fine motor skills over time as measured using the MABC-2.

Regarding H_7, that hypothesis the EMT group would perform significantly better than the SSM group on measures of visual-motor integration and motor coordination as measured using the Beery, the results from the group comparison of the Beery Visual Motor Integration and Motor Co-ordination tasks revealed no significant main effects over time, or interactions between music groups. Failure to replicate the findings of Orsmond & Miller, 1999 were not surprising their study reported statistical significance based on changes over time in raw scores. That is they, the scores analysed were not standardised by age, and as these analyses have demonstrated, raw score analyses can suggest an effect has occurred which is tempered once age typical trajectories of development are taken into account. Of further interest perhaps, the VMI and MC were significantly correlated. The tasks are quite similar (see chapter two) so it may not be worth including this measure in future studies of this nature. In contrast, it should also be noted that the VMI and MABC-2 MD were significantly negatively associated and so should be including in future studies in order to further explore this.

As described by both Orsmond & Miller (1999) and Gilbert (1980), the effect of sex approached significance for females only, although there were no significant differences between SSM and EMT groups for the overall measure of MABC-2. On one task the boys in both groups performing at a significantly higher level than girls in both groups for the MABC-2 A&C task of ball throwing and catching. No other MABC-2 factors or any of the Beery measures showed a sex differential.

With regard to H_8, which referred to McPherson's observation regarding the lack of learning via musical notation in the first year, it was predicted that there would not be any difference between musical learning groups during the experimental period for visual perception. This hypothesis proved correct, as there was no difference between groups over time for the Beery VP.

The next hypothesis in this chapter, H_9 investigated whether the tests used in this chapter were related to each other, or measured separate constructs. As noted earlier, as the Beery VMI and Beery MC were significantly positively associated, and the Beery VMI and MABC-2 MD were significantly negatively associated, it might be considered efficacious for future studies not to include the Beery MC in their batteries. No other statistically significant correlations were found between the different measures used in this study confirming the validity of this battery of measures regarding levels of musical training on separately measureable developmental aspects of fine and gross motor ability and visual-motor integration, visual perception and motor coordination. Further exploratory correlation analysis also asserted there were no association with these measures or any of the cognitive measures used in chapter three.

Concerning H_{10} the hypothesis considering whether the amount of hours doing the activities, or the EMT/SSM group division generated the differences in the MABC-2 A&C discussed earlier, the amount of hours per week spent doing other physical and leisure activities (as reported by parents) were compared to the hours per week musical activity reported by parents in order to try to specify causality of any changes evident over the experimental period. However, the range of hours per week reported for the children for these activities by parents meant that groups were uneven, disabling further analyses. Therefore, this study was not able to confirm or reject H_{10} that music, in comparison to other activities, was responsible for any changes observed.

Placing these findings within the existing literature is difficult because of the different ages of the participants in the samples and also the differing methodologies and durations of training. For example, Schlaug et al. (2005) failed to observe increases in fine motor skills and auditory discrimination (tested using Gordon's PMMA). Whilst their sample had completed one year of musical instrument lessons, their participants were younger than those described herein at five to seven years old. In their cross-sectional study of nine to eleven year old children, Forgeard et al. (2008) reported that an instrumental group, with three years of musical training, significantly outperformed a musically untrained group on measures of left and right hand motor learning. Motor learning was tested using a four-finger sequence task and increases were associated with increased performance on Gordon's Intermediate Measure of Musical Aptitude (IMMA, Gordon, 1986) tonal test. Similarly, Hyde et al. (2009) found a significant effect of musical training on a right hand four-finger motor sequence and a strong trend to significant (p = .06) for the left hand in a group of six-year-old children. The authors proposed that this effect could be explained in terms of duration of learning, intensity of practice and/or power, or sample size. When these three reasons are considered separately, it is interesting to note that the duration of training reported in different studies is often highly variable. For example, the study by Schlaug et al., 2005 spanned one year, whereas the studies by Forgeard et al. (2008) was cross-sectional and considered children who had trained for three years, whereas the Hyde et al. (2009), spanned 15 months.

One study which did include gross motor and movement skills (Derri et al., 2001) reported that 10, twice-weekly music and movement interventions resulted in a significantly greater improvement in locomotor skills such as running, jumping and skipping in the experimental group compared with the control group of 68 four to six year olds. Derri and colleagues used the Test of Gross Motor Development (Ulrich, 1985). However, it could be argued that these movements are too far removed from the musical task, or similar to the intervention training, to indicate successful near transfer of acquired skills, which is the focus of this study. Whilst Orsmond and Miller (1999) reported increases on the Beery visual motor integration after only four months of training, this finding was surprising as the music training relied on the Suzuki method, which does not use musical notation at the initial stages. However the analysis of the VMI scores was carried out on the raw rather than the standardised scores. Furthermore it was compared to three other measures of cognitive skills and the results reported were not corrected for multiple comparisons.

Hyde et al. (1999) suggest that intensity of practice, as well as duration of time learning is a possible explanation for transfer effects. Palmer & Meyer (2000) found that with increasing skill, motor and conceptual dimensions became distinct within a sequence representation. This means that individuals who are able to perform a task automatically can then think about how to perform components of the task separately. Jänke contributes that *"Whether mental planning and low-level motor actions are learned independently and whether learning is dependent on the level of skill is a long-standing matter of dispute."* (Jänke, 2006, p. 31). Therefore, it may be that Orsmond and Miller (1999) found an effect purely because the method of teaching relied solely on the mirror neuron system audio-motor coupling (Behmer & Jantzen, 2011) of the Suzuki method, rather than more typical teaching methods that incorporate music reading. In the study reported here, the children learned instrumental technique and music reading at the same time and the combination of audio-motor coupling and music reading may lead to cognitive overloading (Mayer & Moreno, 2003). This then may be an alternative explanation as to why the current results failed to observe the advantage reported in Osmond and Miller's study. Further studies equating teaching methods with near or far transfer effects (aligned with achievement outcomes such as musical grades) would be necessary in order to isolate the origins of such an effect. In order to try to further probe this question, qualitative data comparing two individuals journey of learning over the year, with the quantitative group means in chapter six explore these individual differences.

4.7 Limitations

As the research design is the same throughout the child study, and the limitations of this overall are discussed in depth in chapter nine, the focus here is on the measures used in this chapter. With regard to the Beery tests, the children did not find them engaging. The scores for the whole sample reduced over time suggesting they were not attending to these tasks in particular. Furthermore, the scoring requires a protractor and is highly detailed. Though this suggests a higher level of objective measure, in practice it ensures the tests are prohibitively time-consuming to mark within a battery such as this. Regarding the MABC-2, two tasks on MABC-2 were very easy for the majority of this typically developing sample. Children hit ceiling on the hopping and walking the line tasks which contribute to the Balance component. Therefore, this composite may not be an accurate measure of change over time. For future studies, alternative measures for visual-motor integration and balance should be identified.

One other point is necessary to discuss at this stage is the issue of measurement error and regression to the mean (Galton, 1886), in particular for this age group at this developmental stage. Feinstein (2015, p. 337) argues that relative changes in scores between the ages of five and ten years are vulnerable not only to measurement errors but also maturity. The reliability coefficients provided for the MABC-2 cover the range of ages between seven and ten years (see Table 2.10). Feinstein cites Jerrim and Vignoles work (2011; 2013) regarding social mobility and intervention studies. He suggests that caution should be observed when interpreting empirical evidence such as presented in this chapter, as measurement errors are not correlated across ages. Consequently, whilst the statistical significance of the findings regarding Aiming and Catching for the MABC-2 for the EMT group in particular appears robust, it must be replicated and with a much larger sample in order to be considered compelling.

4.8 Chapter Summary

In this chapter, evidence showing that musical training improves performance on the MABC-2 Aiming and Catching subtests is presented. This advantage of extra-curricular musical training in comparison to the standard school group music control group was driven specifically by performance on beanbag throwing task. This relies on the child's ability to judge distance, consider velocity, focus on a specific target and utilise their proprio-, intero- and extero- captive nervous systems. No other components from the MABC-2 or from the Beery (VMI, VP and MC) yielded significant results suggesting that extra-curricular musical training did not provide an advantage in comparison to general group music lessons for measures of fine motor abilities and for visual-motor integration, visual perception or motor coordination. The MABC-2 has not been previously used in musical training research whereas the Beery has. This study therefore contributes substantially to the field. The next chapter will explore how levels of musical learning impact on the socio-emotional wellbeing of children from the perspective of behavioural observations reported by their teachers and parents using the second edition of the Behavioural Assessment System for Children (BASC-2, Reynolds & Kamphaus, 2004).

Chapter Five – The Effects of Musical Learning on Socio-Emotional Wellbeing

5.1 Abstract

This study explores the impact of musical, physical and leisure activities on socio-emotional wellbeing, as reported by parents and school form teachers and measured using the Behavioural Assessment System for Children (Reynolds & Kamphaus, 2004). Group differences were apparent at Time 1. Teacher reports showed that the children receiving extra-curricular music training (EMT) showed lower levels of Internalising Problems, Aggression, Conduct Problems, Depression and Hyperactivity and significantly lower levels of Anxiety than a comparison group of children receiving statutory school music (SSM). Parents reported significantly lower levels of Aggression for the EMT group than the SSM group. Time spent doing musical, physical and leisure activities also had a significant effect on behaviour and wellbeing over time, though the changes seen in this study were not statistically significant due to the small sample size. However, this study contributes methodological and analytic procedures to the field and supports prior research suggesting musical activity is associated with pro-social behaviour.

5.2 Introduction

Hallam's (2010) review suggests strongly that 'the power of music' influences wellbeing. However, whilst much effort has focused on the cognitive benefits of musical learning, much of the empirical evidence regarding social and personal development has relied upon self-report. She further suggests that effects of music and/or musical learning on achievement may be mediated by increases in social and cultural capital. In order to understand the interrelationships between potential cause and effect, (e.g. of interventions and outcomes), it is important to consider the working definition of wellbeing. In the context of this study, an initial framework of wellbeing presented in the Good Childhood Report (Pople et al., 2015) is provided in Figure 5.1. Whilst the report does not consider musical learning per se, the model offers an interesting starting point to assess the current literature regarding the impact of musical learning within this field.

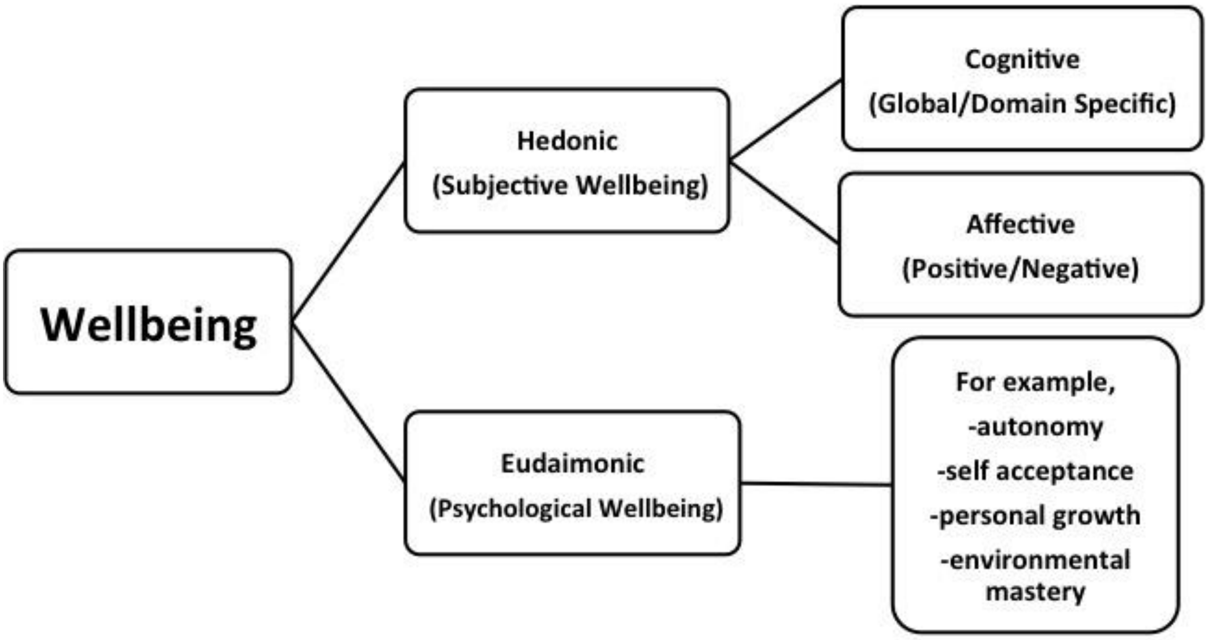


Figure 5.1. Simplification of Framework of Wellbeing, Good Childhood Report, (Pople et al., 2015)

This wellbeing framework illustrates an issue with the way in which wellbeing is reported in music studies, as the impact of musical activity does not fit neatly into a model separating hedonic and eudaimonic aspects. For example, Kokotsaki and Hallam (2007) showed that pupils had themselves noted an enhancement of 'life skills', indexed by an improved ability to both concentrate and relax during stressful periods. As this finding relied upon self-report, it can be categorised as a hedonic measure of wellbeing. However, when self-report tools and psychometric evaluations are compared, findings are less clear. For example, Schellenberg (2011) used the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT-2; Mayer et al., 2003), which is an ability-based measure and found no difference between his musically trained and non-trained comparisons groups. The MSCEIT-2 assesses cognitive-emotional ability, whereas Petrides, Niven and Mouskounti (2006) looked at the impact of the duration of musical training on emotional intelligence using the Trait Emotional Intelligence Questionnaire (TEIQue; Petrides & Furnham, 2004). This is a self-report tool measuring self-perception, or emotional self-efficacy, and Petrides *et al* (2006) reported a statistically significant effect of musical training on trait emotional intelligence.

In order to understand how musical learning has an effect (either direct or transferred) on socio-emotional wellbeing, there needs to be a mechanism which explains how this function of music might be beneficial to humans. Ormel et al's (1999) Social Production Function theory assumes that humans seek to optimise physical wellbeing and social wellbeing, and appears to be relevant to the notion of transfer effects with regard to musical learning. There are five instrumental goals by which wellbeing is achieved: stimulation, comfort, status, behavioural confirmation and affection. The authors suggest this theory updates the traditional positions of *telic need theory* (Maslow, 1970) and *autotelic activity theory* (Csikszentmihalyi, 1975), where these theories refer to motivation for human behaviour in relation to wellbeing. The former suggests a hierarchy of needs must be met, starting with the most basic (e.g. food and shelter) before moving towards higher level needs (i.e. self-actualisation). Meeting these needs could be described as extrinsic, whereas the autotelic activity theory refers to a more intrinsic motivation, in this case, a way of achieving a flow state that facilitates a sense of wellbeing.

The following section reviews the literature regarding music and wellbeing. This will be followed by the aims, exploratory research questions and results of this study. Finally, the discussion section will return to the above-mentioned models in order to attempt to situate the findings within the broad spectrum of work on wellbeing. As is illustrated below, wellbeing encompasses multiple aspects of transfer from the physical, to the psychological, to the concept of self.

5.3 Studies of Musical Activity, Learning and Wellbeing

One of the difficulties with understanding how the 'arts' affects wellbeing derives from the term 'arts' itself. Outcome measures for drama, dance and art are often combined or discussed as one entity. For example, Harland (2000) reported on the effects of provision for music, art, drama and dance across the U.K. Gathering data from 2269 pupils aged 15/16 years, based across 22 different schools, Harland used a mixed methodology, including questionnaires, classroom observations and case studies. Overall it showed that the greatest impact of engagement with the 'arts' was on the children's personal and social development. The positive outcomes attributed to arts participation included an increase in ability to utilise a broad range of affective expressions (such as excitement or sadness) as well as increased self-knowledge. Whilst Harland noted that the teachers were deeply committed to providing an enriched environment and that the programmes offered a general sense of positive reinforcement for the children, it is hard to know exactly which aspects of wellbeing were enhanced as a result of which arts participation in particular, especially as those who participated in arts reported experiencing a creative or affective therapeutic outlet in whichever medium. For music however, Harland did note that whilst there was an increase of parental involvement with some schools, at the same time there was a similarly sized reduction of parental involvement in others and social class mediated that change. It is important to discuss socio-economic status, provision (parent and school) and culture here because many of the studies contained within this review note that there was an effect of this.

5.3.1 Socio-Economic Status, Provision and Cultural Capital

Hallam (2010) refers to the effects of social class in her review, suggesting that the effects of musical learning on achievement may in part be mediated by an increase in what she describes as social and cultural capital. This view also encompasses Schellenberg's (2004, 2006) premise that musical training functions in a similar way to extra schooling and enrichment effects are an artefact of privilege. Hallam is referring to Bourdieu's description of social, cultural and economic capital in relation to the unfairness of social stratification, academic performance and the success of the elite. Hargreaves (1986) had previously suggested that the distinction between cognitive and affective responses to music is artificial. Instead he promoted the idea that social cognition refers to the interdependence between social and cognitive development. Koelsch (2014) suggests that musical group activities encourage individuals to share goals, attention and intentionality. These joint actions create a communal sense of 'we' due to music-evoked positive emotions. This emotional contagion in music, Koelsch suggests, has an evolutionary function to facilitate the seven socials Cs of contact, cognition, co-pathy, communication, coordination, cooperation, and cohesion.

5.3.2 Musical Self-Concept

In Hallam's 2010 review, she suggests several manifestations of the social benefits of musical learning. With regard to self-concept, she cites three studies. Whitwell (1977) reports that creative participation in College bands develops positive attitudes about oneself and improves self-image and self-awareness. Marshall (1978) found that involvement and achievement in school music helped to build positive self-image, and this helped motivation for academic learning for urban black middle school pupils (aged 11-14 years). Lillemyr (1983) studied 10-year-old children and found no correlation between students' interest in school music and general self-esteem, though she did find a relationship between teacher ratings and pupil self-perception. She suggested that this might reflect a problem with scale validity as the teacher ratings might be biased from the outset. Whilst a sense of musical achievement and success correlated positively with self-esteem, avoidance of failure also correlated negatively with this but did not transfer to general sense of self. For music, a sense of satisfaction and achievement specifically meant playing an instrument. In chapter one, it was apparent that Dweck (1986) had provided considerable evidence regarding the importance of self-concept in learning with regard to transfer effects. On an individual level, Elliott (1993) suggests that a goal-directed pleasurable reward system supports the acquisition of musical skills over time, promoting motivation to continue practising as the emerging musician learns the *autotelic* value (a meaning unto itself) of playing their instrument. However, Broh (2002) suggested that the increased contact time between music students, teachers, parents, and parents of the children's peers were socially beneficial and led to increased self-esteem, which in turn led to higher motivation and feelings of self-efficacy. With regard to a developing musical self-concept, Müllensiefen and colleagues (2015) suggests this may develop particularly during adolescence. This development of musical self-concept may in turn increase the personality trait of 'openness to experience' which has been associated with musicality more than other personality traits (Greenberg et al., 2015; Müllensiefen et al., 2014; Vuoskoski & Eerola, 2011). Personality and musicianship in adulthood is explored in chapters seven and eight as part of the qualitative investigation incorporated in this thesis.

5.3.3 Biomarkers of Wellbeing

Experimental studies have shown promising results physiological health benefits. For example, whilst it is known that piano playing exercises the heart as well as a brisk walk (Parr, 1985) and drum playing expends so much energy that it is a viable alternative to traditional exercise (De La Rue et al., 2013), it is singing, and group singing in particular that appears to be of particular benefit to general wellbeing (Clift & Hancox, 2001). Further studies demonstrated that singing in groups supported the immune system by increasing salivary immunoglobulin production (Clift et al., 2008). Positive emotions have been associated with a reduction of emotional stress due to an endocrine effect, such as lower cortisol levels. Koelsch (2014) reviewed the latest research into emotions and music. An important starting point for this review was that in psychology, emotions have been understood to be percepts (or pre-verbal subjective feelings, Koelsch, 2014, p. 171) of affect-generating systems in the brain that regulate and modulate emotional effector systems (i.e. interoceptive, proprioceptive and cutaneous exteroceptive information). Music research has been used to study experiences such as hedonic response, joy and fear, tension and violations of expectancy, consonance and dissonance and levels of conscious awareness. Naturally, these experiences are just as important, if not more so, for being musically generative as well as receptive. Three limbic areas are particularly important with regard to music and emotion. The amygdalae respond to emotional valence stimuli, activating appropriate approach-withdrawal mechanisms. The nucleus accumbens appears to regulate intensity between anticipation and experience with regard to primary rewards and dopamine availability. The hippocampus extends emotional capacity beyond reward into learning, memory and spatial orientation and is also implicated in stress response due to its role in regulating the hypothalamus-pituitary-adrenal axis. A recent study (Baste & Gadkari, 2014) of medical students in India showed how music can be used to reduce perceived stress levels, with pleasant music both increasing dopamine release in areas aforementioned, and stimulating the inferior frontal gyrus and Rolandic Operculum, areas implicated in working memory as well as in laryngeal and pharyngeal control (for speaking and singing). Interestingly, a different study suggested that listening to natural sounds (rippling water) was more effective (than preferred music or no music) at reducing stress hormone (cortisol and salivary alpha-amylase) responses (Thoma et al., 2013).

Juslin, Barradas and Eerola (2015) have similarly considered the mechanisms underlying of emotional reactions to music. They tested the multi-mechanism BRECVEMA framework. This acronym conveys eight mechanisms: Brain stem reflex, Rhythmic entrainment, Evaluative conditioning, Contagion, Visual imagery, Episodic memory, Musical expectancy, and Aesthetic judgement. They questioned the value of field data due to the insufficiency of experimental control. Instead during a series of four experiments using naturalistic music excerpts they were able to provide evidence that suggests these mechanisms are *"mainly hard-wired and subject to little effect of individual experience"* (Juslin, Barradas & Eerola, 2015, p. 300).

Fancourt, Ockelford and Belai (2014) provide a comprehensive systematic review of potential biomarkers of musical affect in the form of socio-emotional wellbeing at a neurophysiological level. Recent research reported that the creation and maintenance of social bonds through group singing can increase pain thresholds through endorphin release (Weinstein et al., 2015). Such group rituals, including singing and dancing, contribute to the idea that the function of music enabled some aspects of evolutionary adaptation (Weinstein et al., 2015). Whilst this avenue is of great interest, it is beyond the realms of this study.

This review of literature shows that there is ample evidence that music can effect emotions. The mechanisms for this appear to be measurable in terms of physiological change elicited by music. However, does musical learning enhance these mechanisms, and/or transfer behaviours to wellbeing observed in ways other than addressed by self-report questionnaires. In order to relate this research to children aged between seven and nine years, it is necessary to return to a study discussed in previous chapters.

5.3.4 Music as an intervention

Costa-Giomi (1999; 2004; 2005) discussed the co-development of motor and cognitive skills in a piano learning intervention programme for nine-year-old children. She reported that evidence for music-induced increases in socio-emotional wellbeing in children in this age group is sparse and equivocal. For example, some studies showed no effect (Legette, 1994) whilst others showed only limited effects (Lomen, 1970; Wamhoff, 1972). Therefore, in her three-year study, half of the participants of which were starting to learn piano, Costa-Giomi included the long form of the Coopersmith Self-Esteem Inventory (Coopersmith, 1981) in her battery of measures. Cost-Giomi (2004) reports that as the Group x Year analyses was close to significant ($p < .08$) she investigated further. This analyses showed that the musically trained group increased their measure of self-esteem significantly overall whilst the control group did not. This effect was not attributed to a particular time point though the trend was for experimental group scores to increase between years one and two. Costa-Giomi interpreted her results as evidence for the positive effect of the musical treatment, although she did suggest that multiple factors might have played a role in the self-esteem increases observed in the music group. Factors cited included the individual attention of experienced teachers, the opportunities to perform in front of peers and parents and the time spent practising, and interacting with family members who adopted a supervisory role. Costa-Giomi controlled for the effects of sex, family income, parental employment and family structure in her study and this gives weight to her claim that the process of participation was important. Responding to results obtained by Duke et al. (1997) showing that typical piano students were highly privileged with regard to education and provision of facilities, Costa-Giomi specifically targeted families with low incomes. This study also provided important evidence in showing that the time spent practising and rehearsing did not have a detrimental effect on attainment scores in other lessons such as maths and language. Instead music engagement worked in tandem with enhanced experiences in other areas of study to improve self-esteem. Whilst the piano lessons in the Costa-Giomi study were provided outside school lesson times, some schools offer individual music lessons within the school timetable and these do not appear to have a detrimental impact on academic skills such as reading (Zulauf, 1993). One study of children described as low-level ability and disaffected, reported improved self-reliance, and social adjustment, as well as a more positive attitude and increased social cohesion with classmates following a musical intervention (Spychiger et al., 1993).

In his 2004 study investigating the impact of musical learning on intelligence, Schellenberg used what he describes as a test of adaptive and maladaptive social behaviour (Behavioural Assessment System for Children; BASC, Reynolds and Kamphaus, 1992). Schellenberg included the parent report version of the BASC alongside standardised IQ tests with the aim of specifying which aspects of development are affected by musical learning. As with the other tests used in the study (the Wescher Intelligence Scale for Children, third edition, WISC-III; Wechsler, 1991, and the Kaufmann Test of Educational Achievement; Kaufman & Kaufman, 1985), the BASC was administered before and after the 36-week intervention study including 132 six-year-old children. Participants were randomly assigned to one of four intervention groups of either standard keyboard lesson or Kodály voice lessons (maximum of six children per group) for one year, or drama lessons, or received no intervention. All four groups showed significant increases in IQ scores although the magnitude of change was different between musical training and control groups (see chapter three). Schellenberg reported significant improvements in adaptive social behaviours in the active control group (drama lessons) only and no change in the musical training or the no intervention control group. However, he does not report which specific scales or composites of scales were affected. Given Schellenberg's claim that musical instruction transfers to cognitive development more than drama instruction which he describes *"is not an extracurricular activity associated with notable increases in intellectual development"* (Schellenberg, 2004, p. 512), it is surprising that he does not mention the fact that his results failed to reveal any effects of extra-curricular music lessons on social behaviour, especially as the musical training took place in small groups rather than individual one-to-one tuition.

Schellenberg released two later reports investigating musical learning and cognitive and emotional intelligence. The 2011 study focused on undergraduate college students and claimed to measure emotional intelligence (EI) as a trait rather than as ability. However, Schellenberg used the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT-2; Mayer et al., 2003), which is an ability-based measure. The findings from the study showed that whilst the musically trained group had higher IQ scores, they did not have higher EI scores, leading Schellenberg to conclude that *"non-musical associations with musical training are restricted to measures of cognitive ability"* (Schellenberg, 2011, p. 190). Petrides (2011) traced the roots of EI back to Thorndike's notions of social intelligences, which in turn informed Gardner's (1983) theories of multiple intelligences, specifically via the difference between interpersonal and intrapersonal intelligence (Gardner, 1999). Petrides describes the difference between the construct of EI either as a trait, or ability. Trait EI (or emotional self-efficacy) concerns a cluster of self-perceptions associated with personality and is measured via self-report. In comparison, Ability EI (or cognitive-emotional ability) is related to cognitive abilities, which are measured using maximum performance tests. Schellenberg's use of the MSCEIT-2 brings the interpretation of his results into question, as the tool of measurement is not appropriate for the construct in this situation. In contrast, Petrides, Niven and Mouskounti (2006) used a trait measure of EI (the Trait Emotional Intelligence Questionnaire, Petrides, 2009; Petrides, Pita & Kokkinaki, 2007) and found that the duration of musical training was positively correlated with EI trait scores.

In further exploration of musical training and emotional intelligence, Schellenberg & Mankarious (2012) focused on children aged seven to eight years old (N=60). They hypothesised that musical instrument learning might predict improved emotional abilities. The authors do not specify what they mean by emotional abilities or how this might relate to musical abilities, other than suggesting that music and perception of emotions, feelings and expressions are inextricably linked (Hunter & Schellenberg, 2010; Juslin and Västfjäll, 2008). As these concepts of affect rely on continuums of arousal and valence, it seems strange that they chose to use the Test of Emotional Comprehension (TEC; Pons & Harris, 2000), which does not tap the variables motivating the study. However the authors argued that this test was chosen because it measures emotional understanding, which might also improve with musical training. Musically trained participants (MT) had received at least eight months of musical training and were either currently continuing these or had stopped less than one year prior to testing. The control group had received group music lessons in school but no individual music training. The study also sought to test for correlations between intelligence and emotional understanding. Importantly, the MT participants had a significantly higher IQ than the untrained control group (MT mean =119, Control mean=104, standard deviations for both groups was 16 points). The musically trained group also scored significantly higher on vocabulary and matrix reasoning subtests. Multiple regression analyses showed that when examined jointly, the variables of music lessons, family income, age and non-musical activities accounted for 35.6% of the total variance in IQ. In the model, music lessons uniquely accounted for 14.1% of the variance in IQ scores. In comparison, family income had accounted for 9.9% whilst age and non-musical activities did not contribute significantly in isolation. For the TEC, the musically trained group scored significantly higher than the control group and musical training uniquely accounted for 6.67% of the variance in TEC scores. IQ and TEC scores were positively correlated (r = .54, p < .001). Subsequent multiple regression analyses, whereby musical training was dummy coded, on which TEC scores were predicted as a function of IQ, found that IQ contributed 18.2% variance, and music training did not contribute significantly to this model whether treated as a continuous variable (months training) or not. Overall, Schellenberg and Mankarious state the findings suggested *"high-functioning children* [are] *more likely than other children to take music lessons"* (Schellenberg & Mankarious, 2012, p. 889).

A positive association between musical training and performance on the TEC did suggest pre-existing differences, although the significance was only just over one standard deviation difference in IQ score across the groups. The authors suggest three explanations. Firstly, that high-functioning environmentally privileged children choose to take musical instrument lessons. Secondly, that transfer between musical training and emotional understanding occurs via the auditory domain that the TEC could not demonstrate, as it is visual and language-based. Thirdly, that musical training which takes place on an individual one-to-one basis and requires solitary practice does not harness the social function of music because it does not take place in a social context (Kirschner & Tomasello, 2010).

5.3.5 Overview

The social aspects of music can be manifested in many ways. For example, soothing a crying baby with the musical contours of Motherese (also Parentese or Singese) is a potent combination of vocal communications (Parncutt, 2009; Trehub et al., 1993). Extending to a larger arena, emotions have also been found to transfer from performers to audiences during musical performance (Juslin & Laukka, 2003; Marin & Perry, 1999) and this illustrates how performers and composers can manipulate the emotions of listeners. Huron (2006) suggests there are innate reward systems that are activated when our predictions about upcoming musical events are correctly anticipated. Indeed there are substantial overlaps in the psychoacoustic cues that convey emotions in music and human vocalisations. For example, musical and vocal expressions of fear are characterised by similarities in speed (tempo and speech rate), in fundamental frequency patterns and pitch contour, in micro-structural irregularity, and in low intensity and little high frequency energy (Binder et al., 2000). Patel (2011) refers to the distinct and domain-specific, yet integrated system as the 'syntactic architecture' of musical and linguistic sequencing.

Koelsch (2014) presents his seven social Cs explicating the potency of music-evoked emotions with regard to evolutionary survival mechanisms. He begins with social contact as a basic human need, citing the deleterious effects of health and life expectancy of social isolation as the opposite force. Social cognition follows, that is attempting to understand the intentions' of others use of music. Here he illustrates his point with the transfer of socio-cognitive skills using music therapy for individuals with, for example, co-morbid aspects of Autism Spectrum Disorder (ASD) such as alexithymia (Allen & Heaton, 2010). Next he suggests co-pathy as a function social empathy, reducing conflicts and enabling group cohesion. Fourth, he cites communication as a primary, sometimes non-verbal skill enhancing other aspects of social bonding. Fifth he suggests coordination, not just of one's own body but also with each other, synchronising movements to form a sense of group identity. This leads to his penultimate C; cooperation, implying shared goals and intentions, inspiring trust and fostering future good relations. Finally, social cohesion encapsulates the human need to belong, a strong motivation for personal attachments and increasing life expectancy. For each of these, Koelsch provides evidence of the neural correlates co-opting music and emotion, ultimately presenting a physiological example in that 'happy' music triggers zygomatic (cheek bone) muscle response whilst 'sad' music activates the corrugator muscles (brow bone). In fact, motor response to rhythmical sound is posited to also have strong survival coupling, gating between behaviourally antagonistic approach and withdrawal systems, with cerebral asymmetry diverging to the left for positive emotional responses eliciting an approach reaction, and a right hemisphere negative response for withdrawal (Blood & Zatorre, 2001; Schmidt & Trainor, 2001). Asymmetry in these areas in the left premotor and inferior parietal cerebrum and right anterior cerebellum developed over time is thought to be a function of goal-orientated action dynamics associated with emotional and musical communication (Rizzolatti, Fogassi & Gallese, 2001; Williamon & Davidson, 2002).

An alternative, or perhaps complimentary theory is offered by Overy and Molna-Szakac (2009). They posit a Shared Affective Motion Experience (SAME) model that suggests that the human mirror neuron system enables both the generator and receiver of music to share the experience in an embodied way. They suggest the human mirror neuron system plays an essential role as the mediator between the exogenous and endogenous worlds. The SAME model proposes the anterior insula acts as a neural conduit between the human mirror neuron system and the limbic system assisting in an emotional contagion system (Carr et al., 2003; de Waal, 2008). The human mirror neuron system is thought to promote efficiency through the minimisation of error prediction by observing which cortical levels will need to be engaged during movements (Kilner, Friston & Frith, 2007). This in turn is thought to underlie the mechanisms by which automaticity of actions associated with musical performance enables further neural resources to be recruited for dynamic attendance (Large, 2008).

Given the paucity of evidence of the effects of musical learning on socio-emotional wellbeing, the aim of the study described in this chapter was to explore current concepts of wellbeing within an ecologically valid framework in order to ascertain the effects of musical training on children in comparison to other activities.

5.4 Hypotheses and Research Design

In order to find a balance between objective and subjective measures of socio-emotional wellbeing and to be able to include the social aspect of any observed change, the perspective of measurement altered from the children to the teachers and parents in this study. The Behavioural Assessment System for Children (BASC-2; Reynolds & Kamphaus, 2004) was used for parent and teacher reports collected and at the start of the school year and again at the end.

This study was exploratory in nature and the hypotheses were rather more open research questions than specific predictions. The aim was to investigate psychological wellbeing from a eudaimonic rather than hedonic perspective. Rather than relying on self-report, the study sought to understand whether parents and teachers noticed any differences between children receiving extra-curricular music training (EMT) in comparison with statutory school music (SSM) over time. Furthermore, the data gathered from parents enabled a direct comparison between the amount of time children spent doing other activities, such as sports and/or leisure, to music. Theoretically, it was considered that the Shared Affective Motion Experience (SAME) model of human mirror neuron system integrative functioning might be the mechanism by which the Social Production Function theory first utilises music to combine exogenous and endogenous musicality at various levels of social communication.

5.5 Methods, Measures and Participants

A full description of the sample is described in chapter two. The participants for the extracurricular music training (EMT) group and the statutory school music (SSM) group remain the same as the previous chapters. The BASC-2 (Reynolds & Kamphaus, 2004; outlined in detail in Section 2.2.6) contains descriptors of behaviour that the respondent rates on a four-point scale of frequency (Never, Sometimes, Often and Almost Always) and takes 10-20 minutes to complete. The results of the parent and teacher reports will be presented separately in the results before being considered together in the discussion that follows.

5.6 Results

5.6.1 Teacher Report Results for the Behavioural Assessment System for Children (2nd Edition, Reynolds, & Kamphaus, 2004)

Attrition was a problem with the teacher reports. Although form teachers initially said they would take part, 13 of the 38 (five for SSM group, eight for EMT group) did not return the BASC-2 forms at either Time 1 or Time 2.

Levene's test of homogeneity found between group differences at Time 1 for the composite scale of Internalising Problems (p = .015), and the clinical scales of Anxiety (p = .001) and Somatisation (p <. 001). These were subsequently analysed for change over time between groups using the non-parametric Wilcoxon's Sign Rank Tests (WSRT) with a split file by music group function. Within group issues of normality were found for the clinical scales of Aggression, Attention Problems, Conduct Problems, Somatisation and Withdrawal. Two participants' (P25 and P27) repeatedly appeared with outlying data. As the data points were ± 3 SD from the mean group scores these were removed from the analyses of those scales (see Table 5.1). P25 had been assessed for Asperger's but did not meet all the criteria for diagnoses. P27 received a diagnosis of ADHD during the school year. However, the issue of non-normality within groups increased as a result of removing those data points. One other outlier data point was removed for one participant (P5) for Time 2 as teacher report scale of Somatisation as the score exceeded ± 3SD of the mean scores. As a consequence of not meeting the assumptions required for parametric data analyses, a non-parametric alternative, WSRT was used as well as independent t tests, which are robust to issues of distribution, to analyse these scales.

The standardised scores are similar to percentiles, although in the case of clinical scales scores above 70 are described in the BASC-2 manual as cause for concern, requiring further investigation. Ideally, the direction of change would therefore be for these scores to reduce to somewhere in the typical range. In contrast, for the adaptive composite and scales the cause for concern delineation is scores under 30. In the case of adaptive scales, an increased score is desirable.

Table 5.2 display the values for the teacher reports for Time 1 and Time 2 for the composite scores for the overall measure, the Behavioural Symptoms Index, and for the other composites of Externalising Problems, Internalising Problems, and School Problems. Table 5.2 also includes missing values data for transparency.

Due to the nature of scoring the BASC-2, if two items are either not marked or mismarked (for example if a teacher write “somewhere in between never and sometimes”) then this scale cannot be used. This is problematic as if those scales form part of the composite, that composite can then not be reported (see chapter two).

Table 5.3 illustrates the clinical scale scores, and Table 5.4 the adaptive scale scores and the overall adaptive composite scores for Time 1 and Time 2 for the teacher reports.

Change over time was calculated (T2-T1) then compared between groups using independent *t* tests. RM ANOVA analyses were also carried out with no significant findings. No significant differences between groups were found for the composite scores of the overall Behavioural Symptoms Index (BSI), Externalising Problems, Internalising Problems, School Problems or the non-clinical composite of Adaptive Skills (all $p > .1$). Similarly, no significant differences between groups were found for adaptive scales of Adaptability, Functional Communications, Leadership, Social Skills and Study Skills, and for the clinical scales of Aggression, Anxiety, Attention Problems, Atypicality, Conduct Problems, Depression, Hyperactivity, Learning Problems, Somatisation and Withdrawal (all $p > .1$).

Table 5.1. Removed Outlying Standardised Scores for Teacher Report Behavioural Assessment System for Children (2nd Edition, Reynolds & Kamphaus, 2004)

Scale	Aggression		Atypicality		Conduct Problems		Hyperactivity		Externalising Problems		Behavioural Symptoms Index		Somatisation	
Participant ID	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
25	79	68	93	74	66	66	77	62	-	-	-	-	51	59
27	49	74	57	90	50	73	56	80	52	77	54	81	-	-

Table 5.2. Descriptive Statistics for the Clinical Composite Scores for Teacher Report Behavioural Assessment System for Children (2nd Edition, Reynolds & Kamphaus, 2004)

		Externalising Problems Composite		Internalising Problems Composite		School Problems Composite		Behavioural Symptoms Index	
Music Group		Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
SSM	Missing	3	3	3	3	3	3	3	5
	Mean	49.44	53.69	54.56	57.69	48.00	48.25	49.13	52.43
	Std. Deviation	9.31	13.74	16.75	13.08	6.35	7.32	8.53	13.21
EMT	Missing	9	9	8	8	8	8	9	9
	Mean	46.20	44.20	42.82	47.36	47.64	46.09	45.60	44.30
	Std. Deviation	10.55	10.76	4.05	10.52	9.09	10.87	9.49	7.42

Table 5.3. Descriptive Statistics for Clinical Scale Scores for the Teacher Report Behavioural Assessment System for Children (2nd Edition, Reynolds & Kamphaus, 2004)

	Clinical Scale	Aggression		Anxiety		Attention Problems		Atypicality		Conduct Problems		Depression		Hyperactivity		Learning Problems		Somatisation		Withdrawal	
	Music Group	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
SSM	Missing N	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	5
	Mean	49.00	54.44	53.44	57.00	45.44	46.63	49.19	52.19	50.94	52.38	54.44	57.75	49.38	52.81	51.38	49.88	49.73	50.15	47.25	49.93
	Std. Deviation	9.04	15.71	12.56	11.31	8.09	7.86	7.72	12.93	9.86	12.53	11.05	12.11	8.64	11.75	7.23	8.04	8.8	9.89	6.78	6.60
EMT	Missing N	10	10	8	8	8	8	10	10	10	10	8	9	10	9	8	8	9	9	8	8
	Mean	43.33	44.67	42.64	48.00	47.00	44.82	45.56	44.22	43.78	44.33	46.82	46.60	43.00	48.80	48.55	48.82	43.00	48.50	49.27	47.64
	Std. Deviation M	43.33	2.00	4.01	9.88	8.59	9.19	5.39	2.33	2.22	1.66	Í6.31	6.88	2.55	11.36	9.44	11.40	1.414	7.41	13.36	11.10

Table 5.4. Descriptive Statistics for Adaptive Composite and Scale Scores for the Teacher Report Behavioural Assessment System for Children (2nd Edition, Reynolds & Kamphaus, 2004)

Adaptive Scale		Adaptive Skills Composite		Adaptability Scale		Functional Communications Scale		Leadership Scale		Social Skills Scale		Study Skills Scale	
Music Group		Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
SSM	Missing N	3	4	3	4	3	3	3	3	3	3	3	3
	Mean	47.44	46.67	39.38	41.07	45.44	45.13	49.00	50.06	52.50	52.19	45.25	45.88
	Std. Deviation	5.16	6.79	4.35	7.12	6.11	8.77	6.12	8.64	9.13	10.27	5.52	8.52
EMT	Missing N	8	8	8	8	8	8	8	8	8	8	8	8
	Mean	47.00	49.64	42.18	42.64	45.36	45.55	48.09	51.91	49.55	51.91	44.73	46.45
	Std. Deviation	8.26	9.98	6.91	8.15	7.51	8.44	9.26	11.42	12.746	13.51	7.85	9.34

Table 5.5. Wilcoxon Ranked Signed Test P Values for the Composites of the Teacher Report Behavioural Assessment System for Children (2nd Edition, Reynolds & Kamphaus, 2004)

Music Group	Externalising Problems Composite	Internalising Problems Composite	School Problems Composite	Adaptive Behaviours Composite	Overall Behavioural Symptoms Composite
SSM	$p = .08$	$p = .53$	$p = .63$	$p = .61$	$p = .21$
EMT	$p = .74$	$p = .06$	$p = .08$	$p = .13$	$p = .18$

Table 5.6. Wilcoxon Ranked Signed Test P Values for the Clinical Scales of the Teacher Report Behavioural Assessment System for Children (2nd Edition, Reynolds & Kamphaus, 2004)

Music Group	Aggression	Attention Problems	Anxiety	Atypicality	Conduct Problems	Depression	Hyperactivity	Learning Problems	Somatisation	Withdrawal
SSM	$p = .06$	$p = .35$	$p = .59$	$p = .30$	$p = .75$	$p = .36$	$p = .09$	$p = .27$	$p = .39$	$p = .12$
EMT	$p = .04$	$p = .06$	$p = .15$	$p = .34$	$p = .26$	$p = .73$	$p = .08$	$p = .76$	$p = .04$	$p = .65$

Table 5.7. Systematic Differences Between Groups for Teacher Report Clinical Scales of the Behavioural Assessment System for Children (2nd Edition, Reynolds & Kamphaus, 2004)

Clinical Scale	Aggression	Anxiety	Conduct Problems	Depression	Hyperactivity
Music Group	Equal Variance Not Assumed	Equal Variance Not Assumed	Equal Variance Not Assumed	Equal Variance Assumed	Equal Variance Not Assumed
t value	$t(15.29) = 2.78$	$t(23.54) = 3.31$	$t(16.94) = 2.87$	$t(24) = 2.70$	$t(17.52) = 2.81$
p value	$p = .014$	$p = .003$*	$p = .011$	$p = .013$	$p = .012$
Mean Difference between groups	10.55	15.30	11.18	14.31	10.11
Confidence Interval (Lower–Upper)	2.48–18.62	5.75–24.86	2.96–19.40	3.37–25.26	2.54–17.69

*$\alpha p/9$=.005 significance level

These calculations were repeated using the non-parametric WRST (Split File for Music Groups). No significant change between Time 1 and Time 2 were found for the BASC-2 teacher report composite scores (see Table 5.5) or clinical scales (see Table 5.6). No significant change between Time 1 and Time 2 were found for the BASC-2 teacher report adaptive scales using WRST. All $p > .2$ so these values are not reported here.

To approach the analyses in a different way as this was an exploratory study, the overall difference between groups was calculated by summing Time 1 and Time 2 scores and dividing by two to reach an average as a way of maintaining the ecological validity of the scores (i.e. that the averages were akin to percentiles, rather than observing more abstract differences between scores).

For the composite scores, the groups only differed systematically for Internalising Problems $t(25) = 2.61$, $p = .015$. Exploring the composite of Internalising Problems further, teachers reported the EMT group scored lower than the SSM group by an overall mean of 16.91 standardised points. The group mean for SSM at Time 1 was 54.56 (SD 16.75) and Time 2, 57.69 (SD 13.08) so the average was 56.13. For EMT, the group mean at Time 1 was 42.82 (SD 4.05), and at Time 2, 47.36 (SD 10.52), the average was 45.09. The difference between groups was 11.04 standardised points and the SD for the average difference for EMT was 8.09. The confidence intervals (CI) did not cross zero suggesting this is a systematic difference between groups (CI 3.56–30.25). However, when corrected for multiple comparisons (αp/4 teacher report clinical composites $p = .0125$), the result is just above the level required for statistical significance. All other composite scores were $p > .1$.

For the scales scores, no significant overall systematic differences were found between groups for the adaptive scales of Adaptability, Functional Communications, Leadership Skills, Social Skills or Study Skills. For the clinical scales, teachers reported no overall systematic differences for Attention Problems, Learning Problems, Somatisation or Withdrawal between groups. However, significance differences were revealed for the remaining scales as reported in Table 5.7. The only clinical scale, which reaches new *αp* significance level, is Anxiety. The group mean for SSM at Time 1 was 53.44 (SD 12.56) and Time 2, 57.00 (SD 11.31) so the overall average was 55.22. For EMT, the Time 1 average was 42.64 (SD 4.01), and the Time 2 average was 48.00 (SD 9.88). Therefore the overall average was 45.32. The difference between groups was 9.9 and the SD for the average difference for EMT was 7.98. However, the confidence intervals (CI) did cross zero suggesting this difference between groups for the scale of Anxiety was not systematic.

5.6.2 Parent Report Results for the Behavioural Assessment System for Children (2^{nd} Edition, Reynolds & Kamphaus, 2004)

Thirty-one out of the thirty-eight parents returned the BASC-2 forms. The attrition rate for the SSM group was the same as for the teacher report (five parent report forms were not returned) but less for the EMT group where only two sets of forms (Time 1 and Time 2) were not returned.

Independent *t* tests found only one scale with significant differences between groups at Time 1, Aggression $t(32) = 3.51$, $p = .001$ (equal variance within groups assumed), with a mean difference between groups of 7.33 standardised points (CI ranging 3.07–11.59). This scale was subsequently analysed using WSRT.

Although no significant outlier scores were found, within group variance violated assumptions of normality (figures for KS/SW provided in brackets) for EMT group for Externalising Problems (p = .026/.008) and Leadership (p = .038/.042). For the SSM group, the scale of Social Skills violated assumptions of normality (p = .015/.042). Consequently, both parametric and non-parametric equivalent techniques were used.

Table 5.8. Parent Report Group Means at Time 1 and Time 2 for Adaptive Composite and Scales of the Behavioural Assessment System for Children (2nd Edition, Reynolds & Kamphaus, 2004)

		Adaptive Skills Composite		Acts of Daily Living Scale		Adaptability Scale		Functional Communications Scale		Leadership Scale		Social Skills Scale	
Music Group		Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
SSM	Missing N	5	7	4	7	5	7	4	6	4	6	4	6
	Mean	41.71	40.67	38	35.50	40.43	38.58	39.73	39.69	46.87	45.62	46.40	47.46
	Std. Deviation	6.57	9.75	6.43	7.96	9.49	10.73	7.12	8.99	6.38	7.10	9.31	10.74
EMT	Missing N	2	2	0	1	2	2	0	1	0	2	0	1
	Mean	43.34	42.59	37.21	35.11	43.29	40.88	38.37	38.89	45.79	47.71	50.26	51.11
	Std. Deviation	5.24	8.56	6.22	7.94	5.44	7.47	7.95	9.61	7.95	7.12	7.42	9.40

Table 5.9. Parent Report Group Means at Time 1 and Time 2 for Clinical Composite and Scales of the Behavioural Assessment System for Children (2nd Edition, Reynolds & Kamphaus, 2004)

		Externalising Problems Composite		Aggression Scale		Attention Problems Scale		Conduct Problems Scale		Depression Scale		Hyperactivity Scale		Somatisation Scale	
Music Group		Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
SSM	Missing N	4	6	4	6	4	6	4	6	4	6	4	6	4	6
	Mean	52.27	52.46	56.33	53.00	56.60	56.85	51.07	53.31	54.93	54.08	49.13	50.08	49.73	50.15
	Std. Deviation	6.32	8.11	5.89	6.72	9.97	10.95	6.77	9.14	7.12	11.44	7.03	9.84	8.81	9.90
EMT	Missing N	1	2	0	2	0	1	0	1	0	1	1	2	0	1
	Mean	48.06	49.65	49.00	49.35	52.53	51.89	48.11	51.22	53.11	53.78	46.78	49.35	46.74	45.56
	Std. Deviation	7.09	11.24	6.18	7.04	10.88	13.03	7.95	10.07	7.12	8.76	7.06	9.51	6.74	8.47

Tables 5.8 and 5.9 show the group mean data for the parent report composites and scales at Time 1 and Time 2.

Change over time was calculated (T2–T1) then compared between groups using independent *t* tests. No significant differences between groups were found for the composite scores of Externalising Problems, or the non-clinical composite of Adaptive Skills. Similarly, for the adaptive scales of Acts of Daily Living, Adaptability, Functional Communications, Leadership and Social Skills and for the clinical scales of Aggression, Attention Problems, Conduct Problems, Depression, Hyperactivity, and Somatisation, parents reported no significant differences between groups over time. Similarly WRST revealed no differences over time except for one clinical scale for EMT whose parents reported an increased score on the scale of Conduct Problems $Z = -2.197$, $p = .03$. However, when corrected for multiple comparisons ($\alpha p/6$ parent report clinical scales $p = .008$) this finding does not remain significant.

Regarding parentally reported overall differences between group (T1+T2/2 Mean) analysed using independent *t* tests, for the clinical scales no significant differences were found for the composite of Externalising Problems, or for the scales of Attention Problems, Conduct Problems, Depression, Hyperactivity or Somatisation. The only scale where parents reported a systematic difference between groups was for Aggression $t(27) = 2.49$, $p = .02$ equal variance assumed, mean difference = 8.41 standardised points, confidence interval ranged between 1.47 and 15.36. The SD for SSM (8.30), and for EMT (9.41), a difference of only 1 SD, and when corrected for multiple comparison ($\alpha p/6$ parent report clinical scales $p=.008$) this finding does not remain significant.

5.7 Discussion

This study explored the use of the BASC-2 as a measure of the effects of musical learning on the socio-emotional wellbeing of children learning musical instruments, either in large groups at school (SSM) or as extra-curricular musical tuition (EMT). The research design explored potential changes through the perspectives of the form teachers (rather than music tutors) and the participants' parents. The design was a pre/post repeated measures quasi-experiment.

Regarding changes in behaviours over the time period of this quasi-experiment, neither teachers nor parents reported any significant positive or negative changes for the composites or scales of the BASC-2. Whilst these results appeared disappointingly uninformative initially, the figures did suggest some systematic differences between groups. An analysis of the average scores of both time points was conducted suggesting systematic groups differences. For example, the teachers reported that children in the EMT group scored significantly lower than the children in the SSM group for the composite of Internalising Problems (Mean difference between groups (MDiff) = 19.91), as well as for the clinical scales of Aggression (MDiff = 10.55), Anxiety (MDiff = 15.30), Conduct Problems (MDiff = 11.18), Depression (MDiff = 14.31), and Hyperactivity (MDiff = 10.1). However, once the statistics had been corrected for multiple comparisons, only the composite of Internalising Problems and the scale of Anxiety remained significantly lower for the EMT group in comparison to the SSM group. However, in reality the range of scores for both groups was well within normal parameters as described in the BASC-2.

The teachers did not report significant systematic differences between EMT and SSM music groups overall for the clinical or adaptive composites or scales. The only scale where parents reported a systematic difference between groups was for Aggression on which the EMT group scored significantly lower than the SSM group (MDiff = 8.41). Whilst this finding did not withstand correction for multiple comparisons, the trend towards significance supports other studies suggesting an effect of musical activity in promoting pro-social behaviours (Croom, 2015; Hille & Schupp, 2014; Kirschner & Tomasello, 2010; Moore, Burland & Davidson, 2003; Rabinowitch, Cross & Burnard, 2012), though the methodologies and age groups involved in those studies are very different.

It is important to note that this sample includes children in mainstream education in the U.K. It was therefore unsurprising that the BASC-2 scores suggested normal behaviours over the experimental period for most of the participants.

5.8 Limitations

There are some methodological limitations in this study, as with the studies in chapter three and four. One of these issues is that the active control group was also receiving group music lessons. It may be that group effects would only emerge in a study that included a comparison group who were deprived of musical enrichment, although such a study would be unethical. It is also conceivable that the small sample size (exacerbated by the lack of parent report returns at Time 2) does not provide enough statistical power for a significant effect to emerge. However, it is noteworthy that occasional outlying data points did reflect issues that occurred for the participants during this experimental period. This suggests that the BASC-2 has satisfactory internal validity and is sensitive to change over the time period. However, replication and refinement of this study would be necessary in order to advance hypotheses regarding the nature of these activities and how they affect results as co-occurring active variables. It would be possible to choose some scales rather than all. This would reduce the participant demand and also the difficulty with correcting alpha *p* for multiple comparisons. Alternatively, a different measure could be employed which would reflect the socio-emotional wellbeing of the participants more subjectively (see Figure 1.1). However, as the literature reviewed in this chapter suggests, that approach also has limitations.

5.9 Chapter Summary

Using the BASC-2, this study considered the impact of musical learning on the socio-emotional wellbeing of children aged between seven and nine from the perspective of their parents and teachers. No evidence was found to support a hypothesis that extra-curricular musical learning in comparison to statutory school group music lesson advantageously affected the socio-emotional wellbeing of children in this study. Whilst group means did not change significantly over the experimental period, individual differences in scores suggested that the BASC-2 had internal validity and was sensitive to change over time. In order to explore the individual differences that were apparent in the data for the study presented in this chapter, the next chapter presents case studies of two participants whose experiences of the same music teacher, instrument and school demonstrates the very different behavioural outcomes possible due to developmental differences.

Chapter 6 – Case Study: Investigating the Impact of Individual Differences and Special Educational Needs on the Process of Learning a Musical Instrument

6.1 Abstract

This chapter presents and compares the quantitative and qualitative data of two children at the same school who had just begun to learn the tenor horn in shared lessons. The case study describes Charlie, a child with an atypical developmental trajectory and Michelle, his apparently typically developing peer. Both children were above average in intelligence and musical aptitude. During the year Charlie received a diagnosis suggesting co-morbid Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), visual and auditory processing difficulties as well as dyslexia and dyspraxia[16]. The results of the measures used in chapters three, four and five, and also between reports from the parent, form teacher and horn tutor were inconsistent with some aspects of Charlie's complex diagnosis. The inconsistencies suggested that problems with concentration and attention impacted Charlie's learning and behaviour most prominently. Despite Charlie's difficulties staying focused on tasks in lessons, he progressed and played in the school music festival at the end of the year with Michelle who had made more consistent progress. His musical learning seemed to provide him with an opportunity to develop his own agency and identity and this may be in part due to his own interest and therefore motivation to progress, but also the support of his tutor and his own family.

6.2 Introduction

Karkou and Glasman (2004) suggested that interest in art-based learning has been re-ignited as prevention is now regarded as more efficacious than intervention. As evidence based practice has become a necessity of funding (as well as good practice), the lack of consensus regarding operational definitions of wellbeing have led to much

[16] Dyspraxia was the term reported by the mother. Though the term Developmental Coordination Disorder is preferred in psychology, as the author was unable to see the report, the term used by the mother is reported here.

research being based on subjective experience and self-reports. This has resulted in various commentary and reports simultaneously criticising the process yet suggesting evidence (to varying degrees) of improved subjective wellbeing which have so far contributed to the intention, but not the delivery of the provision of music for all (see e.g. Hallam, 2010; Harland et al., 2000; Henley, 2011; Kokotsaki & Hallam, 2007). This is important because evidence based practice often relies on the gold standard of randomised control trials (RCTs) and these have not provided robust or unequivocal evidence on the efficacy of musical interventions (see e.g. Bilhartz, Bruhn & Olson, 1999; Costa-Giomi, 1999; 2004; 2005; Mehr et al., 2013). Chapter five presented an alternative framework of socio-emotional eudaimonic wellbeing by considering the perspectives of the stakeholders, i.e. the parents and teachers using the BASC-2 (Reynolds & Kamphaus, 2004). The results of that study provided evidence that the BASC-2 is a sensitive measure of individual differences in children in this age range over one academic year. Part of the agreement with the participants' parents was that they would be given individual reports based on the data collected over the year. In addition to informing the parents' understanding of their children's progress, the compilations of these reports provided detailed information about the learning experiences of the children. The analyses of the data in chapter five led to an alternative research strategy inspired by McPherson (2005; 2006); that of considering learning trajectory profiles for these children in the context of their group and the active control group in order to understand how musical learning was impacting on their cognitive, behavioural and socio-emotional wellbeing.

McPhersons' (2005) study of musical learning in 157 seven to nine year old children suggested large individual differences regarding strategies related to success in five different measures of musicality. His study highlights some important distinctions between measures of musical learning and their differing patterns of development, or acquisition. For example, between the first and second year, the children's ability to perform rehearsed music increased on average by 99% (M=12.95, SD=7.22) with only 1% remaining at the same level and 0% decreasing in this ability. Between the second and third year, 93% (M=10.78, SD=8.62) increased, 6% remained the same and 1% decreased in performing rehearsed music. For the skills of sight-reading, between the first and second year 87% improved (M=13.24, SD=10.83) but 8% decreased in this ability and 5% remained at the same level. Between the second and third year, 78% increased their sight-reading ability, (M=8.74, SD=11.88), 2% remained the same and 20% decreased in their measure of sight-reading performance. For playing by memory, 89%

increased between the first and second year (M=14.88, SD=13.63) with 0% remaining the same and 11% decreasing over this time. Between the second and third years, 73% continued to increase this ability (playing from memory, M=8.76, SD=14.33) whilst 4% remained at the same level and 23% decreased in this ability. For playing by ear, during the first measured period 83% increased (M=12.76, SD=15.64) whereas 1% remained the same and 16% decreased. Between the second and third year, 78% increased their ability to play by ear, whereas only 1% remained the same and 21% decreased in this ability. In the measure of musical improvisation, 80% increased this ability between the first and second year (M=9.4, SD=11.99) whilst seven remained the same level and 13% decreased. Between the second and third year however, only 54% increased the ability (M=2.63, SD=14.01) whereas 8% remained level and 38% decreased in their improvisational skills.

With regard to playing from memory, McPherson identified three strategies. The first he suggested was conceptual and could involve either imagining a visual contour of the melody, or a repetitive chanting of either the rhythmical or melodic aspects. The second strategy he called kinesthetic, whereby the child chanted rhythmically or melodically whilst roughly moving their fingers in associations but without great awareness of doing so. The third approach, which he describes as both musical and optimal, integrates the mental approach with a high level of visual, auditory and kinesthetic awareness, or embodiment.

McPherson continues that playing by ear appeared to be marked along similar conceptual (auditory or visual), kinesthetic and musical approaches although he does not discuss improvisation as it became apparent during testing that this age group were largely unable to describe this experience. For these skills, practice time only predicted success for performance achievement across the years, whereas the chosen mental strategy predicted achievement on the other measures. These findings led McPherson to state that understanding the mechanisms of children's learning was far more important than simply examining the relationship between accumulated practice and achievement, especially if research is to have any impact on teaching.

Since the aim of this thesis is to investigate the effects of musical learning on the cognitive, behavioural and socio-emotional domains using a holistic perspective, this case study chapter contributes information about atypical learning patterns within a specifically musical context.

The following section begins with a short characterisation of the participants based on the parental background information questionnaire, followed by their standardised or raw scores and percentiles where appropriate. Comparisons between the individual case studies and extra-curricular music training group (EMT: their group) have been provided for Gordon's Primary Measure of Musical Aptitude (PMMA; Gordon, 1986), the Wechsler Abbreviated Scale of Intelligence (WASI, Wechsler, 1999), the Children's Memory Scale (CMS; Cohen, 1997), the Movement Assessment Battery for Children (MABC-2; Henderson, Sugden & Barnett, 2007) and for the teacher report and parent report[17] of the Behavioural Assessment System for Children (BASC-2; Reynolds & Kamphaus, 2004). However, the Beery tests of visual-motor integration are not included. This is because, in contrast to the MABC-2, which the children enjoyed, the Beery tests appeared to be the least engaging of all the measures in the test battery. In the group studies, some did not complete all three tests at Time 2 (including Michelle), and started drawing other pictures instead. This is reflected in the decrease in all the group scores over time. Although the Beery results may have reflected Charlie's visual processing difficulties as the scores for the Visual Perception component remained very low (5^{th} to 3^{rd} percentile) and the VMI and MC were also both below average at both times of testing and Michelle's results for the Beery tests tended to decrease from Time 1 to Time 2, and she did not complete the Visual Perception tests properly for Time 2. Therefore further analyses of these results are omitted to avoid obfuscating rather clarifying matters. The characterisation of the participants that follows includes the authors observations made during testing.

6.3 Case Study

During the course of the group study described in chapters three, four and five, one child, Charlie, appeared to show a pattern of motivation and learning that was atypical and merited further investigation. Charlie was one of a group of three children learning the tenor horn in a mainstream school in the midlands of England. Charlie's data is directly compared with another child in his group, a typically developing girl, Michelle. Charlie and Michelle were not from advantaged backgrounds and their parents were only expected to make a small contribution for their music lessons (£1.00), the rest of the cost

[17] For BASC PRS, the clinical scales of Anxiety, Atypicality and Withdrawal are missing due difficulties between questions spanning over the age period leading to issues of internal validity.

being subsidised by a charity and local music hub. The music tutor who worked with the group provided extensive notes on their music lessons and these are summarised in Table 6.1.

6.3.1 Charlie

Charlie was a white male left-handed student attending a performing arts school. He lived in a working class area in the midlands of England. He was eight years at the start of the study and eight years and nine months at the end. His mother completed the questionnaires.

In the initial background information form, Charlie's mother reported that she was educated up to the age of 16 (GCSE/O'level standard) and that she had *"mild dyslexia"*. She reported that Charlie had "*Difficulty with movement of hands and coordination, and above normal hearing range resulting in over sensitivity to high pitch noises*" and said he had a *"Provisional diagnosis (age 4) Asperger's and ADHD"*.

With regard to her musical self, she reported that she played piano and guitar and sang, writing, *"Music plays an important part of our daily lives".* Her attitude to learning music was that it is 'essential'. With regard to Charlie, she reported he spent under one hour each week engaging in music at school, but up to three hours each week engaging in music at home, that this was his choice and that he enjoyed most of his musical activities. She described these activities as *"1-2 hours dancing with Mommy and 2-3 hours practising singing songs for school with sisters".*

She also reported that Charlie engaged in two hours of physical activity in school, and two hours outside school (football and running) every week, and found this enjoyable. He also spent one hour at boys' brigade club, one hour cooking, and one hour playing computer games each week. Whilst she had encouraged him to take part in these activities, he only appeared to enjoy some of them even though it was his decision to continue. In the second questionnaire, at the end of the year, she reported that her son had received formal diagnoses of *"ASD, ADHD, Visual and Auditory Processing Disorders, as well as showing signs of dyslexia and mild dyspraxia"*. This list of co-occurring difficulties will henceforth be referred to simply as Charlie's diagnosis. With regard to significant events that Charlie experienced during the previous year, she reported that she and her partner were separating. She also reported that Charlie had spent more time at home practising his tenor horn, but that the time he spent engaging in other physical and/or leisure activities had not changed.

My own observations of Charlie were that he seemed an intelligent and determined young man who was quite aware of and sensitive about his social and learning difficulties. He appeared to adopt maladaptive behaviours in order to cover up what he perceived as inadequacies. For example, he often took on the role of the class joker in an attempt to distract others from his inability to complete set tasks. He was very worried about moving to his next school, as he feared his teachers would not understand him.

In the group analyses, described in chapters three to five, some of Charlie's test scores were >3SD from the group mean and formed outlying points. Whilst these outlying data points were removed from the analysis, as Charlie was attending mainstream school and had not received a formal diagnosis (at Time 1) and did not have a statement of special educational needs, he was not removed from the overall analysis as one of the aims of this naturalistic study was to conduct ecologically valid research.

6.3.2 Michelle

Michelle was a black female right-handed student attending the same performing arts state school as Charlie. She shared tenor horn lessons with him and, comparing her data to the group averages, she was a fairly typically developing Year 3 student. She was seven years 11 months at the beginning of the study and eight years eight months at the end. Michelle's mother, who filled in the questionnaires, had been educated to the age of 16 (GCSE/O'level standard) at school, and had played the recorder as part of her school music lessons. She described the experience of learning an instrument as 'important' for her daughter. Michelle's mother reported that Michelle did two hours of physical activity in school each week, and one hour outside school. This activity was swimming, which was her daughter's choice, and which she mostly enjoyed. She reported that Michelle spent two hours in school each week doing musical activities, which she definitely enjoyed, but did not answer regarding whose choice this activity was. Michelle did choose to attend weekly cookery classes as part of the leisure activities her mother reported (two hours in school, one hour outside school), which she definitely enjoyed. She also reported that her daughter had not experienced any significant physical, psychological or emotional difficulties or any major changes in behaviours during the period of the study.

My personal observation was that Michelle was slightly conflicted in wanting to be a model student in school but also part of a 'cool gang'. On occasion I observed her allowing her own behaviour to be derailed by her peers and then regretting being caught 'doing something naughty'.

6.3.3 Comparison

Whilst it is important to acknowledge that there are marked differences between Charlie and Michelle (most notably gender and race) the focus for comparison here is to evaluate their individual differences in order to understand how and why two different children with the same teacher and instrument, can have different yet perhaps equally valuable experiences of learning a musical instrument. This is especially important where mainstream schools are providing special educational needs for children with complex diagnosis such as Charlie. However, it is also acknowledged that the author has not seen Charlie's diagnosis report and so can only report was has been reported by way of the teachers and parent. This is also valuable information.

6.3.3.1 Qualitative Observations

Whilst it is not apparent in the data, the school took great care to ensure that Charlie (and his teachers) got the support needed. Music was seen as a positive way to help Charlie to focus his behaviour, so that he could shine and also join in *"making as much noise as he liked for a change".* Charlie and Michelle shared the same horn lessons and it appeared (from the teacher's observations – see Table 6.1) that the two children influenced each other's behaviour. Table 6.1 provides a verbatim copy of the tenor horn tutor's notes describing the content, behaviour and progress of the children throughout the year.

Table 6.1. Charlie and Michelle's Horn Tutor Lesson Notes

Tutor Notes on Charlie	Lesson and Date	Tutor Notes on Michelle
1st lesson, covered embouchure formation, and notes C, D	(1) 09/09/13	1st lesson, covered embouchure formation, and notes C, D.
Covered tonguing today, and reading C crotchets and minims. Took some music to practice.	(2) 16/04/13	Covered tonguing today, and reading C crotchets and minims. Took some music to practice.
Hasn't got the tonguing going yet. Played C crotchets and minims then improvised on C and D	(3) 23/04/13	She can tongue notes (the other group members haven't got it yet). Played C crotchets and minims, then improvised on C and D.
Very chatty - kept wanting to talk about other stuff, and kept talking when others were having their turn at playing. Answered questions about crotchets/minims - he knew that minims are longer but said 'five beats'. He prefers demonstrating on his instrument over answering questions. He can read and play C and D nicely.	(4) 30/09/13	Confidently answered questions about crotchets and minims. Could identify C's and D's on the stave, but when played, under pitched the D's (but got it later in the lesson). The two boys were chatty and [she] didn't speak much.
Answered questions well re: crotchets and minims, and could say which note was higher than another. The group all tried C, D & E today. [He] could read/play the notes but was a little un coordinated.	(5) 07/10/13	Answered questions well re. notes covered so far. She has stopped under pitching D, and can now play C, D and E well.
Could play C, D & E today. Good at recognising individual notes but not so much when in a tune. Messed around a bit today. Gave him P. 7/8 to practice (C, D, E crotchets and minims).	(6) 14/10/13	Good at playing C, D, & E today. Used pages 7 and 8 to practice C, D, E crotchets, minims and semibreves. Made a few mistakes, but corrected herself.
Tutor away	21/10/13	Tutor away

School Inset day	04/11/13	School Inset day
Revised C, D, E crotchets & minims. After a few minutes I sent him out, for swearing at another pupil.	(7) 11/11/13	Revised C, D, E crotchets and minims. She was the best in the group. Didn’t say much. No under pitching. Good technique.
Practised pages 7 and 8 today, C, D, E. Also wrote out a tune on the board using letters instead of notes. All could play the notes but [he] is the only one still unable to recognise the notes on the stave.	(8) 18/11/13	V. good music reading, and counting. Asked her to learn all the pieces on p. 7/8.
Practised 'Hot Cross Buns' today (C, D, E). He didn't seem to know which note was which, unless looked at individually. I met with his Mum - she told me that he has dyspraxia, and all sorts of other things. He likes colours, so we agreed on getting [him] to colour code his notes.	(9) 25/11/13	Practised Hot Cross Buns – found it easy enough – just needs a bit of practice.
Got him to choose colours e.g. red for all C's, green for all D's etc. He drew coloured circles around each note - seemed to really enjoy it, and it helped with playing.	(10) 02/12/13	She can play [Hot Cross Buns] v. well. Played various other CDE pieces, and moved onto new note F.
He could play Hot Cross Buns today, looking at the colour coded notes. It seems to work.	(11) 09/12/13	Played Pease Pudding Hot really well (C, D, E, F).
He played the same piece as everyone else today (Pease Pudding Hot).	(12) 16/12/13	Played Pease Pudding Hot with the rest of the group
A bit noisy today. He'll practice notes C, D, E, F. Joined the school brass band today.	(13) 13/01/14	Moved onto five notes (up to G). Joined the school band today.
No practice - still needs to practice C, D, E, F.	(14) 20/01/14	v. good – onto When the Saints
He hasn't played since last week, so no progress.	(15) 27/01/14	v. good Told her she can move onto quavers next week.

Same again, and he says he has lost his book. The school staff will speak with his mother.	(16) 03/02/14	She took well to quavers today
Much better today. Still on the same page, 11 (CDEF). (Message during the week from the school bursar to say he stood up to play a solo at school orchestra club).	(17) 10/02/14	P. 35, number 4 (a quaver study). No problems.
Learned some new notes today (A, B, F#, D#) in preparation for some new band music. Seems to be reading music well.	(18) 24/02/14	Learned new notes today, for new band music, (A, B, F# and D#). She coped better than most people at band, later on.
Away today	(19) 03/03/14	Revised last week's new notes, then played tunes with quavers.
Reading and playing CDEF well, and can play higher. Revised A, F#, D# for band music.	(20) 10/03/14	Asked her to practice "Shaker Melody" and to send off for a new book – Easy Winners. Revised A, F#, D# for band music.
He needs to practice C, D, E, F, G.	(21) 17/03/14	Needs a bit more practice on Shaker Melody
[Tutor] was off work today	24/03/14	Tutor away
Talked about counting the beats (tutor draws notated example)	(22) 31/03/14	Talked about counting beats today (tutor gives example of two minims, a crotchet, two quavers and two more crotchets)
Revised counting from last week. Practised 'Hungarian Goulash' trio, and Pease Pudding Hot.	(23) 07/04/14	Revised counting from last week, practised 'Hungarian Goulash' trio, and practised Shaker Melody
Had dropped his instrument, so hadn't played for a while. Once working, he could play through Pease Pudding Hot.	(24 28/04/14	She'll practice the 'quaver trios' from the back of her book.
Struggling to play simple tunes - he says he isn't allowed to practice at home. I'm not sure I believe him. The school bursar said she'll speak with his Mum.	(25) 12/05/14	Looked at various pieces from her new book 'Easy Winners', to get a feel for it.
Better today.	(26) 19/05/14	She was upset about something today and didn't want to play

Arrived v late for his lesson. Pretended he'd been practising his pieces even though he'd left his music in school before half term. Funny.	(27) 02/06/14	She'll practice 'Love Me Tender'. Coping well with new book.
Didn't come today.	(28) 09/06/14	v. good. She'll learn 'It's Me, O Lord'.
Chose/practised solos for [school] festival. [He] chose 'Hot Cross Buns'	(29) 16/06/14	Chose solo pieces for [school] festival. [She] chose 'Don’t' Sit Under the Apple Tree'.
Practised solos and band parts for [school] festival. [He] needs to lengthen his notes in his solo. He guessed at the band music.	(30) 23/06/14	Practised solos and band parts for [school] festival. [She] corrected all the rhythmic errors in her solo.
Moved on to pieces based on five notes CDEFG.	(31) 30/06/14	Moved onto a Grade 1 piece - 'Theme from a Musical Joke'. Played her solo well at [school] festival, and played in the brass band. Her Mum was there - it's the first time I've met her. She seemed very supportive.

Working in a small group, Charlie formed friendships and whilst Michelle was seen as a 'good influence' on Charlie, it was also observed that his behaviour had a negative effect on Michelle at times. Whilst Charlie's approach to learning his instrument appeared to be somewhat disorganised and atypical, his test scores showed that his intelligence and musical audiation were above average. At baseline, his IQ score was 103, his tonal aptitude in the 64th percentile and his rhythm aptitude in the 62nd percentile. Behaviours associated with his neurodevelopmental difficulties included echolalic tendencies and auditory sensitivity and these required careful management within the test administration.

As can be seen in Table 6.1, Charlie and Michelle's music tutor noted differences in their progress as early as their third lesson. The differing learning trajectories of the children's technique, the notes learned, notation reading, playing, attendance and behaviour are depicted in the teacher notes as the short synopsis that follows illustrates.

Charlie struggled with the tonguing techniques initially and was described as uncoordinated on occasion. He did learn A, B, C, D, D$^{\#}$ E, F, F$^{\#}$ and also crotchets, minims. However his ability to remember these from week to week was inconsistent. After learning that Charlie had dyspraxia in November, (from speaking with Charlie's mother), the tutor and Charlie created a system of colour coding the notes. This helped Charlie to learn a piece of music, Hot Cross Buns, before the Christmas holidays. However, in the new term his practice became irregular and was mentioned six times in the tutor's notes. There appeared to be a variety of issues including forgetting, dropping his instrument and not being allowed to practice at home (which his tutor did not believe). He also said that he had practised during a period when his music was left at school so the tutor knew he had not actually practised. He did join the school orchestra club and played a solo in school assembly. However, his behaviour during lessons also seemed to deteriorate around this period as he changed from being a bit 'chatty' in lessons, to being described as messing around, being noisy and was even sent out for swearing at another student. His attendance also suffered during this period with lateness, though he only missed two lessons.

In contrast, Michelle appeared to be rather reserved and quiet, though she answered questions confidently. She had made consistent progress and learned to read the stave positions for A, B, C, D, D$^{\#}$ E, F, F$^{\#}$ and the duration of four different note lengths (semibreves, minims, crotchets, and quavers). She was able to self-correct mistakes. She also learned several pieces of music including Hot Cross Buns, Pease Pudding Hot and Shaker Melody. Although this last piece proved challenging, her tutor moved her on to the next book, Easy Winners, and she had started the Grade 1 syllabus by the end of the year. She played in the school orchestra club, where she was described as 'coping better than most'. She performed with the school orchestra club and the brass band and played a solo piece in the school music festival. There was one occasion (19/5/16) when she appeared upset about something and did not want to play but she attended every lesson and was never mentioned as being late.

6.3.3.2 Quantitative Data Comparison

The quantitative data will now be presented in the same order as the data for the group studies in chapters 3, 4 and 5. In order to provide a contextual perspective, the two children are directly compared to the EMT group. All differentials are calculated by dividing the difference over time (Time 2-Time 1) by the standard deviation (SD) for the means of the EMT group. This measure is provided in order to ascertain the individual differences in change over time as measured by standard deviations in comparison to the group. In order to explore differences in reported data from other studies, (for example Orsmond & Miller, 1999, Schellenberg, 2004, and Rickard et al., 2010) raw, standardised and percentile figures are provided where possible to aid interpretation and transparency. Chapter three investigated the effects of musical learning on musical aptitude, intelligence and memory. The following three sections provide a short overview of the group study findings with regard to these measures before illustrating the individual differences for Charlie and Michelle in comparison to the EMT group.

6.3.3.2a Gordon's Primary Measure of Musical Aptitude

In the group study, only the SSM group scores increased significantly over time for both components and the composite of Gordon's PMMA. The EMT group score increased for the composite only. The raw scores and percentiles are presented Tables 6.3, which also shows the SD for the EMT group as a direct comparison. Table 6.2 shows the SD of the change over time for both groups to illustrate that no vast within-groups difference were evident. However, Charlie and Michelle's scores were compared to the EMT group as they were both learning the tenor horn.

Table 6.2. Group Mean Standard Deviations for Difference between Time 1 and Time 2 for Gordon's Primary Measure of Musical Aptitude (Gordon, 1986)

Gordon's PMMA	Tonal		Rhythm	
Music Group	Raw Score	Percentile	Raw Score	Percentile
SSM	2.38	22.21	4.15	23.26
EMT	3.69	24.70	4.87	27.89

Table 6.3. Raw Scores, Percentiles and Standard Deviation Differentials Over Time for Gordon's Primary Measure of Musical Aptitude (Gordon, 1986)

	Tonal Raw			Tonal Percentile			Rhythm Raw			Rhythm Percentile		
	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT
Time 1	35	35	29.53	74	74	64	30	34	29.89	62	86	58.82
Time 2	34	34	35.89	66	66	74	35	34	32.33	91	86	72.72
SD Differential	- .27	- .27	+1.72	-.32	-.32	+ .4	+1.03	0	+ .5	+1.03	0	+ .5

[a]Charlie

[b]Michelle

Table 6.4. Group Mean Standard Deviations for Difference between Time 1 and Time 2 for the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999)

Music Group	Vocabulary	Similarities	Block Design	Matrix Reasoning
SSM SD	8.81	10.44	6.35	9.94
EMT SD	14.10	9.53	7.71	7.52

Table 6.5. Factor T Scores and Standard Deviation Differentials Over Time for the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999)

Time	Vocabulary			Similarities			Block Design			Matrix Reasoning		
	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT
T1	52	45	52.95	64	70	61.58	46	46	51.68	45	53	51.79
T2	58	78	60.42	71	63	61.95	42	53	52.74	58	54	56.42
SD Differential	+ .43	+2.34	+ .53	+ .73	-.73	+ .03	-.52	+ .91	+ .14	+1.73	+ .13	+ .62

[a]Charlie

[b]Michelle

As can be seen in Table 6.3, Charlie and Michelle had above average musical aptitude for both tonal and rhythm components of Gordon's PMMA. However, both children's tonal audiation raw scores dropped by one point, an observed decrease from the 74th percentile at Time 1 to the 66th percentile at Time 2. Although the EMT group went up from the 64th to 74th percentile for the tonal component, this was not a statistically significant increase (see chapter three).

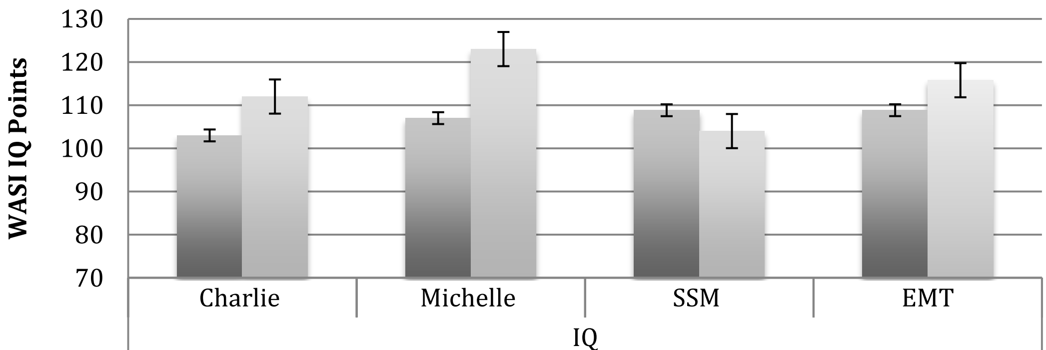
For the rhythm component, although Charlie's Time 1 rhythm score is lower than Michelle's, it was higher than the EMT group mean. At Time 2 his score had increased from the 62nd to 91st percentile. Michelle's scores remained stable and above average in the 86th percentile. The analysis comparing raw scores with percentiles in Table 6.3 shows that this is problematic when using the percentiles as standardised scores as the change is distorted for tonal but not for the rhythm components of this measure.

For the EMT group, the composite score increased significantly, by 14.8%. In comparison, Charlie's composite increased by 6.2% and Michelle's decreased by -1.5%. This suggests that musical training was not having an impact on the musical ability of these two children in comparison to the EMT group. Although Charlie's rhythm scores increased by 16.7%, it is likely that his score was lower than his ability suggests at Time 1 due to his difficulties attending and the demand of the test battery. The tests comprise of 40 pairs of tone phrases and durations, the rhythm component being monotone. The rhythm test is given after the tonal test. Although a different measure (the Beery tests of visual motor integration) was administered in between the tonal and rhythm tests, this may have failed to counteract Charlie's potential boredom and difficulties concentrating. Such problems are commonly observed in children with a diagnosis of ADHD.

However, there are two alternative explanations here. Firstly, Charlie's scores at Time 1 may be lower because Charlie may have found it more difficult to mimic the atonal rhythmic tests. During administration of these tests Charlie was repeatedly asked to avoid repeating the phrases out loud. This strategy initially appeared to aid his memory, but had the secondary gain of amusing the other participants in the study. However, children with ASD may rely more on tonality than typically developing children. As it appeared that Charlie's focus of attention was misdirected at times, his initially low rhythm scores may not have provided a fair representation of his musical ability. The behaviours exhibited during testing were consistent with the qualitative evidence provided by his horn tutor, and seem likely to have impeded his progress.

6.3.3.2b Wechsler Abbreviated Scale of Intelligence (WASI, Wechsler, 1999)

Based on previous research (e.g. Forgeard et al., 2008; Hyde et al., 2009; Schellenberg, 2004) that suggested that musical instrument learning increased intelligence, the study described in chapter three also compared the EMT and SSM groups of children on measures of intelligence (WASI, Wechsler, 1999). The findings replicated those studies cited above. This effect was primarily driven by the results from the matrix reasoning subtest (a measure of fluid intelligence), although improvements in vocabulary (a measure of crystalised intelligence) were also significant for the EMT group. Furthermore, these measures, conceptualised as the far transfer of cognitive ability, were independent of musical aptitude.



	Charlie	Michelle	SSM	EMT
Time 1	103	107	108.83	108.84
Time 2	112	123	104	115.79

Figure 6.1. Group and Individual Comparison Over Time for IQ as Measured using the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999)

Figure 6.1 illustrates the IQ points for both children and both groups. The EMT group mean score increased by 6.4% whilst the SSM group mean decreased by 4.4% over time. For both children, IQ scores were higher than the population norm of 100 (SD 15) points. Charlie was below the mean for the EMT group mean although the group means for SSM and EMT were also above the population norm. Charlie's IQ point measure increased by 8.7% (.6 of an

SD, from 103 to 112) and Michelle's IQ point measure increased by 15% (1.06 SDs from 112 to 123) over the experimental period. Both these increases were larger than the EMT group mean increase. For the remaining analyses, standardised scores (T Scores) were used to compare each component of the WASI. Table 6.4 shows the group mean SDs for the WASI measures. Table 6.5 shows the mean scores for the two children and the EMT group and the SD differential over time based on the EMT SD over time.

Two subtests increased significantly in the group studies; vocabulary and matrix reasoning (see chapter three). For vocabulary, the EMT group mean increased by 14.1% (.53 SD), Charlie's score increased by 11.5% (.43 SD) and Michelle's by 73.3% (2.34 SD). For matrix reasoning, the EMT group mean score increased by 9% (.62 SD), Charlie's by 28.9% (1.73 SD) and Michelle's by 1.9% (.13 SD).

Considering Charlie's test performance in the context of his complex cluster of diagnoses it is notable that he achieved an above average global IQ score. Whilst some children with ASD score in the normal range on measures of global IQ, IQ profiles can be very uneven with high scores on the block design test and low scores on tests probing language and communication skills (Charman et al., 2010). Charlie did not show particularly poor performance on the vocabulary subtest or high performance on the block design subtest, although the fine motor control demands of the block the design test does present difficulties for children with dyspraxia. His horn tutor mentions (Table 6.1) that he seems uncoordinated but does not specify how exactly. Charlie's motor abilities will be further considered in the section that reports his MABC-2 results. Given Charlie's dyspraxia and the fine motor demands imposed by the block design test, it seems likely that the results from the matrix reasoning subtest provides a more accurate measure of his fluid intelligence than the block design test.

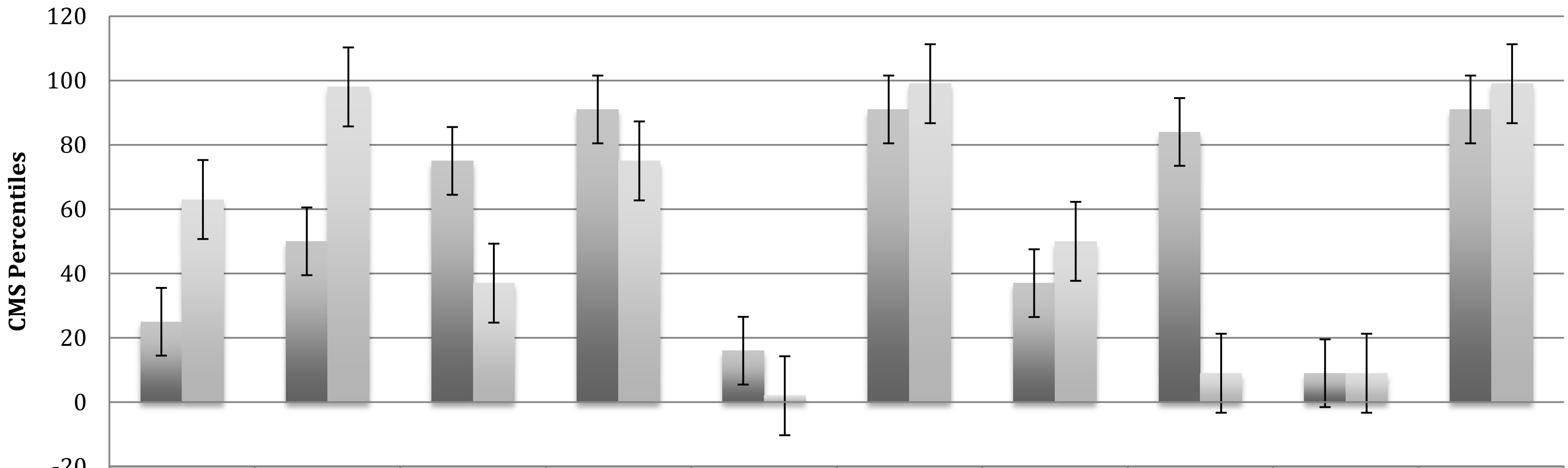
Table 6.6. Group Mean Standard Deviations for Difference between Time 1 and Time 2 for Children's Memory Scale (Cohen, 1997)

Music Group	Word List Learning	Word List Recall	Digit Span Forwards	Digit Span Backwards	Sequences
SSM	2.92	2.84	2.66	2.01	2.29
EMT	4.15	3.19	2.59	3.47	2.24

Table 6.7. Standardised Scores and Standard Deviation Differentials Over Time for the Children's Memory Scale (Cohen, 1997)

	Word List Learning			Word List Recall			Digit Span Forwards			Digit Span Backwards			Sequences		
	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT
T1	8	10	9.11	12	14	10.89	7	14	10.53	9	13	9.32	6	14	10.53
T2	10	16	10.63	9	12	11.37	4	17	11.58	10	6	10.16	6	17	12.89
SD Differential	+ .48	+1.45	+ .37	- .94	+ .63	+ .15	-1.30	+1.16	+ .41	+ .29	-2.01	+ .24	0	+1.34	+1.05

[a]Charlie
[b]Michelle



	Word List Learning		Word List Recall		Digits Forwards		Digits Backwards		Sequences	
	Charlie	Michelle	Charlie	Michelle	Charlie	Michelle	Charlie	Michelle	Charlie	Michelle
Time 1	25	50	75	91	16	91	37	84	9	91
Time 2	63	98	37	75	2	99	50	9	9	99

Figure 6.2. Group and Individual Percentiles Over Time for the Children's Memory Scale (Cohen, 1997)

6.3.3.2c Children's Memory Scale (Cohen, 1997)

Chapter three also considered the findings of previous studies (e.g. Fujioka et al., 2006; Lee et al., 2007 and Rickard et al., 2010) that had suggested that musical training has a positive effect on auditory memory. However, the evidence from this study did not support this hypothesis as no differences were found between groups for any of the aspects of memory tested using the Children's Memory Scales (CMS, Cohen, 1997) in the first year of musical learning. The standard deviations of the difference between group means for both EMT and SSM groups are presented in Table 6.6. Standardised scores for both children and the EMT group are presented in Table 6.7. Figure 6.2 compares the percentiles for Charlie and Michelle.

To recap regarding the use of subtest from the CMS in the studies described in this thesis, Word List Learning and Word List Recall were taken from Domain A, which measures auditory and verbal learning in children. Word List Learning requires participants to learn a list of ten words over the course of four trials. Word List Recall required participants to recall the list they had learned after a distractor list of ten different words had been learned (only one trial). This places further demand on working memory (Cohen, 1997). Digits Span Forwards (DSF) and Digit Span Backwards (DSB) and Sequences were taken from Domain C, which measures attention and concentration in children (Cohen, 1997). DSF is believed to measure short-term memory whilst DSB loads more heavily onto working memory (St. Clair-Thompson, 2010; 2013). A comparison of Charlie's and Michelle's standardised scores and percentiles follow.

Both children increased on Word List Learning, showing an improvement in auditory Short Term Memory (aSTM). Charlie's score improved over time by 25% (.48 SD), Michelle's by 60% (1.45 SD) and the EMT group mean by 16.7% (.37 SD). However, the children's performance on Word List Recall decreased. Charlie's score fell by 25% (.48 SD) and Michelle's fell by 14.3% (.63 SD). However, the EMT group mean score increased by 4.4% (.15 SD). This suggested Charlie and Michelle may have been having difficulties with consolidating information. Although these results were not significant in this study, the direction of change suggests some support for previous studies that found that musical training increased aSTM (Fujioka et al., 2006; Ho et al., 2003; Lee et al., 2007; Rickard et al., 2010).

Charlie's diagnosis of ADHD suggested he might experience difficulties with measures of focus and attention, such as the digit span and sequences tests (Klingberg, Forssberg & Westerberg, 2002). Consistent with that prediction, on the DSF Charlie's performance decreased over time by 43.9% (-1.3 SD), whereas Michelle's increased by 21.4% (1.16 SD) and the EMT group mean score by 10% (.41 SD). However, his DSB score increased over time by 10% (.29 SD). For this measure, which for children is considered as measure of working memory (St. Claire-Thompson, 2013), the EMT group mean increased by 9% but Michelle's score decreased by 53.8% (-2.01 SD).). Whilst the EMT group scores change over time was not significant for these measures, it was for the Sequences subtest, which is thought to be a measure of executive function. On this the EMT group mean score increased by 22.4% (1.05 SD), and Michelle's also increased by 21.4% (1.34 SD). However, Charlie showed no change on this measure. His score was stable on the 9th percentile at both time points. The CMS Manual (Cohen, 1997) suggests test-retest reliability coefficients of .59 – .89 for these subtests over a period of 65 days. The experimental period for this study was in excess of this. As it is unlikely that working memory would be preserved, but not aSTM, and we have already seen that Charlie's scored well on the World List Learning task, this suggest this his low score of the DSF is more likely to be as a result of his difficulties with attention and focus. However, the inconsistency of Michelle's score for DSB suggests the reliability of this test is low.

A major problem arising from multiple diagnoses is that the cognitive profiles for these different disorders sometimes conflict. Whilst the horn tutor obviously noted difficulties with Charlie's behaviour and attention, characteristic of ADHD and possibly also ASD, he did not note that Charlie was sensitive to sounds. Children with ASD can suffer from mild to moderate hearing loss and/or hyperacusis (Rosenhall et al., 1999). Once Charlie's mother had been in contact with the horn tutor to discuss Charlie's diagnosis, the tutor adapted his teaching in order to support to Charlie's learning to the best of his knowledge. One example described in Table 6.1 is that his tutor used note colours to help Charlie learn and remember them more easily. This is a teaching aid commonly found in books for beginners. The tutor included Charlie in this process, asking him to choose colours for each note. Charlie's tutor maximised Charlie's learning experience by adopting a flexible, intuitive, individualised and intelligent approach, and this may have positive effects that are important for Charlie's long-term musical development.

Overall, whilst it is difficult to make a clear prediction about Charlie's profile of memory impairments on the basis of his multiple diagnoses, a potential explanation for his mixed performance across the memory tasks is that his ADHD difficulties impacted on his ability to stay on task in consistent way. Large discrepancies (and the anomalistic decrease in Michelle's DSB score) across memory tasks may then reflect lapses of concentration rather than deficits within specific components of memory. In spite of these difficulties, the increase in both children's Word List Learning scores as evidence of the effect of musical learning on aSTM is supported by previous literature as already discussed.

The next section considers the individual and EMT group scores on a measure of fine and gross motor abilities. Charlie's diagnosis which included dyspaxia would predict low scores for this test (the MABC-2, Henderson, Sugden & Barnett, 2007).as it is a measures commonly emplyed to assess the severity of developmental coordination disorder.

6.3.3.2d Movement Assessment Battery for Children (MABC-2; Henderson, Sugden & Barnett, 2007)

Chapter four acknowledged the rationale of Forgeard et al., (2008) and Klingberg (2010) that evidence of near transfer of learning must be concurrently observed if evidence of far transfer are to be attributed to the skill being trained. As a tapping paradigm was not suitable for this study due to the range of musical instruments learned by the children, a measure novel to music enrichment studies, the MABC-2 (Henderson, Sugden & Barnett, 2007) was utilised to assess near transfer of fine and gross motor skills. The results of the group study in chapter four showed that the EMT group outperformed the SSM over time on the Aiming and Catching component. However, as both groups improved it could be suggested that EMT in this sample provided an accelerated learning effect, rather than a differential trajectory. However, with regard to Charlie's complex diagnosis, it would be possible to predict a poor performance on measures of motor ability (Dewey et al., 2002). Deficits in attention, motor control and perception (referred to as DAMP; Hellgren et al., 1994) have even been suggested as more clinically relevant than the concept of ADHD (Kadesjö & Gillberg, 1998). The issue may be particularly significant for males (Pitcher, Piek & Hay, 2003). As has been described for the previous measures, to follow are the data relating to this measure

Table 6.8. Group Mean Standard Deviations for Difference between Time 1 and Time 2 for the Movement Assessment Battery for Children (Henderson, Sugden & Barnett, 2007)

Group SD	Total	Manual Dexterity	Aiming & Catching	Balance
SSM	1.20	2.16	3.19	2.74
EMT	3.21	3.43	2.55	2.91

Performance on the MABC-2 (Table 6.9 and Figure 6.3) suggests that Charlie's initial scores improved over the year with his Total score increasing by 25% (.62 SD). Michelle also showed a Total score increase over time of 9.1% (.31 SD) and the EMT group mean score increased over time by 13.1% (.38 SD). Charlie's Manual Dexterity score increased over time by 42.9% (+ .87 SD), Michelle's by 20% (+ .58 SD) and the EMT group mean score increased by 3% (.27 SD). For Aiming & Catching, Charlie's score increased by 42.9% (+1.18 SD) over time, Michelle's decreased by 10% and the EMT group mean increased by 6.7% (.11 SD). For Balance, Charlie's score decreased by 9.1% (.34 SD), Michelle's score increased by 36.4% (1.37 SD) and the EMT group score increased by 4.95 (.18 SD).

The horn tutor had noted by lesson 3 that Charlie was having difficulties tonguing, though Michelle was not. In lesson 5 she was making confident progress but Charlie appeared 'a little uncoordinated', though he could read and play the notes. However in lesson 24 Charlie reported having dropped his instrument and consequently had not played or practised. Whilst the MABC-2 results were not consistent with Charlie's diagnosis, the horn tutor did observe some difficulties. Furthermore, the mother's communication with the horn tutor enabled him to adapt his teaching methods to help Charlie, who appeared to appreciate the individual approach.

Table 6.9. Standardised Scores and Standard Deviation Differentials Over Time for the Movement Assessment Battery for Children (Henderson, Sugden & Barnett, 2007)

	Total			Manual Dexterity			Aiming & Catching			Balance		
	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT
Time 1	8	11	9.26	7	10	9.05	7	10	10.16	11	11	10.84
Time 2	10	12	10.47	10	12	9.32	10	9	10.84	10	15	11.37
SD Differential	+ .62	+ .31	+ .38	+ .87	+ .58	+ .27	+1.18	- .39	+ .11	- .34	+1.37	+ .18

[a]Charlie
[b]Michelle

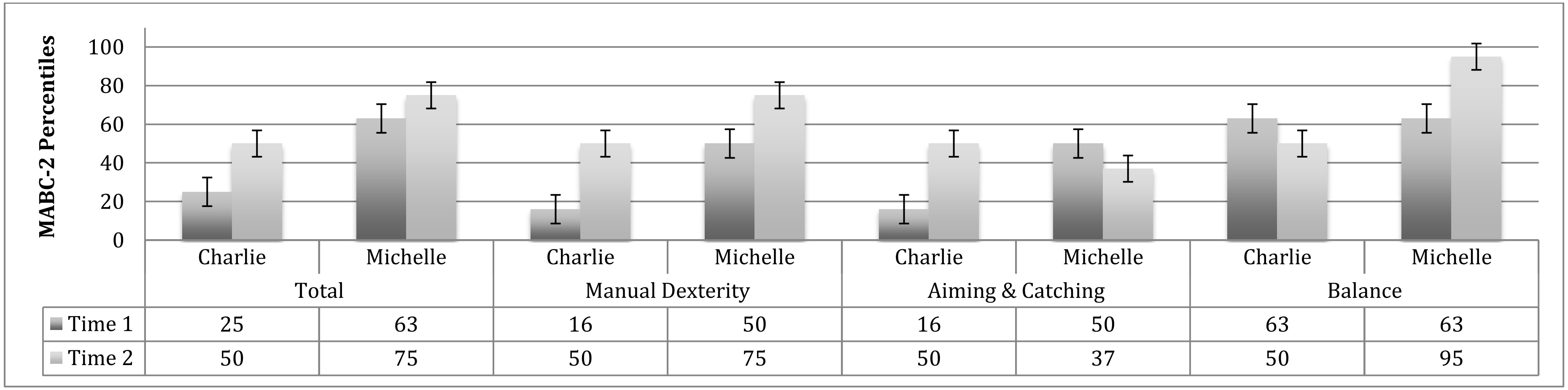


Figure 6.3. Group and Individual Percentiles Over Time for the Movement Assessment Battery for Children (Henderson, Sugden & Barnett, 2007)

As previously suggested, children with ASD often perform well on the block design task subtest (Heaton, Hermelin & Pring, 1999; Shah & Frith, 1993), but a co-morbid diagnosis of dyspraxia would predict difficulties on this task for Charlie due to impaired motor ability. The music tutor did note early on that Charlie was 'uncoordinated', but it was not clear whether this referred to poor was physical coordination or poor organisation (i.e. coming to lessons on time). He did however note some difficulties with Charlie's tonguing. However, Charlie increased (ranging in magnitude from .39 to 1.18 SD) on all MABC-2 components. This is not consistent with his diagnosis. One difference noted during the data collection was that Charlie enjoyed completing the MABC-2 tests, far more than he enjoyed completing the cognitive tasks, and was interested in how he could improve his test scores. When he was unable to 'beat' his first score on the Balance board test he kept going until he could balance for almost one minute. Therefore, this measure might have better reflected his ability than the cognitive tasks (such as the CMS), which were less engaging.

In summary, in chapter four the EMT group significantly outperformed the SSM group for the MABC-2 component of Aiming and Catching. Here we see that Charlie's performance improved 36.2% more than the EMT groups. Furthermore, though the EMT group mean performance did not increase significantly for fine motor skills measured using the Manual Dexterity component of the MABC-2 (a 3% increase), in comparison Charlie increased his performance on this measure by 42.9%. This would suggest musical training was significantly positively affecting Charlie's fine motor skills and his understanding of the relationship between time and space and his own control over velocity within these concepts.

6.3.3.2e Behavioural Assessment Systems for Children (BASC-2 Reynolds & Kamphaus, 2004)

The final measures on which Charlie and Michelle were compared to the EMT group on were the parent and teacher questionnaires of the BASC-2. These data are presented in Tables 6.11 – 6.17b, and Figures 6.4 – 6.7. The scales in the BASC-2 parent report include both adaptive and clinical behaviours. The figures illustrate percentile scores. The tables indicate the standardised scores, which are very similar to percentiles for the BASC-2. For clarity, Table 6.10 (reproduced for ease from chapter two) describes the behaviours as captured in the BASC questionnaires. Table 6.10 also shows the categorisation (adaptive or clinical).

According to the BASC-2 manual, for the adaptive scales (shown to the left in the figures), scores below the 30th percentile are considered cause for concern and require further investigation.

For the clinical scales (shown towards the middle and right of the figures) reaching the 70th percentile or above is considered cause for concern and warrants further investigation (see chapter two for full descriptions).

As with the other measures in this chapter, the children's scores are compared to the EMT group means. The magnitude of change over time is devised by subtracting the Time 2 score from the Time 1 score and dividing it by the standard deviation (SD) of the change over time recorded for the EMT group mean. A comparison between the change over time for the EMT and SSM group standard deviations (SD) are provided in Tables 6.11, 6.14 and 6.16. Missing data means only scales and not composites are presented for these children.

Chapter five reported that no group differences were revealed and both group mean scores at both time points were consistently within the average range for children of this age group (i.e. between the 30th and 70th percentiles).

As seen with the other measures, such as the WASI, the CMS, and the MABC-2, whilst Charlie's diagnosis would predict difficulties on some of the subtest tasks, in fact he performed well on most of them. As his diagnosis included ADHD, it is difficult to know whether it was difficulties in attention and focus, or for example deficits in aSTM that impacted upon the scores for the tasks he appeared to struggle with (in this case the DSF/DSB). In contrast, the parent and teacher BASC-2 results present a profile more consistent with his diagnosis. Furthermore, the parent and teacher report of the BASC-2 suggest that Michelle was struggling with some aspects of her socio-emotional development, in contrast to her above average scores on the PMMA, WASI, CMS and MABC-2 measures. A reconciliation and discussion of the parent and teacher BASC reports, the quantitative data and the qualitative data from the mothers and the horn tutor now follows.

Table 6.10. Adaptation of Table 7.6. TRS and PRS Scale Definitions (Behavioural Assessment System for Children, 2nd Edition, Reynolds & Kamphaus, 2004, p. 60)

Scale	Type	Definition
Activities of Daily Living	Adaptive	The skills associated with performing basic, everyday tasks in an acceptable and safe manner
Adaptability	Adaptive	The ability to adapt readily to changes in the environment
Aggression	Clinical	The tendency to act in a hostile manner (either verbal or physical) that is threatening to others
Anxiety	Clinical	The tendency to be nervous, fearful, or worried about real or imagined problems
Attention Problems	Clinical	The tendency to be easily distracted and unable to concentrate more than momentarily
Atypicality	Clinical	The tendency to behave in ways that are considered "odd" or commonly associated with psychosis
Conduct Problems	Clinical	The tendency to engage in antisocial and rule-breaking behaviour, including destroying property
Depression	Clinical	Feelings of unhappiness, sadness, and stress that may result in an inability to carry out everyday activities or may bring on thoughts of suicide
Functional Communication	Adaptive	The ability to express ideas and communicate in a way others can easily understand
Hyperactivity	Clinical	The tendency to be overly active, rush through work or activities, and act without thinking
Leadership	Adaptive	The skills associated with accomplishing academic, social, or community goals, including the ability to work with others
Learning Problems	Clinical	The presence of academic difficulties, particularly understanding or completing homework
Social Skills	Adaptive	The skills necessary for interacting successfully with peers and adults in home school and community settings
Somatisation	Clinical	The tendency to be overly sensitive to and complain about relatively minor physical problems and discomforts
Study Skills	Adaptive	The skills that are conducive to strong academic performance, including organisational skills and good study habits
Withdrawal	Clinical	The tendency to evade others to avoid social contact

Table 6.11. Group Mean Standard Deviations for Difference between Time 1 and Time 2 for the Parent Report Adaptive and Clinical Scales for the Behavioural Assessment Systems for Children (Reynolds & Kamphaus, 2004)

Group SD	Activities of Daily Living	Adaptability	Functional Communication	Leadership	Social Skills	Aggression	Attention Problems	Conduct Problems	Depression	Hyperactivity	Somatisation
SSM	8.63	8.34	7.12	7.46	8.20	8.30	4.46	7.41	10.28	9.09	9.20
EMT	5.55	5.81	5.69	5.91	6.45	9.41	8.01	5.29	4.10	5.27	5.20

Table 6.12. Standardised Scores and Standard Deviation Differentials Over Time for the Parent Report Adaptive Scales for the Behavioural Assessment Systems for Children (Reynolds & Kamphaus, 2004)

	Activities of Daily Living			Adaptability			Functional Communications			Leadership			Social Skills		
	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT
Time 1	5	11	37.87	9	3	44.07	10	26	39.2	62	21	48.27	78	15	53
Time 2	1	8	36.2	1	0	41.73	2	37	38.6	25	49	48.67	56	12	53.53
SD Differential	- .70	- .54	- .30	-1.38	- .52	- .15	-1.41	+1.93	- .11	-6.26	+4.74	+ .06	-3.41	- .47	+ .08

[a]Charlie

[b]Michelle

Table 6.13. Standardised Scores and Standard Deviation Differentials Over Time for the Parent Report Clinical Scales for the Behavioural Assessment Systems for Children (Reynolds & Kamphaus, 2004)

	Aggression			Attention Problems			Conduct Problems			Depression			Hyperactivity			Somatisation		
	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT
Time 1	93	34	49.07	81	28	51.47	93	8	48.6	81	56	51	89	25	47.6	24	21	46.27
Time 2	93	0	49	95	5	51.6	97	3	51.13	84	63	51.53	98	0	49.6	4	10	45.33
SD Differential	0	-3.61	-.007	+1.75	-2.87	+ .02	+ .75	- .95	+ .48	+ .73	_1.71	+ .13	+1.71	-4.74	+ .38	-3.85	-2.12	- .18

[a]Charlie

[b]Michelle

Table 6.14. Group Mean Standard Deviations for Difference between Time 1 and Time 2 for the Teacher Report Adaptive Scales for the Behavioural Assessment Systems for Children (Reynolds & Kamphaus, 2004)

Group	Adaptability	Functional Communication	Leadership	Social Skills	Study Skills
SSM	6.90	5.92	7.90	8.42	7.14
EMT	6.98	5.56	10.63	6.23	6.26

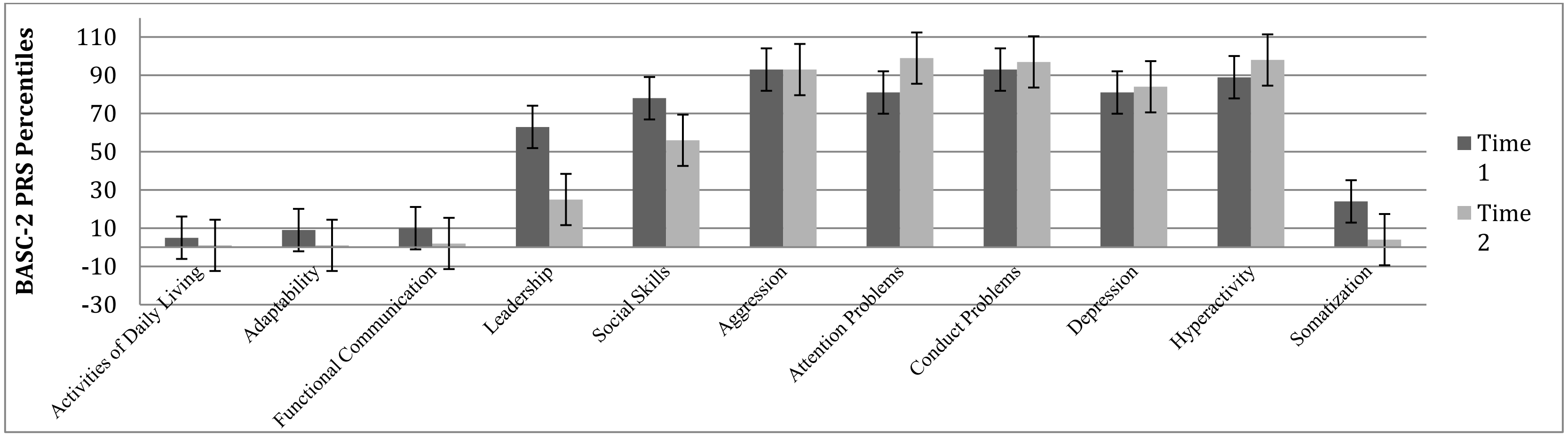


Figure 6.4. Parent Report Percentiles for Charlie for the Behavioural Assessment Systems for Children (2nd Edition, Reynolds & Kamphaus, 2004)

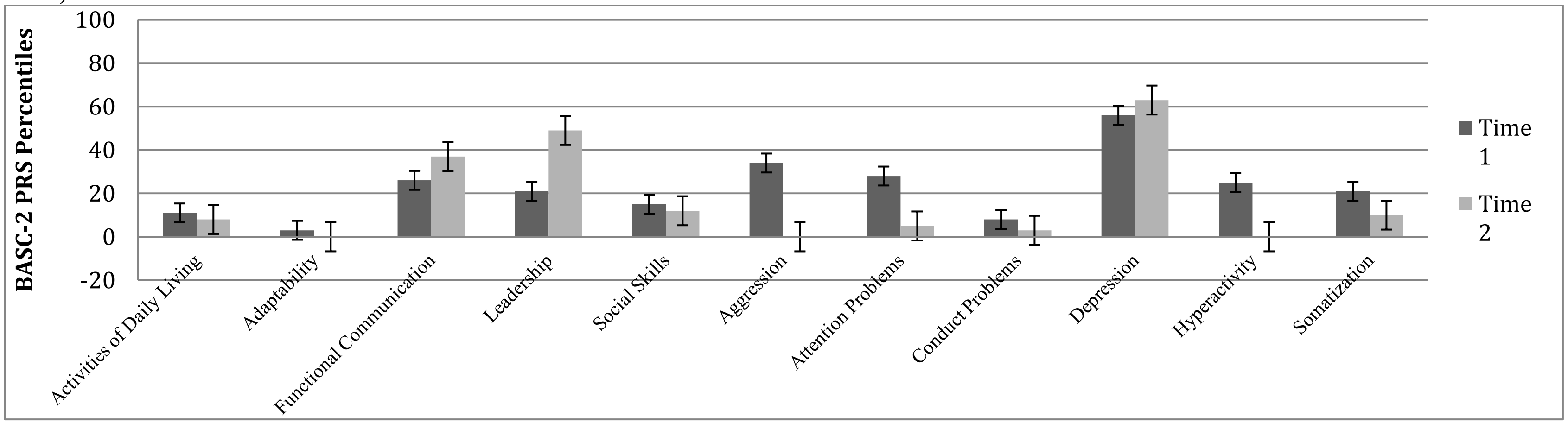


Figure 6.5 Parent Report Percentiles for Michelle for the Behavioural Assessment Systems for Children (2nd Edition, Reynolds & Kamphaus, 2004)

Table 6.15. Standardised Scores and Standard Deviation Differentials Over Time for the Teacher Report Adaptive Scales for the Behavioural Assessment Systems for Children (2nd Edition, Reynolds & Kamphaus, 2004)

	Adaptability			Functional Communications			Leadership			Social Skills			Study Skills		
	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT
Time 1	13	25	43.22	27	28	47.44	23	37	50	49	34	51.67	19	23	46.33
Time 2	3	19	44.78	14	42	48	12	62	54.78	17	43	55.22	5	49	49.22
SD Differential	-1.43	- .86	+ .22	-2.34	+2.52	+ .15	-1.03	+2.35	+ .45	-5.14	+1.44	+ .57	-2.24	+4.15	+ .46

[a]Charlie

[b]Michelle

Table 6.16. Group Mean Standard Deviations for Difference between Time 1 and Time 2 for the Teacher Report Clinical Scales for the Behavioural Assessment Systems for Children (2nd Edition, Reynolds & Kamphaus, 2004)

Group	Aggression	Anxiety	Attention Problems	Atypicality	Conduct Problems	Depression	Hyperactivity	Learning Problems	Somatisation	Withdrawal
SSM	12.64	13.09	6.63	9.80	8.49	10.88	7.11	5.33	8.92	8.94
EMT	12.24	7.98	6.19	3.28	1.33	7.33	3.93	4.61	6.90	7.80

Table 6.17a. Standardised Scores and Standard Deviation Differentials Over Time for the Teacher Report Clinical Scales for the Behavioural Assessment Systems for Children (2nd Edition, Reynolds & Kamphaus, 2004)

	Aggression			Anxiety			Attention Problems			Atypicality			Conduct Problems		
	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT
Time 1	58	24	43.33	59	45	42.22	51	32	44.67	81	21	45.56	60	18	43.78
Time 2	96	68	44.67	94	5	46.89	89	8	41.11	99	24	44.22	96	27	44.33
SD Differential	+3.1	+3.59	+ .11	+4.39	-5.9	+ .59	+6.14	-3.88	-.58	+5.49	+ .91	-.41	+27.07	+6.77	+ .41

[a]Charlie

[b]Michelle

Table 6.17b. Standardised Scores and Standard Deviation Differentials Over Time for the Teacher Report Clinical Scales for the Behavioural Assessment Systems for Children (2nd Edition, Reynolds & Kamphaus, 2004)

	Depression			Hyperactivity			Learning Problems			Somatisation			Withdrawal		
	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT	C[a]	M[b]	EMT
Time 1	84	74	44.44	75	12	43	90	11	45.67	21	17	43	62	49	45.33
Time 2	98	67	44.89	99	63	45.33	98	24	45.33	90	19	46.89	87	2	43.56
SD Differential	+1.91	- .95	+ .06	+6.11	+12.98	+ .59	+2.0	+3.24	- .34	+10	+ .29	+ .56	+3.21	-6.03	- .02

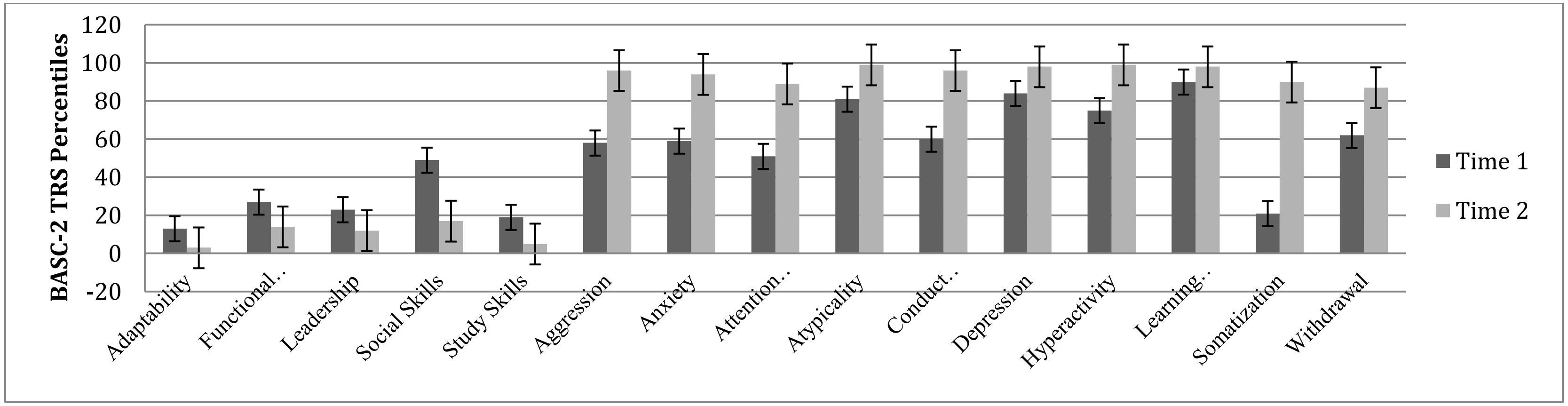


Figure 6.6. Teacher Report Percentiles for Charlie for the Behavioural Assessment Systems for Children (2nd Edition, Reynolds & Kamphaus, 2004)

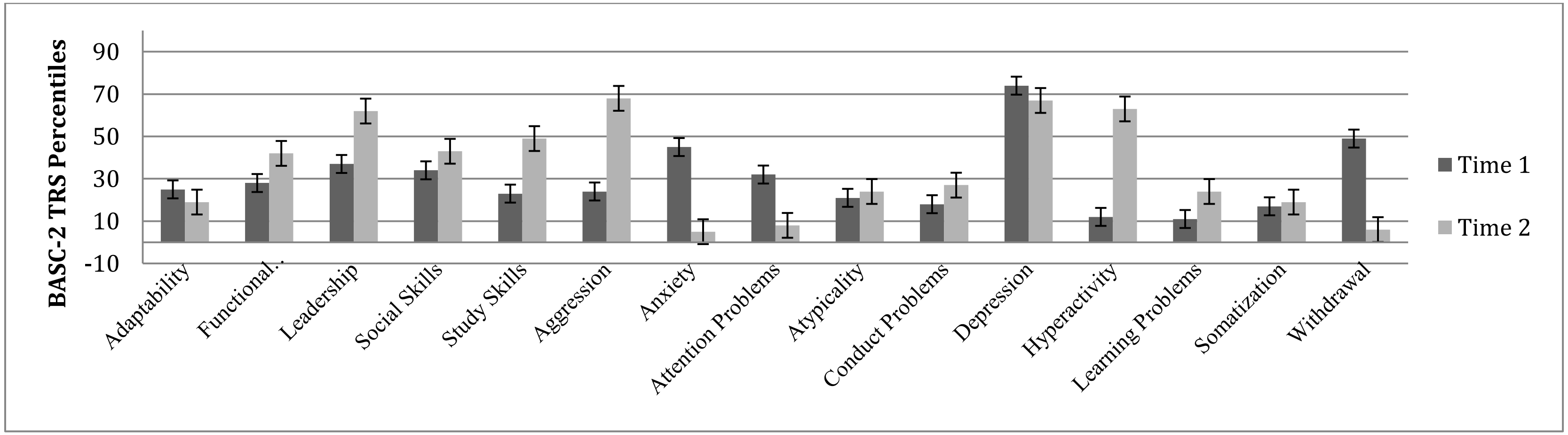


Figure 6.7. Teacher Report Percentiles for Michelle for the Behavioural Assessment Systems for Children (2nd Edition, Reynolds & Kamphaus, 2004)

As none of the scales for the BASC-2 parent or teacher report changed significantly over time in the group study, the following analysis reflects the relationship between Charlie and Michelle's musical learning and their socio-emotional wellbeing. Percentage change is only noted for those scales which parents and teacher reported a notable change over time.

The scale of Atypicality is only available for the teacher report and reflects unusual behaviours. Charlie's form tutor reported a score of above the 70th percentile at both time points for Charlie, whereas Michelle's form teacher indicated her behaviours were not atypical. It is apparent that the horn tutor also noted Charlie's behaviours were atypical in comparison to his more typically developing peers, such as Michelle. For example, by lesson 8 the horn tutor noted that Charlie did not seem able to recognise the notes whereas Michelle was described as making good progress. This was the same in lesson 9 at which point the tutor met Charlie's mother. She explained about Charlie's dyspraxia and 'all sorts of other things'. In lessons 10 and 11 the tutor attempted to adapt his teaching to enable Charlie to learn by choosing colours for the notes. This appeared successful. Michelle continued to make progress. However, in lessons 14 and 15 Charlie had not practised and was making no progress whilst Michelle continued to learn new songs and improve.

However, mixed results were reported for most of the adaptive scales. Both parents and teachers for both children reported them as being below average (Adaptability, Activities of Daily Living, Functional Communication, see Tables 6.9.3 and 6.9.7). However, Charlie's mother initially reported average levels for Leadership and Social Skills, although these decreased over time by 59.7% (6 SD) and 28.3% (3 SD) respectively. Charlie's teacher reported a similar pattern for Social Skills (a reduction of 65.3% from average to under the 30th percentile). However, for Leadership whilst the teacher also reported a decrease (by 47.8%), the initial score was below average and decreased further at Time 2. These initial scores are highly inconsistent with a diagnosis of ASD. Furthermore, ASD is not a condition that appears over one year in eight-year-old children. This suggests some other factor was causing Charlie to demonstrate less leadership and social skills to his parent and teacher over the year.

Michelle, whose parent and teacher had also reported below average scores for adaptive skills at Time 1, displayed a different pattern over the year as her scores mostly increased coming into line with the EMT group mean scores. However, for the Social Skills scale Michelle's parent report score was below average levels at Time 1 and reduced by a further 20% over time. For the teacher report of Social Skills Michelle's initial score was below the EMT group average but just above the 30th percentile. Although her score did increased (by 26.5%, it did not quite come into line with the EMT group mean.

The horn tutor observes that in lesson 4 Charlie was described as chatty to the point of being disruptive. In contrast Michelle was described as not speaking much and being focused on the tasks. By lesson 12 Charlie and Michelle were able to play together. Both children joined the school band. In lesson 16 Charlie said he had lost his book. Lesson 17 presented a surprise as Charlie had played a solo in the school band that week. Lesson 18 to 23 saw both children reading and playing well and making progress. By lesson 26, Charlie was *"much better"* but Michelle was upset about something and did not want to play. The final three lessons saw both children appearing motivated as they were due to play in the school's summer festival. The school concert provides a focus and Charlie behaves well in three consecutive lessons. It is possible that, he has begun to see that musical learning has provided him with a framework, a reason to understand the benefits of sustained practice and developed goal-directed behaviour. The horn tutor described Charlie as chatty, which shows some social skill (though not when disrupting others obviously). He did not really describe typical ASD type behaviours. Michelle's mother' reports also suggested some social difficulties, so these were apparent for both Michelle and Charlie but manifested in different ways. The horn tutor noted that Michelle took to the school band 'better than most' and Charlie appeared to enjoy playing his solo. Perhaps there is something about the structure of musical learning, the boundaries, the hierarchies and even the stereotypes that supports individuals who find it hard to navigate the unwritten rules of social interplay.

Whilst the observation of Charlie's adaptive and social behaviours were not entirely consistent with his diagnosis, the BASC-2 presents a typical profile of behaviours associated with ADHD according to parents and teachers and this is supported by the qualitative descriptions. These behaviours seem to be the biggest obstacle Charlie faces with regard to making consistent progress learning his instrument. Charlie's scores for

Attention and Conduct Problems, and Hyperactivity were very high from both parent and teachers as would be predicted from his diagnosis (on the 70th percentiles or above at both time points). On the scale of Hyperactivity, Michelle's teacher observed a sharp increase of 425% (+12.98 SDs) in comparison to her mother's report of a distinct 100% decrease (-4.74 SDs) in this behaviour. Michelle's form teacher had reported an increase of 183% (3.59 SDs) to above average levels on the scale of Aggression, though her mother had again reported a 100% decrease in this scale score over time. This seems to suggest that Michelle was behaving differently at school from how she was either home or with her horn tutor. For example, in lesson 6 Charlie was described as *"messing around"* whereas Michelle was by then self-correcting mistakes. In lesson 7 the tutor sent Charlie out for swearing at another student, but he does not mention aggressive behavior in Michelle. In lesson 13, Charlie was described as a 'bit noisy'. In lesson 25 he was described as struggling to play simple tunes and complaining he was 'not allowed' to practice. The tutor said he wasn't sure he believed him and asked the school bursar (who organised the music at the school) to speak to Charlie's mother. Michelle continued to make consistent progress. Charlie was very late for lesson 27. He pretended he had practised but the tutor knew this was not the case as he had left his music at school. Charlie did not come to the next lesson. Speculatively, Michelle seems able to release her frustration with her peers in her form class (perhaps influenced by Charlie), but would not behave like this for her music tutor or at home whereas Charlie's frustration seems to boil over and he could not yet channel it consistently.

Both parents and teachers reported both children showed higher than average levels of Depression. Charlie's mother scored him in the 80th percentiles on both occasions, increasing by 3.6% over time. His teacher reported a higher increase of 16.7% from the 84th to the 98th percentile over the year. Michelle's mother's scores on this scale increased 12.5 % from average to above average (from the 56th to the 63rd percentile). However, her teacher observed a higher level initially (74th) but subsequently reduced her scores by 9.5% to the 67th percentile. Charlie's depression score may reflect his difficulties coping with the many challenges he faced but the reason for Michelle's depression score is not apparent in the data.

Somatisation is a scale that reflects a tendency to be overly sensitive to and complain about relatively minor physical problems and discomforts. Here there is some evidence that Charlie behaved differently at school from home. Charlie's mother reported below average and decreasing further (by 83.3%) scores on this scale. However, his teacher reported a sharp rise of 32.9% from a low level to the 90th percentile. Speculatively, it might be that Charlie needed an outlet to deal with the frustration of having to constantly battle the challenges he faced cognitively, physically, and socio-emotionally and that somatising at school helped him avoid situations that caused him distress. Michelle was not reported as somatising by her form teacher or parent. However, the horn tutor she did write once that she did not want to play because she was upset. This is not somatising per se but it is of interest because although the parent and teacher reports showed higher than average level of depression, Michelle's behaviour is highly focused and high achieving in the main. It is interesting that she found a space to be able to let her guard down with her music tutor in this way and felt that it would be acceptable for her to say she did not feel like playing.

Charlie's teacher reported an average Anxiety score at Time 1 but this increased by 59.3% (3.1 SD) over time[18]. This is reflected somewhat in the horn tutor notes. When Charlie struggles with learning (his Learning Problem scales were notably reported by his form teacher as above the 90th percentile at both time points), his anxiety increases and he acts out his frustrations. This manifests as disrupting others during lessons, and is evident in his approach/avoidance patterns towards attendance and practice. In contrast, Michelle's teacher reports her anxiety levels, which were initially in line with the EMT group, decreased by 88.9% (5.9 SD) to very low levels by the end of the study. Whilst this cannot be directly attributed to musical learning, her success through consistent practice and attendance led to her playing in the school festival which may have provided some feelings of achievement and agency contributing to the reduction in her anxiety. Michelle showed signs of becoming less withdrawn at school according to her teacher report. However, Charlie appeared to become more withdrawn as his teacher reports his level on the scale of Withdrawal[19] increased over time by 40.3% (3.21 SD) from the 60th to the 87th percentile. In contrast, the horn tutor reports that towards the end of the year Charlie is focused and practising, making progress as he and Michelle prepare for the end of year school music festival. If Charlie found the courage to play a horn solo, perhaps his music lessons, with the support of his tutor and school and mother can provide a way for Charlie to develop a sense of agency and identity in his own life. Many great musicians have overcome obstacles.

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[18] Due to missing data, this scale is not available for parents in this study.
[19] The scale of Withdrawal is only available for teacher report in the BASC-2.

6.4 Discussion

This chapter presented a case study of the individual differences between two children and a group study comparing the effects of musical learning during the first year of taking up a musical instrument. Both children were in mainstream schooling, though Charlie was suspected of having a cluster of developmental neurological difficulties, which might have been expected to impact on his music perception. The results based on the measures used in chapters three to five demonstrated that both Charlie and Michelle were intelligent and had higher than average musical aptitude, but that Charlie's conditions variously affected his results. Furthermore the complex diagnosis was not consistently represented in the measures. The overall profile, including the horn tutor notes suggested that the majority of Charlie's difficulties were related to focus and attention, leading to slower overall progress than Michelle though both joined the school orchestra and played in the end of year concert.

A systematic review of the results shows that, in line with the group study, extra-curricular musical tuition did not appear to increase scores significantly on a test of musical aptitude, measured here using the PMMA. The group study showed significant increases for the EMT group but not the SSM for fluid intelligence as measured using the WASI. Significant increases in the subtests of vocabulary and matrix reasoning were also apparent for the EMT group but not the SSM group. In this chapter, Charlie and Michelle displayed differing patterns with increases over and above the EMT group mean scores for matrix reasoning and vocabulary respectively. Comparative analysis of the CMS suggested both children increased their aSTM more than the EMT group, as measured using the word learning list subtest. However, these advantages were not consolidated as both children decreased their scores over time on the word list recall subtest, whereas the EMT group mean score increased slightly. Whilst no significant group differences were observed over time with the CMS measure, all participants (including the active control group) did increase on the subtest Sequences, which is a measure of executive function. Charlie recorded a low score for this test (9^{th} percentile) and his score did not change. Michelle's score increased in line with the EMT group mean score by ~20%. For the MABC-2, the EMT group had improved significantly more than the active control group on the Aiming and Catching component (see chapter four). Charlie's scores increased 36% more than the EMT group mean, and also increased by 42.9% for the Manual Dexterity component. Although the group study did not show a significant change over time for either group on this component, this was particularly important due to the impact musical instrument learning appeared to be having on Charlie's motor abilities.

Whilst the BASC-2 teacher and parent reports did not show any change over time in the group study, here the results of this measure enabled a deeper understanding of how Charlie's difficulties were impacting upon his socio-emotional behaviours. The results also provided a direct comparison of some modes of behaviour showing some differences between home and school, especially for the scales of Somatisation. The teacher report also provides a scale of Anxiety and for Charlie, his score increased from the 60^{th} to the 90^{th} percentile over the year. Simonoff and colleagues (2008) suggest 70% of children with ASD have at least one co-occurring disorder, and 41% have two or more. The most common of these are social anxiety disorder (29.2%) and ADHD (28.2%). These combined might account for Charlie's difficulties in focusing during testing and in lessons. However, he did continue to make progress and both he and Michelle seemed to find something in their developing musical lives which they were not afforded elsewhere. For example, although Michelle appeared to be a very competent and well-behaved student, the BASC-2 provided evidence that she was suffering with some social difficulties. Whilst she became more aggressive in her peer group over the year, she did not demonstrate this behaviour at home or with her horn tutor. Indeed, she felt safe enough with her horn tutor to say that she did not feel like playing when she was upset on one occasion. Furthermore, she and Charlie joined the school band and seemed to enjoy positive motivation towards performing at the end of year concert.

Differences were identified between children with regard to their mental strategies for each of the five types of musical learning categorised by McPherson (2005; 2006). For performing rehearsed music, attitudes to practice formed four key themes which were; organisation of practice, order of practice, improvement strategies and self-correction strategies. In this case study, the horn tutor reported that for Michelle all four of these aspects were in place and she was making good progress. However, Charlie's difficulties result in problems with organisation, which may lead to unsystematic practice. However, according to the PMMA, he appeared to possess good auditory discrimination and according to the CMS, good auditory memory skills. Along with his horn tutor notes, it seems Charlie might have adopted the effective strategy of playing by ear.

Charlie and Michelle were compared in this case study chapter for three reasons. Firstly, because they were starting to learn the tenor horn as their first musical instrument at the same time and they shared their tenor horn lessons. Secondly the tutor generously provided a detailed qualitative report of each lesson enabling direct comparison of their learning. Thirdly, whilst some outlying data points had been noted associated with Charlie, the BASC-2 in particular identified the difficulties he faced learning in a mainstream school. However, the mixed methods evidence shows that learning a musical instrument can help develop motor abilities and provide a safe social group for differing natures and rates of progress. It seems appropriate at this point to refer to the addendum presented in Appendix E regarding the current status of Charlie and Michelle. Charlie is still playing the tenor horn but his tutor reports he is making slow progress. He can play and recognise the notation for five notes consistently, but his lack of practice is still holding him back. However, he is aiming to take his Grade 1 next year. Michelle was reported as being the schools' 'star pupil'. She took her Grade 1 Tenor Horn last summer (2015) and passed with distinction, and she is taking her Grade 2 later this spring (2016). Whilst the musical journey for Michelle may be easier at this stage, it is possible that Charlie's determination and personality may stand him in good stead for the brass section as shall become evident in chapters seven and eight.

Music is not an intervention (Hetland, 2000) and we need to think carefully about which questions we ask and how we attempt to research the phenomenon when a meaningful sample cannot be constructed with ecological validity and randomised control trials may not be ethically or practically viable (Jermyn, 2001; Swan & Atkinson, 2012; Thomson et al., 2004). The next chapter reframes the question regarding transfer effects by asking musicians themselves about their experiences. Do they have any awareness of how music has changed their lives? Is musical learning transformative in a positive way? Or are their negative costs involved in the choices they made to become musicians? The next chapter asks, what benefits if any, are musicians aware that being a musician has brought them in their lives?

6.6 Limitations

There are several limitations to this case study. Firstly, although the study was possible because the music tutor taught both children simultaneously and provided notes on the lessons, essentially it was a convenience sample. This presents some difficulties with regard to being able to generalise the findings as the children in the case study are identify as different genders, ethnic groups and also one has been reported as being diagnosed with developmental neurological conditions which may effect learning, whereas the other has not. Developmental delay is known to have implications that may have affected Charlie more than Michelle (Allerton, Welch & Emerson, 2011; Hinckson & Curtis, 2013). Furthermore, there are issues pertaining to generalisability concerning measurement error due maturation and regression to the mean (Feinstein et al., 2015). In this case study, it is important to note that developmental trajectories may differ between the children. However, by comparing the individuals with the extra-curricular music training group, it is possible to demonstrate the magnitude of observed changes within an appropriate context. Further observations in chapter eight regarding teaching and learning of music to children with special educational needs suggests the music tutor's approach was not unusual with regard to attempting to adapt his teaching strategy to accommodate and support Charlie's needs. There are also difficulties with case studies regarding a bias created by the addition of the researchers opinion. However, the inclusion of the group data also balances this. The largest limitation of this case study is that the researcher did not have access to the diagnostic report. However, the data in chapter two demonstrates that other apparently typically developing children were also dealing with learning difficulties and psychosocial problems. All these children attend mainstream schools and therefore it is proposed that this study is valid ecological research reflecting a typical range of school children.

6.7 Chapter Summary

The analyses of the data in chapters three, four and five suggested some individual differences were worthy of further investigation. Therefore, inspired by McPherson (2005; 2006) and McPherson, Davidson and Faulkner (2012) a case study of individual differences undertaken specifically regarding one child (Charlie) whose variation in measures had variation had led to the removal of some data points as outliers.

Quantitative data from the musical instrument tutor was available for this child and one other (Michelle) with whom he shared his music lessons. Charlie presented an atypical profile cognitively, behaviourally and socio-emotionally. His scores on the measures of these domains are compared to a typically developing peer, Michelle which whom he shared his music lesson. Their scores were also systematically compared with the extra-curricular music training group. This provided a deeper understanding of how co-occurring neurodevelopmental and social difficulties may be impacted by learning a musical instrument. In particular, the evidence suggests that Charlie's tenor horn lessons were having a significantly beneficial impact on his motor abilities. Furthermore, this study provides new insights into the structures supporting musical learning. For example, the end of year concert provided motivation to practise pieces to be performed. However, more interestingly, it seems the school orchestra provided a constructed and hierarchical set of social codes of behaviour that enabled Charlie and Michelle to navigate their positions within this structure providing a safe place to explore and express their developing musicality.

Chapter Seven – Musicians and Personality

7.1 Abstract

In order to characterise the musicians participating in the grounded theory study in chapter eight, this chapter provides a short overview of research into personality traits before reviewing the literature researching personality in musicians. Qualitative descriptions of the participating musicians and quantitative analyses, using a brief Big Five personality inventory provides background and context for the upcoming study. The analyses found that this sample reflects previous research on musicians and personality in that these musicians score higher than the general population on the dimension of Openness to Experience, and that female musicians scored higher than the general female population on the dimension of Extraversion. However in contrast to previous research, no differences in personality were associated with specific musical instruments in this sample.

7.2 Introduction – General Overview of Research into Personality Traits

Kluckholn & Murray's (1953) assertion that every person is in certain respects like all other people, like some other people and like no other person, conveys the essence of speculation regarding the consistency of behaviours associated with personality traits. Allport (1961), an early pioneer of personality research, identified over 4000 words in the dictionary that are used to describe people. He divided these into descriptions of traits, which he described as cardinal, central and/or secondary. These were based on a distinction between a *genotype,* which reflects the endogenous state of a person; how they retain information and use it to interact with the external world. In comparison, the term *phenotype* reflected how a person is affected by others and reflects their acceptance of their environment or exogenous state. He observed that there are common traits in which dimensions of stable behaviours can be compared (known as a nomothetic approach) and individual traits, which focus on the individuals' unique experiences (known as an idiographic approach). Common traits, such as aggressiveness for example, tend to be described along a continuum and are relatively universal. Individual traits are based on the individuals' experiences of the world they have developed in and are very difficult to compare systematically. Therefore, the literature referred to in this chapter is based on a nomothetic approach to the psychometric measure of personality traits.

Eysenck and Cattell were able to reduce Allport's 4000 traits of personality, though by using different methods. Eysenck's (1965) had worked in a psychiatric hospital with ex-servicemen who were presenting with neurotic disorders following the Second World War. He gave 700 soldiers extensive questionnaires about their behaviour and used a statistical technique known as factor analysis to analyse their answers. Based on the four temperaments (Melancholic, Choleric, Phlegmatic and Sanguine), and therefore assuming that personality factors would not be correlated, he used an orthogonal rotation to identify three clusters of behaviours. These he described as Extraversion, Neuroticism and Psychoticism. However, Cattell (1965) did not believe that personality could be defined through only three dimensions. He recruited a range of participants that he believed reflected the general population and used data from three sources (L-data; life records such as school grades, Q-data; self-report questionnaires rating personality, and T-data; a specially designed questionnaire designed to probe individuals personalities), which he factor analysed using an oblique rotation. This technique assumes that factors will be correlated, as Cattell believed that personality traits were connected to some degree. He identified 16 personality traits, which were divided according to a hierarchy of surface traits, which are visible and easily identified by others (such as warmth); source traits that are less visible but underlie behaviours (such as anxiety) and a lower level of habitual responses. These multi-trait theories of personality were still prevalent until the 1990s when a consensus emerged that five factors adequately described personality (Costa & McCrae, 1992; Digman, 1990; Goldberg, 1993; McCrae & Costa, 1987 & 1989). The 'Big Five' are seen as descriptive classifications of individual differences. The five descriptors are Openness to Experience, Conscientiousness, Extroversion, Agreeableness and Neuroticism (Digman, 1990; Goldberg 1990). Each of these has desirable and undesirable behaviours associated as a continuum. Scoring highly on Openness to Experience positively includes being imaginative, intelligent and creative. Conversely, low scores suggest behaviours that can manifest as being considered shallow, unsophisticated and unperceptive. Conscientiousness is characterised by being organised, thorough, tidy and competent (high score) or as being careless, unreliable and sloppy (low score). Individuals with high scores on Extroversion are outgoing, sociable and assertive, whereas those with low scores on this factor are introverted, reserved and passive. With regard to Agreeableness, this can be demonstrated as being kind, trusting, warm, altruistic and modest or as coming across as hostile, selfish and cold. Finally, scoring highly on the trait of Neuroticism (or Emotional Stability) would suggest a high level of anxious, moody, temperamental and impulsive behaviours compared to a low score, which would suggest a calm, even-tempered and imperturbable personality. Traits are measured using Likert scales on which a participant rates him or herself as either agreeing or disagreeing with a statement about how they see themselves (see section 7.5.2). This yields a score ranging from 0-10, in which five reflects an average population score. Research has investigated personality traits of individuals in expert groups, and the few studies into personality traits in musicians will now be explored.

7.3 Musicians and Personality

Kemp (1981) suggested that attempts to define a clear association between personality and musical ability have not been successful, though he implies that this may reflect the broad range of personality inventories used in studies. With regards to young children he cited two early exploratory studies (Schleuter, 1972; Thayer, 1972), which investigated correlations between musical aptitude and personality. The measures used were the Musical Aptitude Profile (Gordon, 1965), the Iowa Test of Musical Literacy (Gordon, 1971), and the High School Personality Questionnaire (Cattell & Cattell, 1969). The results of these studies were inconclusive as no robust associations between personality traits and musical ability were found using these measures. A study by Shuter, (1974), did suggest a link between sensitivity, self-control and musicality as measured using the Children's Personality Questionnaire (Porter & Cattell, 1959) and the Bentley Measures of Musical Abilities (Bentley, 1966), although the sample size was small, comprising only 32 participants. In comparison, Martin (1976) studied 200 older secondary school children and observed significant correlations between musical involvement and extraversion, adjustment, intelligence and sensitivity.

Warburton (1968) and Entwistle (1972) had found a facilitating effect of personality traits, which appear to change around the age of 14, on academic achievement. Kemp had wondered if there was a similar pattern with regard to musical achievement. He suggested that whilst an early interest in music might be facilitated by *"an extraverted and adjusted temperament"* (Kemp, 1981, p. 4) the process of selection, for example to conservatoires, might be supported by the opposite manifestation of those same personality traits, i.e. introversion and doggedness. He also believed that developmental changes in personality might explain the apparent lack of consistency in findings regarding musicality and personality. Roberts, Viechtbauer & Walton (2006) have since provided robust evidence that personality traits can alter across a lifespan. In the 1980s though, Kemp investigated three different age groups of musicians in order to test his theory regarding personality and maturation effects in musicians. His samples included: 1) 496 secondary school student ages between 13 and 17 years (with a control group of 272 students who were not interested in music or creative activities), 2) 688 full-time music college students aged between 18 and 25 years (with a control group of 160 students who were not studying music) and 3) 202 professional musicians aged between 24 and 70 years. For this group he did not attempt to recruit a non-musical adult control group, but used normed data in the analysis. As with the other studies reported, he utilised Cattell's High School Personality Questionnaire (Cattell & Cattell, 1969), which measured 16 personality traits. In this questionnaire, traits are rated as a continuum from a negative to a positive pole. For example one of the first order factors (Source trait A) presents a negative description, *Sizia,* as a reserved, detached, critical or aloof personality trait. The positive pole contrast, *Affectia*, describes an outgoing, warm-hearted and participatory personality trait.

Kemp found that the profile of musically interested secondary school students included significant levels of Introversion, Pathemia[20], Dependence, Intelligence and Good Upbringing. For the second group of music students, he reported high levels of Introversion, Anxiety, Pathemia, Intelligence and Good Upbringing. The third group differed from the normed data in showing higher than average levels of Introversion, Anxiety, Pathemia, Independence, Naturalness, Subjectivity (in males only) and Intelligence. To summarise, Kemp found high levels of Introversion, Pathemia and Intelligence across all age ranges in performing musicians. He concluded that musicians have the *"ability to withdraw into a colourful and imaginative inner mental life,* [whilst] *at the same time providing the single-mindedness necessary for the acquisition of technical skills."* (Kemp, 1981, p. 12).

One further factor of interest and of possible relevance in this study was Kemp's findings regarding gender roles amongst musicians. Gardner (1955) had reported that that in high school, male instrumentalists tended to be less masculine and less active than their non-musician peers (as measured using the Guilford-Zimmerman Personality Survey; Guilford & Zimmerman, 1955). Eysenck and Eysenck (1969) had highlighted the importance of considering sex differences in personality research, and this led Kemp (1982) to re-analyse the data from his 1981 study. He found significant differences between male and females on the dimension of extroversion/introversion. Females musicians showed significantly greater divergence from the norm than males by demonstrating a trend towards aloofness and self-sufficiency. Kemp described this as *"sex-identity ambivalence in female musicians"* (Kemp, 1982, p. 53). In *The Musical Temperament* (1996) Kemp confirmed his sexual androgyny hypothesis, proposing that male musicians exhibit more female characteristics and vice versa. In general he indicated that musicians tended to be more sensitive than is typical in the general population and he suggested that they showed an increased tendency towards factors of Openness to Experience such as being imaginative, creative and interested in change.

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[20] Recently, Charmorro-Premuzic and Furnham (2014) have suggested *Pathemia* as a replacement for the term Agreeableness or Affection. They suggest that Will or Independence is a more appropriate descriptor than Openness to Experience and also suggest including a measure of *g* as a sixth factor of personality.

However, the picture is not entirely clear. For example, Marchant-Haycox and Wilson (1992) administered the Eysenck Personality Profiler with a group of musicians and reported that they tended to be introverted and unadventurous. Gillespie & Myors, (2000) then considered the personality traits of 100 rock musicians and found high levels of Neuroticism and Openness to Experience which were not mediated by instrument, type of rock music, duration of playing rock music, level of musical ability or commercial success.

More recently, Corrigall, Schellenberg & Misura (2013) presented two studies focusing on far transfer effects between musical training, cognition and personality. They adopted the Big Five Personality dimensions (McCrae & Costa, 1987), which they describe as the dominant framework for contemporary research regarding individual differences in personality. The authors hypothesised that individual differences in personality might explain recent findings dissociating musical training with wellbeing. They investigated personality traits in an adult sample of 118 undergraduates and also a child sample of 167 ten to twelve year olds who were actively involved in music training during at the time of testing. Corrigall and colleagues suggest that learning a musical instrument could be facilitated by the trait of Conscientiousness and/or by Openness to Experience as these traits are also thought to be associated with intellect and achievement (Dollinger & Orf, 1991; Harris, 2004; McCrae, 1993). They used the 44-item Big Five Inventory (BFI: John et al., 1991; 2008) and the Wechsler Abbreviated Scale of Intelligence (WASI: Wechsler, 1999) to test the adult sample (Mean age 20 years, 78 women, 40 men) who were grouped according to years of musical learning and controlled for socio-economic status (SES). Annual family income was measured on a 9-point scale in Canadian dollars (1 = < \$5,000, 9 = \$200,000). The average family income for the sample was between \$75,000 and \$100,000 per annum. They reported higher levels of Conscientiousness in females than in males generally in their sample, and also that participants with highly educated parents had a higher family income. Analysis of the BFI showed that Openness to Experience was associated with regular music playing (r = .32). It was also associated with having more highly educated parents (r = .19) and higher IQ (r = .26). There was no effect of age, sex or family income for this personality trait in adults. Further multiple regression analyses revealed that Openness to Experience was associated with duration of music playing when IQ and demographics were held constant.

Corrigall and colleagues also investigated these variables with a group of 10-12 year old children (N=167, mean age=11.5 years, 82 girls, 85 boys). Of these, 108 had some musical training and 57% were taking music lessons at the time of the study with a mean duration of 25.7 months (SD 32.4). They used the Inventory of Children's Individual Differences (Deal et al., 2007) rather than the BFI for this study. The children who received music lessons for longer had higher family incomes (r = .18), more highly educated parents (r = .32), higher IQs (r = .21), and school grades (r = .25). They also scored higher on Openness to Experience (r = .27), and Conscientiousness (r = .22). When these two factors were included in a multiple regression analysis, the model of association between demographics, non-musical activities and cognitive ability (which accounted for 18.2% of variance) improved by a further 3.7% (totalling 21.9%). A final model showed duration of musical training and IQ accounted for 24.1% of variance at the first step, and adding the two personality traits contributed a further 21% resulting in a model whereby musical training, IQ, Conscientiousness and Openness to Experience explained 45.1% of the variance in the average grade of the children. However, neither duration of musical training nor Openness to Experience were significant unique contributory factors in this model. The authors suggested that in studies investigating the effects of musical training, personality must be included as a variable that might have a systematic effect.

Finally, Corrigall and colleagues suggest that pre-existing differences form a natural bias that ensures positive correlations between measured variables. For example, they suggest that children with low musical aptitude are unlikely to choose to pursue music. Therefore, it is not surprising that studies on these samples (comparing musically trained with control groups) demonstrate a positive effect of musical training to improve listening abilities (see e.g. Besson, Chobert & Marie, 2011; Kraus & Chandrasekaran, 2010), enhance speech perception (Degé & Schwarzer, 2011), and language processing (Moreno et al., 2009; 2011b). Furthermore, motivations to pursue musical training are important and complex (see e.g. McAuley, Henry & Tuft, 2011; McPherson 2005). However, whilst Corrigall and colleagues assert that personality is a stable heritable factor (0.5, Bouchard & Loehlin, 2001) similar to intelligence, other research has clearly indicated an effect of maturity in that Extroversion tends to increase and that adolescents become more emotionally stable over time (i.e. score lower on the dimension of Neuroticism, see Roberts et al., 2006). However, evidence of the effect of gender on personality during adolescence has been less equivocal. For example, Branje et al. (2007)

found no change or difference between girls (n=146) and boys (n=142) aged between 11 and 17 who self-reported yearly for Emotional Stability. For Agreeableness girls but not boys increased their scores in a curvilinear pattern. For girls but not boys, scores of Conscientiousness increased in a linear pattern. This was also true for girls on Openness to Experience, but boys' scores decreased in a linear pattern on this factor. For Extraversion, girls increased their scores in a curvilinear pattern, but boys decreased their score in a linear pattern. Klimstra et al., (2009) found gender and age differences on all personality factors. His findings concurred with Branje and colleagues regarding Agreeableness. They found large difference for Conscientiousness (girls scoring higher than boys), which increased during adolescence and then remained stable. Taken together their explanation for these two factors suggested that from an evolutionary point of view, girls need to maintain more positive personal inter-relationships, whereas boys are more focused on social dominance. Klimstra and colleagues found similar levels of Openness to Experience between boys and girls. Regarding Emotional Stability, they found that boy's levels increased during adolescence whereas girls did not. This they explained with evidence suggesting girls internalising problems more than boys. Roberts, Caspi and Moffitt (2001) found that in an older sample (18-26 years) women showed increasing constraint, harm avoidance and control in comparison to men, whereas men showed increasing social potency but decreasing social closeness. Schmitt and colleagues (2008) considered cultural differences and issues of gender in a large sample (N=17,637) across 55[21] of the 56 nations that participate in the International Sexuality Description Project (ISDP; Schmitt & 121 Members of the ISDP, 2003, 2004). They found women score more highly than men on the dimensions of Neuroticism, Extraversion, Agreeableness and Conscientiousness across all the ISDP nations. However, Schmitt and colleagues also found that differences between men and women's personality traits have become more pronounced as society has developed. Their study demonstrated that when measures of life span and health, access to education and economic wealth are taken into consideration, there is less difference in personality traits between genders in less developed than in more highly developed societies.

In two studies, Müllensiefen and colleagues (2014; 2015) explored the dynamics of personality with regard to musical engagement. In the first of these, they included a measure of personality (Study 3d, Ten Item Personality Inventory; TIPI Gosling, Rentfrow & Swann, 2003) to explore potential associations between personality traits and

[21] Only data from the Ukraine was excluded due to an unsatisfactory translation of the BFI

the traits of musical sophistication (McCrae, 2007; Vuoskoski & Eerola, 2011). Their sample included nearly 150,000 participants as part of an online survey. Müllensiefen and colleagues observed a significant relationship between musical abilities and Extroversion (r = .33). They also found a significant correlation between musical abilities and the Openness to Experience (r = .43) trait, as previously reported in Kemp, (1996), Gibson et al., (2009), and Corrigall et al. (2013). However, unlike Kemp (1996), Marchant-Haycox and Wilson, (1992) and Gillespie & Myors, (2000), they did not find a link between musical abilities and Conscientiousness (r = –.16) or Agreeableness (r = .18). Emotional Stability (a more contemporary description of Neuroticism, r = .16) did show some correlation with musical abilities but not to the same magnitude as the other two traits ($p < .05$, rather than $p < .01$, r as reported above). Indeed, supported by previous literature, the strength of the association led the authors to suggest that musical behaviour could be one constituent of the personality trait of Openness to Experience (Müllensiefen et al., 2014, p. 10).

In the 2015 study, Müllensiefen and colleagues tested 300 female students between 10 and 18 years of age on a range of musical and cognitive variables in a cross-sectional study. They also included the TIPI (Gosling, Rentfrow & Swann, 2003), which is similar to the BFI as a short inventory of personality. Using pairwise correlation matrix computations, they revealed that of the five dimensions, only Extraversion was directly related to a musical variable (beat perception). They also found that a range of musical skills and behaviours were connected to the Openness to experience dimension.

In addition to associations between overall measure of musicality and personality traits, some research suggests that specific traits are associated with expertise on specific musical instruments. In a study investigating stereotypes with Glaswegian symphony musicians, Davies (1978) reported that professional brass and string players were believed to possess very different personalities. For example, the brass players described themselves as honest, salt-of-earth, and straightforward whereas they described the string players as oversensitive and wet. In contrast, the professional string players described themselves as hard-working and conscientious and the brass players as loud-mouthed, boozy and coarse (Davies, 1978, p. 203). Kemp (1981b) found that professional woodwind and string players showed higher levels of introversion than brass players, keyboard players and singers. In a study of 100 high school musicians, Builione and Lipton (1983) measured introversion, extroversion and a liking for alcohol. The high school brass players rated themselves as highly extrovert with a liking for alcohol. The high school string and bass players viewed themselves as humorous and percussionists viewed themselves as athletic and sexual. The other high school musicians viewed the woodwind players in general as being feminine, intelligent, or timid. Overall, the authors reported that the stereotyping in the high school was similar to that reported in other studies of professional musicians.

7.4 Hypotheses

Previous research investigating the personality traits of musicians suggests that the trait of Openness to Experience will be higher than other traits and higher than in the general population amongst musicians. As the sample included in this study specifically reflects contemporary working musicians in the U.K. it is important to understand whether this trait is reflected in these participants in order to be able to compare results with other studies. Furthermore, empirical evidence regarding sex differences found amongst musicians from 25 years ago may not or may not reflect contemporary musicians in current society. Therefore a second hypothesis related to gender differences previously observed was included here. Consequently, a 10-Item Short Version of the Big Five Inventory of Personality (Rammstedt & John, 2007) was administered in order to test the following hypotheses.

H_{11} – Musicians will demonstrate levels of Openness to Experience above the mean of the general U.K. population

H_{12} – Female musicians will exhibit higher than general U.K. population norms for the personality dimension of Extroversion

One further exploratory aim was to investigate a potential relationship between personality traits and stereotypes associated with individual musical instruments, age and musical tastes as outlined in Hargreaves, Miell and MacDonald (2002). This has been extended to include descriptions of musical involvement as the following section outlines.

7.5 Materials and Methods

7.5.1 Participants

18 males and 10 females, aged between 20 and 70 years old, took part in the study. They all completed interviews lasting between one and three hours, which were carried out in a range of venues that were convenient for them.

Whilst all played more than one instrument, according to the primary instrument of choice, seven played piano, seven played acoustic/electric and/or bass guitar, five described their voice was their main instrument, four played drum kit, two were string players and two more described themselves as multi-instrumentalists. One participant was a brass player.

With regard to their current status, eight participants were described themselves as being musically creative and were therefore coded as Musical Creatrix [22] (MC: n=8), five explained that they taught music as their main form of income but were also very musically active. These were coded as Musically Active Tutors (MAT: n=5). Four explained they did many things creatively and business-wise with music as their main form of income. These were coded as Music Business Professionals (MBP: n=4). Three did not earn any significant income from playing music, but they described being a musician as their main identity and spent most of their spare time playing music or practising. These were coded as Musical Hobbyist (MH: n=3). Three participants had a classical formal musical learning route and these were coded as Classical Professional Musicians (CPM: n=3). In contrast, two professional musicians who were self-taught and played in the pop/rock/alternative music scene were coded as Alternative Professional Musician (APM: n=2). Finally, three participants had been professional musicians and taught music but had evolved their careers to become academics studying music. Only one of these did not currently play music actively. These three were coded as Musically Involved Academics (MIA: n=3). The following table gives a short anonymised description of each participant.

[22] The term Creatrix was used by Participant 12 to describe the variety of musical activities undertaken by themselves. As it appeared to apply to a number of other participants, it was included as a descriptor.

Table 7.1. Adult Musician Sample Characteristics

P	Sex	Instrument/s	Classification	Musical Status
1	M	Piano	MC	Active Classical and Jazz pianist, independent artist and part-time academic
2	M	Drums	MAT	Retired West End show drummer and active private tutor
3	F	Multi-instrumentalist and singer	MC	Active musician and therapeutic community artist, specialising in bespoke quality of life provision using music and art for the elderly, very young children and young people with disabilities and special educational needs in inner city areas.
4	M	Drums and Voice	MAT	Ex-military trained musician (Queens Guard, 30 years service), active session/function band drummer and private tutor.
5	M	Trumpet	MBP	Semi-active session player (over 20 Top 10 hits) and music company owner
6	M	Piano and organ	MIA	Conservatoire pianist (played for royalty), church organist and academic
7	M	Multi-instrumentalist, songwriter and session drummer	MC	Active musician, ex-session drummer (with international, Top 10 band) teacher and songwriter. Head of song writing at a music school. Duties include advising 200+ students each year on developing on stage performance as musicians and devising shows.
8	F	Voice	MH	Hobbyist award winning choral singer and active supporter of local music service and provision of music lessons to underprivileged children
9	M	Piano	MBP	Touring sound engineer with multiple international chart topping bands
10	M	Drums	APM	Touring drummer and recording artist with international chart topping band
11	F	Piano and Voice	MAT	Retired performer, music school owner and music teacher
12	F	Piano, Voice, Drums and DJ	MC	Community 'Improv.' artist and music teacher specialising in wellbeing programmes for children
13	M	Composer and conductor (Piano)	CPM	Won MBE for services to music. Active in running community radio show, several choirs and still conducts professionally, although past retirement age.
14	F	Classical singer	CPM	Retired from professional singing but runs local radio show and music teaching magazine and website
15	M	Multi-instrumentalist including drums, bass and composing	MC	Head of department at music school but still plays (once per month minimum) for fun. Duties include advising 200+ students each year on developing their artistry as musicians and putting together shows and pre-production composition work. Also records for library music.
16	M	Electric and acoustic double bass player,	MC	Professional session player, 'Improv.' artists and studio based composer and recorder (including jingles). Also Head of department at music school.

		guitarist, singer and composer.		
17	M	Guitar, mandolin and other stringed instruments	MAT	Private tutor and active musician on the ‘local’ scene, in several bands and playing weekly in ‘open mic’ nights.
18	F	Voice	MH	Hobbyist singer, avid music fan and music consumer.
19	M	Electric guitar, bass and voice	APM	Semi-professional musician on the DIY music scene, fanzine writer and infamous bootlegger
20	F	Manager	MBP	High-level artist and events manager with over 20 years experience in the international music business.
21	F	Classical guitar and flute	MIA	Grade 8 level musician, ex-peripatetic guitar teacher, and now full-time academic.
22	M	Guitar	MBP	Ex-semi-professional guitar player in touring band. Now owns and runs own recording studio. Also earns money as a live sound engineer.
23	M	Violin	MC	Touring international level session player and recording artists, who also teaches professionally but part-time with local music service.
24	M	Electric bass guitar	MH	Active hobbyist player on the local scene who ‘lives for music’
25	F	Voice and piano	MAT	Trained primary school music and maths teacher and active semi-professional classical singer
26	M	Conductor and pianist	CPM	Top international conductor and director of international music charity providing lessons for underprivileged children
27	M	Musician, Composer and Producer	MC	Top internationally acclaimed music producer. No longer plays instruments as only uses Pro Tools computer programme. Still thinks of this as playing music.
28	F	Classical Voice and Piano	MIA	Retired from professional singing, now full-time academic.

7.5.2 10-Item Short Version of the Big Five Inventory of Personality (Rammstedt & John, 2006)

The Big Five Inventory of Personality (BFI-44; John, Donahue, & Kentle, 1991) long form contains 44 short-phrase items designed to measure five dimensions of personality. These five (referred to with the acronym OCEAN) include: 1) Openness to Experience, 2) Conscientiousness, 3) Extraversion, 4) Agreeableness, 5) Neuroticism. In response to demand for a shorter, faster and culture fair personality instrument, Rammstedt and John (2007) devised the 10-item version used in this study (BFI-10), which relies on two items per personality construct.

Asked to circle the most appropriate response on Likert scale ranging from 1) Disagree strongly, to 5) Agree strongly, with a neutral mid point (3), participants are asked to complete the following statement *"I see myself as someone who…"*

The 10 statements in the English language version are as follows:

a) … is reserved
b) …is generally trusting
c) …tends to be lazy
d) …is relaxed, handles stress well
e) …has few artistic interests
f) …is outgoing, sociable
g) …tends to find fault with others
h) …does a thorough job
i) …gets nervous easily
j) …has an active imagination

BRI-40 and BFI-10 have been compared using large test samples (N=233 US, N=184 Germany) and this has shown that the BFI-10 captures 70% of the full BFI-40 variance and retains 85% of the BFI-40 test-retest reliability. Whilst population norms do not appear to be available for a UK sample using the BFI-10, Schmitt et al. (2007) carried out a large-scale study obtaining data from 56 countries. For the U.K. the sample included 138 males and 345 females gathered from the general community as well as college students. The norms calculated for the

U.K. (transformed to T scores as reported) were as follows (mean, SD): Extraversion – 49.79 (9.68), Agreeableness – 47.31 (9.44), Conscientiousness – 46.89 (10.66), Neuroticism – 51.39 (9.87) and Openness to Experience – 45.97 (9.71).

The correlations for the factors are as follows: Openness to Experience, r = .79, Conscientiousness r = .82, Extroversion r = .89, Agreeableness[23] r = .74 and Neuroticism r = .86. Convergent validity between the BRI-10 and the NEO Personality Inventory-Revised (NEO PI-R; Costa & McCrae, 1992) averages .67, and .63 for the Ten Item Personality Inventory (TIPI; Gosling et al., 2003b). The wording used in the TIPI typically uses American style language as this example serves to illustrate, *"I see myself as someone… who is disorganized and careless."* As the participants in the study were all European, the BFI-10, rather than the TIPI, was used to obtain personality measures in the study.

7.5.3 Procedure

The participants were recruited via word of mouth, through networking and through recommendations from musician friends and colleagues. In total, 28 musicians working in different musical genres were recruited to the study. Each participant completed the brief Big Five Inventory of Personality (Rammstedt & John, 2007).

7.6 Results

7.6.1 Descriptive Results

The sample included a range of 28 musicians, 17 males and 11 females. Whilst exact ages were not specified, 1 participant was in their twenties (3.6%), six were in their thirties (21.4%), 11 were in their forties (39.3%), and five in their fifties (17.9%) and five were in their sixties or older (17.9%).

Whilst all played more than one instrument, according to the primary instrument of choice, 25% played piano (n=7) and 25% played guitar or bass guitar (n=7), 17.9% said their voice was their

[23] One supplementary question for Agreeableness is provided should that factor require more stability. This was not used in this study.

main instrument (n=5), 14.3% played drum kit (n=4), 7.1% described themselves as either string players (n=2) or multi-instrumentalists (n=2) and 3.6% were brass players (n=1).

With regard to their current status, eight participants were described as being a Musical Creatrix (28.6%), five as a Musically Active Tutor (17.9%), four as a Music Business Professional (14.3%), three as a serious Musical Hobbyist (10.7%), Classical Professional Musician (10.7%), or Musically Involved Academic (10.7%) and two as Alternative professional Musicians (7.1%).

The genre or style of music the participants were most involved in was described as either Classical, encompassing orchestral, choral and formal composition and conducting (n=13, 46.3%), Pop/Rock, such as easily accessible chart music (n=11, 39.3%) or Alternative, subculture, experimental or improvisational music (n=4, 14.3%).

7.6.2 Inferential Statistics

Table 7.2. Results of the Adult Musician Sample Based on the 10-Item Short Version of the Big Five Inventory of Personality (Rammstedt & John, 2006)

Personality Trait		Mean T Score		U.K. BFI-40 Norms[a]	Difference from UK Norms	
		Male[b]	Female[c]		Male	Female
Openness to Experience	Mean	85.9	92.7	45.97	39.93	46.76
	SD	15.8	11.9	9.71		
	Raw Score Range	6-10	6-10	n/a		
Conscientiousness	Mean	81.8	81.8	46.89	34.91	34.91
	SD	16.3	20.9	10.66		
	Raw Score Range	4-10	6-10	n/a		
Extroversion	Mean	68.9	85.5	49.79	19.11	35.71
	SD	15.8	15.7	9.68		
	Raw Score Range	4-10	6-10	0-10		
Agreeableness	Mean	71.8	70.0	47.31	24.49	22.69
	SD	13.3	15.5	9.44		
	Raw Score Range	6-10	4-9	n/a		
Neuroticism	Mean	60.0	50.0	51.39	8.61	-1.39
	SD	22.6	19.0	9.87		
	Raw Score Range	2-10	2-9	n/a		

a (Schmitt et al. 2007) Fe/male data not provided
b Male n=17, c Female n=11

Table 7.2 presents the mean scores of this sample and the U.K. populations norms derived from Schmitt et al., 2007). The mean score (and SD) for both sexes combined for this sample were as follows: Openness to experience 88.57 (14.58), Conscientiousness 81.79 (17.86), Extraversion 75.36 (17.53), Agreeableness 71.07 (13.97), Neuroticism 56.07 (21.49).

A one sample t test revealed that this sample scored significantly higher than the U.K. population on the personality measure of Openness to experience $t(27) = 14.07$, $p < .01$ (CI 33.13-44.44).

A 2 x 5 ANOVA revealed a significant difference between male and female participants for the personality dimension of Extraversion (equal variances assumed) $F(1, 27) = 7.45$, $p = .01$. Table 7.2 shows the means (transformed to T scores), standard deviations and range of raw scores for males and females. Post-hoc analyses (independent *t* test) confirmed this effect $t(26) = 2.73$, $p = .01$ with females scoring more highly than males. A one sample t test showed that females in this sample scored significantly higher than females in U.K. population $t(9)=6.86$, $p <.01$ (CI 22.92-45.50).

7.7 Discussion

The sample of musicians who participated in this study scored highly on the personality trait of Openness to Experience. This confirms the hypotheses that musicians score higher on the personality dimension of Openness to Experience than individuals drawn from the general population. This result is consistent with previous studies of personality traits in musicians (e.g. Corrigall et al., 2013; Kemp, 1996; Müllensiefen et al., 2014). This result also confirms that this sample does not differ from musicians with a singular focus in their training, such as might be expected with a classical or jazz training background. Hargreaves, Miell and MacDonald (2002) discuss representation in regard to the development and dynamics of musical self-concept. Based on a Rogerian understanding of self-image, Hargreaves and colleagues suggest a musical self-concept must be congruous with our past experience, and endure constant comparison between others and ourselves. If this is not possible, it can result in considerable psychological distress. They give examples such as a musician formally trained in western classical music feeling disturbed when asked to improvise in an informal situation. Conversely a musician from an improvisational background may feel embarrassed by their lack of ability to read musical score, or their lack of knowledge of musical theory. Therefore, this analysis has shown that this sample of participants, which represented a range of working contemporary musicians in the U.K., is in line with other studies with different sample of musicians, all of whom have demonstrated higher than general population norms on the personality trait of Openness to Experience.

However, in comparison to Kemp's findings (which focused on classical musicians in the main) the participants in this sample showed higher than average levels of Agreeableness (or *Pathemia* in Kemp's words). Kemp suggests that the *"paradox of the musician's personality"* (Kemp, 1981a, p. 12) centres around the notion of Pathemia. According to this formulation musicians are able to be sensitive and imaginative but are also aloof. Kemp cites Cattell (1973) and who describes these characteristics as living at the hypothalamic level. Cattell also links Pathemia to Intelligence, and suggests that for musicians this is associated with an inclination to immerse themselves in creative, cultural and symbolic imaginings.

The result of this study also confirmed the second hypotheses as female musicians demonstrated higher than the average level of Extroversion for females in the general population. This result is also in line with previous literature where gender differences have been found (Kemp, 1982).

Regarding the exploratory aim of this study, the results failed to reveal any systematic differences in this sample in personality traits associated with primary instrument choice. Furthermore, no differences were observed in personality due to factors of age or musical genre preference.

7.8 Limitations

Hargreaves, Miell and MacDonald (2002) suggest that definitions of musician, composer, performer, improviser or teacher and culturally defined and central to the identities of professional musicians. Moreover, they consider that musical self-concept is a dynamic and complex network of inter-related and hierarchical constructs. This study simplistically compares a small group of musicians to the general population using a brief inventory of five personality traits. Future studies could include more in depth surveys, and or include larger samples and non-musically active participants in order to provide a more reliable representation of contemporary musicians in comparison to the general population. This is important as Hargreaves and colleagues (2002) as well as Müllensiefen and colleagues (2014) comment that music is increasingly experienced, consumed and utilised across societies with an emphasis on personal and social identity. Hargreaves and colleagues suggest taking the concept of musical identity a stage further by considering musical behaviour from the inside (rather than the outside, as measured using for example personality inventories). Considering the range of musical involvement and experience represented in this sample, it is surprising that this study confirms the higher than average level of the Openness to Experience as a personality trait apparent in musicians. It is acknowledged that a sample of non-musically trained contemporaries may have provided a more accurate comparison. Similarly, the BFI-40 is a more valid and reliable measure than the BFI-10. However, the demand on participants was already high and in this situation, a basic comparison demonstrates the point that a) the range of musicians is homogeneous and b) they score more highly than the general population on all factors of the Big 5 except Neuroticism.

In the next chapter an ontological approach was taken to further understand how individuals evolve from first learning a musical instrument to become musicians. The aim was to understand the framework of transfer effects from the perspective if the potential endpoint. This investigation required a grounded theory methodology due to the paucity of evidence regarding the mode of being in contemporary musicians.

7.9 Chapter Summary

This chapter explored the personality traits of a sample of 28 contemporary working musicians using the brief Big Five Inventory of Personality (Rammstedt & John, 2007). In line with previous studies, this sample showed higher than general U.K. population norms for the trait of Openness to Experience. Female musicians also showed higher levels of Extroversion than females in the general U.K. population. These findings establish the reliability and validity of this sample in comparison to other samples of musicians used in the literature.

Chapter 8 – The Ontology of Musicians

8.1 Abstract

There is a paucity of psychological literature regarding the nature of musicianship and living a musical life. The qualitative study described in this chapter aimed to address this problem by carrying out an in-depth analysis of musicians' responses to questions probing the choices and situations which led to their becoming and being musicians. The participants were 28 adults with professional musical lives incorporating a range of genres, disciplines and experiences with reflect the working lives of members of the Musician's Union in the U.K. Through grounded theory analysis five themes emerged. These were 1) Early Musical Experiences, 2) Developing As A Musician, 3) Emerging Musical Identity, 4) Being A Musician, and 5) Efferent Effects of Being a Musician. A hypothesis was derived from this evidence suggesting there is an ontology of musicians reflecting a way of life, or way of being that goes beyond the music.

8.2 Introduction

Chapters three, four and five report a study investigating the cognitive, behavioural and socio-emotional development of 38 seven to nine year old children who received either extra-curricular music tuition (EMT) for the first time, and/or statutory school music (SSM) over one academic year. The study utilised a battery of neuropsychological measures in order to provide a holistic view of skills potentially associated with emerging musicianship. Some of these have been conceptualised and described as either near transfer or far transfer of acquired skills. However, evidence suggests that some aspects of musical ability, for example auditory memory and discrimination skills, are heritable, as well as trainable (Moreno et al., 2009; Strait & Kraus, 2014), although the interaction of this has yet to be studied systematically and questions remain outstanding. Furthermore, the suggestion of a developmental plateau around the age of nine years with regard to musical aptitude in children further complicates issues of pre-existing differences and trainability (Gordon, 1986; Hargreaves, 1986). On top of this, the notion of talent in research becomes obsfucatory rather than enlightening (Sloboda, 2000).

With regard to the notion of transfer effects there is robust and elegant evidence that high musical ability can be embodied without transfer to other types of social communication (Allen, Hill & Heaton, 2009; Heaton, Pring & Hermelin, 1999; Heaton et al., 2008). This evidence suggests there are limitations to the theory that music might function as part of the human drive to optimise wellbeing in line with a social production function (SPF) theory of music (Ormel et al., 1999). Perhaps the human use of music in recipience does function as socio-emotional and behavioural contagion, and the musicians who generate the music experience only part of that. Or perhaps the process of becoming a musician develops certain skills in stages leading up to this ability. For example, in the early stages the musicians must learn to coordinate and control complex motor sequences and memorise these in order to be able to produce and replicate certain sounds (according to their instrument). During this stage of learning in the U.K., music students are typically taught in one-to-one or small group tutor/student scenarios without an audience. Broh (2002) suggests that contact time is socially beneficial to the music learner, though the reviewed literature and the evidence presented in this thesis suggests there is not yet a framework which facilitates an understanding of the nature of socio-emotional wellbeing with regard to musical learning. In comparison to early learning stages, there is more robust evidence highlighting the development of pro-social behaviours, self-concept and musical identity in secondary stage musical learning (see e.g. Hallam, 2010; Hetland 2000, Hetland & Winner 2004).

It is conceivable therefore, that in order to be able to project the emotional valence of music in performance, the musician must have not only acquired the technical skills that support this, but also be able to feel something through or in the music. The harnessing of these facets requires a delicate dance of control, transference and counter-transference between the composer, the musician and the audience as the process of musical development advances. With regard to the role of personality in this process, Allport (1937) made a distinction between motive and drive. In a process described by Allport as *functional autonomy*, drive, which initially forms in reaction to motive, becomes independent of the original motive. This idea may be an important factor in the development of the musician. In chapter five, consideration was given to the impact of the change from parent or tutor guided practice to self-guided practice as the process of autotelic value (of musical practice) is learned (Elliott, 1993; McPherson, 2005). Whilst it is doubtful that stages in musical learning are clearly defined, there are three psychological frameworks that may relate to the role of the musician with regard to the transferable experience of music in the context of the development of the musician.

The first and second refer to the research by Koelsch (2014) and Juslin et al. (2015) suggesting that there are multiple mechanisms in which music may elicit affect (the seven C's of music and BRECVEMA respectively). These mechanism appear to be generalisable emotion and measureable (at least to the level of observation). The third framework that enables the exploration of the function of music, and thus the role of musicians, is the Shared Affective Motion Experience (SAME) model posited by Overy and Molnar-Szakacs' (2009). The SAME model suggests that that the human mirror neuron system enables both the generator and receiver of music to share the experience in an embodied way facilitated via the human mirror neuron system. This plays an essential role as the mediator between the exogenous and endogenous worlds. In turn this is thought to underlie the mechanisms by which automaticity of actions associated with musical performance enables further neural resources to be recruited for dynamic attendance (Large et al., 2008).

Leaving aside for one moment the complexities of genetic heritable potentiality and focusing on the realisation of skills in an active model of selected environment (Plomin & Deary, 2015), there is ample evidence that parental involvement in musical learning increases motivation and positively effects outcome (see e.g. Davidson, Howe & Moore, 1996; Moore, Burland & Davidson, 2003). In chapter two, qualitative information was gathered from the parents of the children who participated in the quantitative study. This information concerned the parents' attitude to music and musical learning, and their own musical learning background. Furthermore, it asked the parents to disclose experiences they, or their children had of cognitive, behavioural and socio-emotional difficulties. These questions were added to the background information sheet in order to be able to consider the ecological validity of this study and help contextualise any findings within the previous literature (as described above). Appendix E provides further information regarding the outcome and continuation of musical studies for those children. This data may be important because, as Sloboda (2000) suggests, the majority of studies have either concentrated on quantitative measures of Western Art musicians in the framework of expertise, or on children who are only just developing the multiple skill sets that will facilitate their basic musicianship (Bilhartz et al., 1999; Fujioka et al., 2006; Mehr et al., 2013). This is problematic because comparison between the two relies on the assumption of a linear developmental relationship. Logically over-simplistic assertions, such as 'music makes you smarter' are uninformative. Furthermore, musicians are often divided into categories dependent on the duration of their learning, the number of hours they practice, or the genre of music they play. They (the musicians) are then either compared in terms of their levels of status (professional vs. amateur) or to 'non-musicians'. However, these quantitative divisions are misleading as very little is actually known about what musicians do other than the rather obvious assumption that they play music, which is in turn rather difficult to define.

A recent survey commissioned by the Musicians' Union was answered by 1,966 members and supplemented by 25 semi-structured interviews. The resultant report, *The Working Musician* (van der Maas, Hallam & Harris, 2012) concluded that U.K. musicians were highly educated, trained, skilled and experienced. For example, 65% of the sample had completed four or more years of formal education and training and 40% were music graduates. At the time of the survey, 55% spent more than five hours practising whilst 37% spent up to five hours a week practising. However the report also highlighted the financial instability of musicians working in the U.K. Whilst the value of U.K. music exports exceeds £17 billion every year, 56% of respondents were earning less than £20,000 per annum, and 78% were earning less than £30,000 per annum. Moreover 60% of the respondents reported that they had worked without remuneration during the previous 12 months and half the musicians had no regular income at all. The musicians reported that their portfolio careers demanded the creative development of a variety of non-musical skills from business to marketing, and teaching to community engagement work. Two thirds reported that they were using and developing web-based musical resources and technologies and another third had to supplement their income with jobs completely unrelated to music or their musical skills. One particularly interesting finding to emerge from the report was that 60% of the musicians earned their income from teaching whilst only 20% identified themselves as music teachers.

It is apparent that having musicality, living a musical life and being a musician are facets of a phenomenon that requires deeper understanding. In a seminal article Sloboda (2000) argued that a reliance on the concept of talent has impeded progress in understanding this phenomena. Instead, researchers have relied on the notion of musical aptitude and research has focused on identifying underlying cognitive, behavioural and socio-emotional processes supposedly associated with this. However, as Sloboda points out, the art of musical performance is not the ability to tap, but the ability to tap meaningfully with artistic intent and taste.

One approach to understanding what it is to be a musician is to study musical engagement in individuals who have either not yet become, or do not describe themselves, as musicians. Research into music perception in infants for example, has revealed an early sensitivity to contour and harmony (see e.g. Trainor & Trehub, 1994; Trainor & Heinmiller, 1998; Trehub, 1987; Trehub & Hannon, 2006) and these findings are consistent with the idea that musicality is a universal human trait (Trainor et al., 2012). In order to study the musicality of non-musicians, Müllensiefen and colleagues (2014) developed a psychometric instrument, the Gold Musical Sophistication Index (Gold-MSI), which measured multiple facets of musicality and yielded a measure of 'musical sophistication'. After carrying out a comprehensive literature review, Müllensiefen and colleagues initially tested five hypothetical musical dimensions using 153 statement items that could be endorsed at varying levels on rating scales. Iterations of the data analysis eventually yielded five factors of musical sophistication in individuals who did not describe themselves as musicians. These were Active Engagement (with music), Perceptual Abilities, Musical Training, Singing Abilities and Emotions, and an overall measure of Musical Sophistication. The musical training factor is of particular relevance to the current study. It included questions about the respondents' regular daily practice, years of instrument and music theory training, the number of instruments she or he played, experiences of being complimented on performances and also probed musical self-perceptions.

Whilst the Müllensiefen et al. (2014) study focused on the musical sophistication of non-musicians and specifically did not separate levels of musicianship, Lehmann, Sloboda and Woody (2007) proposed that the distribution of musical skills in society has four levels (see also Figure 1.1, chapter one). The lowest level accounts for the musical abilities of average individuals who are capable of basic entrainment and performance of items from a limited repertoire. An example would be the ability to sing 'Happy Birthday to you'. Rather than reflecting musical training, these skills build on early predispositions highlighted in studies of infants (see e.g. Abrams et al., 1998; Winkler et al., 2009) and are subsequently shaped through enculturation. The second level is described as the novice, amateur or semi-professional. These individuals may have had some musical training (formal or informal) but do not earn their living through music. The third level includes a route to a professional musical life, via extensive training. This includes composers, teachers and performers with high levels of musical expertise. In the fourth and highest level this expertise rises to an elite category with individuals developing new domains or style of music or reaching new heights of virtuosity (from Mozart to The Beatles or Bowie to Liszt, (Lehmann, Sloboda & Woody, 2007, p. 17).

As The Working Musician (van der Maas, Hallam & Harris, 2012) reports, only 10% of musicians (of the 2000 who responded) are in full-time salaried positions as musicians. Half had no regular employment as musicians at all. However, 59% described themselves as working full-time and spending 52% of that working time as musicians. The report states;

"Working musicians face a precarious and competitive labour market characterised by the diversity of organisations that commission or engage musicians often for very short engagements. In this context, individual musicians often take on free or under-paid work in the hope it will lead to paid work and better future work prospects."

(van der Maas, Hallam & Harris, 2012, p. 17).

As discussed earlier, these members of the Musician's Union (whom can therefore be assumed to be musicians in the main) describe a huge variety of experiences of becoming and being a musician. In order to reflect this diversity of contemporary musicians, the participants in this study were drawn from different backgrounds. However, all were either semi-professional or professional according to the categorisation laid out by Lehmann, Sloboda & Woody (2007).

One further aspect of music research contributed to the rationale behind the choice of participants and decision to pursue this line of enquiry from a qualitative perspective. The cornerstones of experimentation for many fields are randomised controlled trials (RCTs, though for contemporary commentary on issues surrounding RCTs see e.g. Jermyn, 2001; Swan & Atkinson, 2012). In order for RCTs to provide robust evidence, criteria for recruitment of both the sample and the control groups must be very stringent. In controlling for group differences in music studies, researchers have often included musicians who have trained for a substantial number of years. Due to the nature of education in Western society, this has also meant that musicians have been trained in the genre of Western Art music, more colloquially known as 'classical music' (see e.g. Hallam, 2010; Sloboda, 2000). The hierarchical nature of orchestras performing classical music has often meant that the skills developed for this type of musicianship are quite specific. This may not only be in relationship to the instrument, but may extend to the training, teaching and development of musical skills, in particular creativity (Baker, 2014). Consequently, the operational definition of being a musician is rather unrepresentative in many research studies. The potential consequence of this might be that changes attributed to musical learning were not in fact generalisable and a broader operational definition of being a musician would be required. Therefore, it appeared necessary to approach the question of what it is to be a musician in contemporary times from a qualitative perspective using a grounded theory approach. Allen (2010) describes grounded theory as an exploratory method that is quite different from the hypothetico-deductive approach used in standard research. In order to understanding a range of musicians, the choice of participants interviewed formed part of the research process.

The purpose of research in music education is not to evaluate musical learning as a 'treatment effect' but to understand the formation and nature of the musical being of musicians. The evidence presented so far in this introduction suggests that there is a need to obtain empirical data in order to drive new testable hypotheses regarding the nature of musicianship. Grounded Theory (GT) is a qualitative method of research that facilitates this approach. GT is uniquely applicable in areas where prior research is sparse and where an exploratory approach is appropriate to the research question addressed. GT allows greater theoretical sensitivity than more widely used methods of investigation (Bryant & Charmaz, 2007; Glaser, 1978; Strauss and Corbin, 1990) and is well suited to address questions about what it is to be a musician. GT was originally influenced by *symbolic interactionism* (Blumer, 1969). This theory of socialisation focused on the meaningfulness humans feel towards each other on the basis of having meaningful relationships within a socially interactive context. Charmaz (2000) refers to the interaction between the researcher and the participant as taking a constructivist approach to GT. Here, the notion of bias is harnessed, as the researchers' prior knowledge informs rather than directs the process of reflexive practice. As Dey suggests *"An open mind is not an empty head"* (Dey, 1999, p. 63).

GT is undertaken when there is little other empirical research available on a given topic. In GT, data analysis is not informed or motivated by hypotheses about the importance of specific responses. Instead data patterns, or themes emerge and generate potential hypotheses. These themes may guide the collection of fresh data as the process involves the simultaneous/concurrent collection and analysis of data. The creation of themes is guided through a combination of initial coding and method of constant comparison. The researcher essentially engages in a dialogue with the data. This involves comparing themes, checking for evidence for themes in the data set, rejecting some themes and discovering others, whilst constantly seeking relationships between themes. The aim of this process is to uncover a stable overall structure which survives further interrogation and reveals a pattern which explains the data in the simplest possible terms. This may be hierarchical, with themes being grouped together into categories and subcategories.

The process involves theoretical sampling (in this case the choice of participants) as an on-going process. Coding is usually undertaken with a flexible yet systematic approach. Notes are made at each stage in order to aid the process of reflexivity, defined as the ability of the researchers to reflect upon the data whilst actively acknowledging their own perspective. Typically, the procedure begins with open coding, a line-by-line method linking the empirical reality with the researchers' viewpoint (Charmaz, 2006). This process is generally descriptive and continues until themes emerge. Glaser (1998) suggests that categories have to earn their way into any emerging theories. Axial coding then explores the relationship between categories. Concomitant with this, although it is sometimes seen as the final step, is the process of selective coding, which identifies core themes from which secondary themes and relationships between themes are organised. The process of coding in undertaken *in vivo* and the findings are always referred to as provisional (Glaser & Strauss, 1967) because the potential hypotheses have yet to be tested. The process is fulfilled when refinement of categories suggests that the data analysis has reached a level of saturation. According to Glaser and Strauss (1967) saturation does not necessarily mean exhaustion. Saturation means that the core themes may become stabilised before the entire data pool is analysed. The researcher bases their judgement of data saturation on their epistemological reflexivity during the iterative process.

8.3 Materials and Method

Grounded theory analysis of the transcriptions of interviews with 28 musicians (characterised in chapter seven) was undertaken. Themes became stabilised, and therefore saturation level was reached when 21 of the 28 interviews had been analysed.

The interviews were recorded using an iPad application, Audio Memos and also using a Philips Voice Tracer LFH0662 recording device. The author later transcribed the interviews (transcriptions available on request[24]) and analysed them using grounded theory methodology as described in the section above (Glaser & Strauss, 1967).

NVivo software (Version 10, QSR Intl., 2012) aided the process of GT by providing a system of core (or tree) nodes, from which sub-nodes can be created. However, this process is flexible and can be changed as the analyses of data directs. For a full description of potential coding processes using NVivo the reader is directed to Bazeley, 2007.

[24] The full transcription amount to some 160,000 words

For this study, the process was recorded in a series of NVivo memos over a period of analysis ranging from 23rd April 2014 to 5th January 2016. This procedure assists the reflexive process by recording the researchers thoughts and decisions during the analysis.

The transcriptions were initially open coded line by line. This process was undertaken for thirteen interviews and took nine weeks to complete. In this procedure, words and phrases are highlighted and given a descriptive code. Richards (2005) suggests researchers keep three questions to the forefront of the minds during this stage, as it is easy to become unfocused. These questions, in relation to the data and aims of the research are: 1) What is interesting? 2) Why is it interesting?, and 3) Why are you interested in it? The memo from this initial period states that the intention was to code according to a psychological (rather than lay or music education) framework. The concepts noted included agency, social behaviour, musical and cognitive skills, and states of valence and arousal afforded by musical experience. Furthermore, the questions used in the semi-structured interviews (see Section 8.3.2) afforded some structure and this was adhered to throughout the analysis. From the first iteration, 159 open codes were generated to explore and reflect the information contained within the interviews.

The second memo records that the first review of this initial coding took place because an overlap in codes was observed. This is known as viral coding, a process in which similar information was being coded by slightly different names. For example, codes collating 'childhood memories of musical learning' and 'early musical experiences' may contain some overlapping as well as differential information. The memo states that at this point, writing a clear description of each node (core and sub) will help clarification and decision-making regarding the expansion or collapse, and hierarchy of the various codes. Bazeley (2007) suggests trying to refine down to ten core nodes, which are only two to three sub-nodes deep at this point in the analysis. This first iteration of selective coding resulted in 28 themes (or core nodes), which were only one sub-node deep each at this point in the analysis. The NVivo report of this initial stage (exported to Excel) is shown in Table 8.1.

Table 8.1. Initial core and sub node report after coding thirteen interviews

Core and Sun Node Name	Source	Number of references
Affect	10	23
Arousal	6	8
Chemistry	1	1
Somatic Awareness and Physicality	5	7

Unfulfilled dreams and desires	4	6
Age	10	18
Archetypes or Stereotypes	8	48
Musical Style	5	12
Attributes of Identification	13	191
Approval	1	2
As a musician	9	31
As a teacher	6	14
By others	8	22
Context dependent	5	8
Dissociation	9	26
Identfication with Musical Genre	7	7
Identification with Musical Instrument or Sound	12	34
Self Identification	11	22
Status	9	24
Career	9	54
ambition	6	17
auditions	3	3
end of career	3	7
Payment	1	3
starting	5	6
success and reward	7	18
Class	2	3
Community	4	12
Confidence	8	21
Creativity	8	24
Generative	4	9
Improvisational	6	9
Low or no creative input musically	3	3
Evaluation	6	16
Gender	5	15
Great quotes	6	18

Internal World and Spirituality	10	21
Learning	13	147
By Ear	5	5
Choice of Instrument	9	24
For Fun	5	6
Formal	10	28
Individual	3	4
Institution or Group	2	3
Parental tuition	2	3
School	4	5
Tutor	7	7
Informal	6	12
Parental Tuition	1	1
Self taught	6	9
Teacher	1	1
Learning difficulties	4	6
Level	9	19
Amateur	1	1
Basic	1	1
Grade 8	2	2
Grades	6	10
Music College	4	4
Maths, Puzzles and Patterns	4	8
Natural aptitude	9	21
Number of Instruments Learned	9	13
Motivation	12	100
Avoidance of doing something else	2	3
Challenge	5	7
Competition	2	5
Cultural importance	5	7
Excellence	9	26
Parental	8	17
Maternal	3	3

Other family member	2	2
Paternal	2	3
Relaxation	1	1
School	3	5
Self	4	7
Sound or Instrument Inspiration	6	13
To be with like-minded people	4	7
Musical Activity	10	51
Actively playing	6	12
Playing for pleasure	3	6
Playing in a professional context	3	6
Cessation of Playing	8	13
Occasionally playing - continuation	3	5
Perception of Others	6	10
Playing with others	6	11
Obsessive Behaviour	4	10
Collector	1	1
OCD	2	8
On being... in the moment	10	28
Opportunity	9	45
Cultural expectation	5	16
Free Lessons	5	5
Home	4	6
Privilege	4	6
Provided Lessons	2	2
School	3	5
Screening for Musical Aptitude	1	1
Performance	12	61
Mental Approach	6	11
Performance Anxiety	2	6
Reading Music	3	5
Relationship with the audience	7	12
Solo	1	1

With others	7	15
Zone State	6	8
Practice	8	18
Pressure	3	18
Personal Pressure	3	6
Professional Pressures	2	12
Relationship with Instrument	12	83
Attachment to instrument	6	17
Enabling	8	17
Negative relationship with instrument	4	8
Positive relationship with instrument	1	3
Private	3	5
Public or Open	2	2
Skills Identified	10	29
Relationship with Music	12	128
Academic	2	3
Conduit	7	12
Cultural	4	14
Imagery	1	2
Listening	5	16
Meaningful experience	5	10
Mood	4	6
Negative relationship with music	6	9
Positive relationship with music	8	18
Practical	3	8
Problem Solving	1	5
Produce	1	6
Sharing	8	14
Retired Nodes	1	1
Spirituality	3	7
Talent	3	10
Socialisation Aspects	10	151
Family	8	21

Friends and social life	9	52
Cultural 'norm'	3	14
Negative social pressures	3	11
Perceived status	8	21
Groups	9	51
Connection with Others	8	29
Isolation	2	3
Ensembles	7	22
Brass or Marching Band	3	5
Choirs	4	5
Covers Band	0	0
Folk	1	1
Jazz Band	1	1
Orchestral Classical	3	6
Originals Band	3	4
Relationship with other musicians	6	25
Religion	1	1
Teaching	7	30
Inspiring	6	15
Practical	5	9
Relationship with students	1	2
Therapeutic Use of Music	6	13
Transfer Effects	7	18

In the next stage of GT the researcher seeks to establish the stability of the relationships between the open and the selective codes (i.e. sub and core nodes in NVivo). This is achieved by further iterations of open and selective coding. This iterative process ensures the emerging theories are reliable and underpins their validity as the data is interrogated until a point of saturation is reached. The point of saturation is only achieved when no further contradictory evidence or additions to the emerging theories are found. In total, five complete iterations of themes were completed for this study and 21 of the 28 interviews were coded and analysed to achieve this.

During this process, a number of complexities and contentious or competing codes were identified. For example two core nodes had emerged in which the participants had used different language to describe ‘natural aptitude’ and ‘talent’. Re-reading the coded transcripts, it became clear that these notions were always discussed within the context of early training. Therefore a new core node ‘Talent, Aptitude and Training’ was created (see Figure 8.2.). The content of the other two nodes were copied to this new node, and the two merged nodes were then moved to the ‘Retired Nodes’ node and a note made in the memo to record this process. The node ‘Spirituality’ became part of the ‘Internal World’ node in this way. However, when new data emerged the creation of a new node was necessary. For example, some participants described visual, auditory and sensory imaginings either from listening to or producing music whilst playing their instruments. This resulted initially in a node named ‘Imagery’. However, as this study is focused on being a musician, rather than the literature related to musical imagery per se, a deeper reading of the context of these extracts lead to there reallocation to nodes such as ‘Internal World’, ‘Therapeutic Use of Music’ and ‘On being…in the moment’ as these better reflected the nature of the data (see Figure 8.4.). The results are presented in Section 8.4.

8.3.1 Participants

The participants in this study are the same 28 musicians characterised, analysed and commented upon in chapter seven. They were recruited via word of mouth as part of the reflexive process of grounded theory.

8.3.2 Semi-Structured Questionnaire

The use of semi-structured questions and the addition of items during the research process is acceptable within GT methodology. Twelve questions were used to initiate conversation and to explore experiences during the semi-structured interview process. These were:

1) What was the first instrument you learned and is it your main instrument now?
2) Do you play any other instrument/s, and if so, what are they and in which order did you learn them?
3) How do you consider yourself: e.g. a musician, a drummer, a multi-instrumentalist...?
4) Do you feel that each instrument has a distinct set of skills, and if so can you define them?

5) Going back, can you remember why you learned your first instrument?
6) And going back even further, did you have any problems at home or school, perhaps learning or behavioural difficulties?
7) Was there any particular benefit that learning to play your instrument brought you?
8) Is this still there, or has it evolved over time?
9) How do you feel about your main instrument now, in comparison to when you first learnt it?
10) Do you teach your instrument? If so, tell me about how that came about please?
11) Have you noticed anything distinctive about your students? Personality wise, behaviourally, their motivations for learning, their difficulties?
12) Do you think there are distinctive differences between types of musicians?

8.4 Grounded Theory Results

Section 8.3 described the iterative process of data analysis that resulted in the emergence of the five major themes. These are: 1) Early Musical Experience, 2) Development as a Musician, 3) Being A Musician, 4) Efferent Abilities and 5) Forming Musical Identity.

Each of the five themes is depicted using a model (Figures 8.1-8.5). The following sections (8.4.1-8.4.8) present the results, model and a literature related discussion for each theme. A final model (Figure 8.5) relating the five themes is presented and discussed in section 8.5.

To begin, Theme 1 focuses on early musical experiences. This further characterises the sample and explores how music became a part of their early years, how they started learning musical instruments, and in which context these events occurred.

8.4.1 Theme 1 – Early Musical Experiences

A model of the musician's early musical experience is provided in Figure 8.1. As will be apparent, the nodes are arranged in clusters and are sized differently. This diagram represents the equal emphasis placed on for example, Formal and Informal Learning and Teaching (bottom arc) by the participants. To the right of this, Learning for fun and Learning issues are depicted as equal but separate issues for participants. Above this Motivations forms a larger node because this was of greater importance to the participants. To the left of this but lower down is the Talent, Aptitude and Training node as this was not emphasised as much in the data as

Motivations. Diagonally opposite form Motivations, and almost as large, is the Opportunities node. This placing is reflects the direct link but disconnection between the two. The top left quadrant identified specific information from the data relating to the interview questions. The proximity of the nodes to the central theme suggests the timeframe of the information. That is, The Level of Musicianship Reached occurs after the Choice of Instrument. These four factors emerged as separate yet related concepts from the data, which is why they are clustered together.

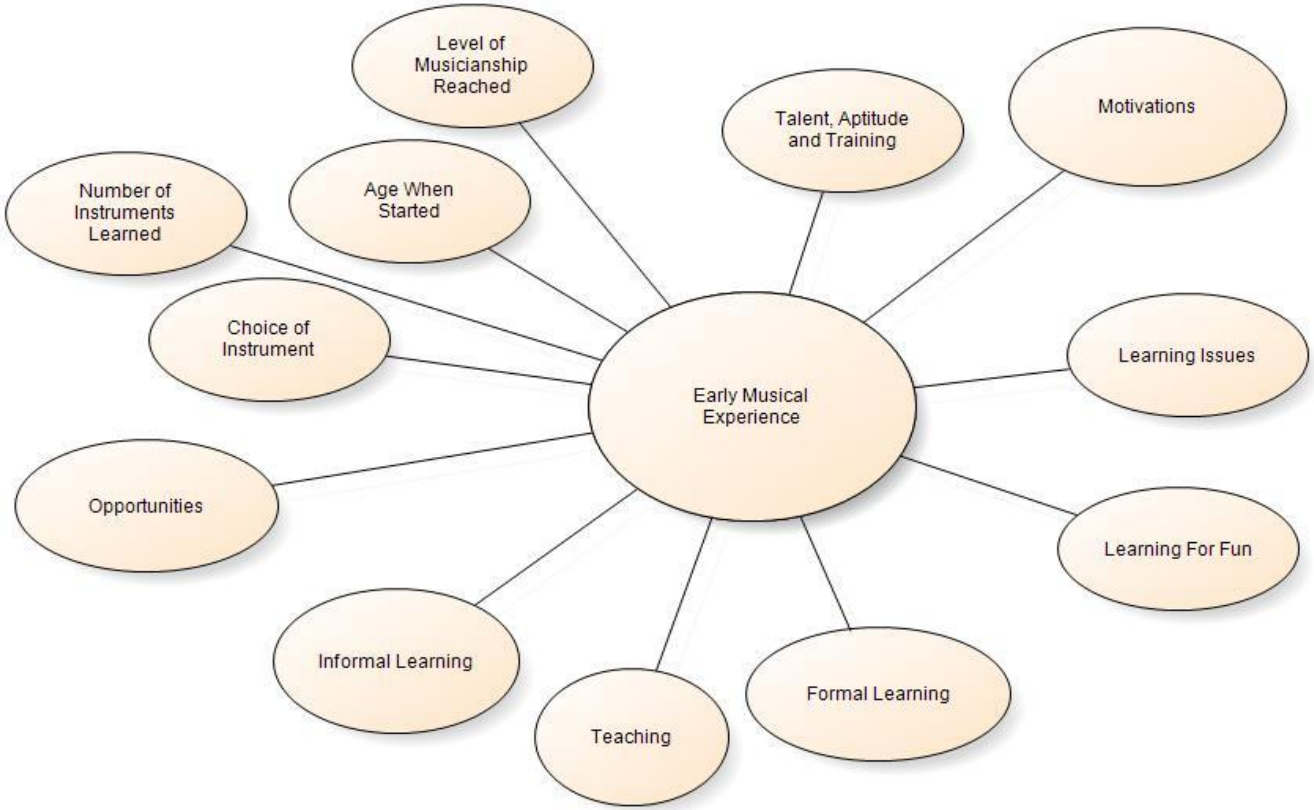

Figure 8.1. Model of Theme 1 – Early Musical Experience

Beginning with this factual information, the average age of commencing learning a first instrument in this sample was seven years old. The youngest was four (piano) and oldest 14 (classical guitar). Most started learning their first instrument between six and eight years old. Everyone in this sample played more than one instrument, except for the novice drummer, whose Mother[25], who was deaf, did not play an instrument. The number of instruments learned and played ranged from two to six. These included piano/keyboards, drums, percussion, bass, guitar, mandolin, cello, violin, viola, voice, oboe, recorder, saxophone, trumpet, DJing, conducting and computer software such as ProTools and/or Sibelius.

Decisions regarding whether formal of informal learning occurred were made according to multiple dimensions of opportunities and motivations, which were also contextually specific. Families and the prevailing culture all impacted upon these aspects, mostly in a positive way. Some relationships were quite complex such as in this case,

"My Grandmother believed that I should have private lesson on the piano, which I think in some respects was against my Mother's belief; that the state should provide that level of tuition. Somewhere between [the two] *I ended up with private lessons." [P.12]*

In contrast some parents were musicians or music teachers themselves and others, who were not, provided a musically enriched environment such as in this instance,

"My Dad had big record collection; there was a lot of music in the house. My Mum and Dad are very big music fans. They love it." [P. 27]

There was also an aspect of cultural heritance with one musician saying they always had to have a piano in the house and another learning the violin because their Aunt's instrument was passed down to them. For one Welsh person, their cultural musical heritage of singing meant that the ability was an expectation and opportunities were frequent and involved social occasions such as sports and family events. If the family attended church, this also presented opportunities for singing in the main.

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[25] Neither the novice drummer or her Mother were included in the BIG 5 Personality analyses in chapter seven.

School also played an important early environmental role. Some schools used musical ability screening tools to choose whom lessons should be provided for. Musicians from the north of England in particular remembered the tests. Quite a few people mentioned that they felt 'lucky' with regard to their early musical opportunities. Sometimes their luck, rather than opportunity was also described as a 'privilege'. This fed into their relationship with music and teaching in particular as will be described in more detail in other themes. For now this quotation by an individual knighted for services to music encapsulates the pervasive attitude towards passing on musical opportunities:

"The idea that we would stop teaching music to children is awful, absolutely awful because we're going to lose a generation of people who are clearly capable. We listen to music all around us, all the time in so many different ways. How could we not want people to write new music? It seems bizarre. We need to have more people teaching, more access to music, more live concerts and we need to have a more democratic and less snobby attitude to music. There should be greater access to music I think". [P. 13]

Formal learning included mention of several different approaches including tutors, parents, school, institutions or groups, and reading music. Individual reward for excellence was often mentioned, from winning awards to moving ahead of peers as this excerpt demonstrates,

"I was really pleased when I stopped doing the group, and this was through recommendation because I was getting ahead of the group so it would be better if I had individual lesson and moved at my own pace" [P. 12]

Within the framework of formal learning, the availability of free lessons was important as a state primary school specialising in the arts in the north of England describes,

"We get charity funding for it [music]. I apply to charities and we get funding for it that way. And exams and music books because it is <u>so</u> important. We have children who never shine at anything, but they shine at an instrument. And we make sure that they get a chance to perform". [P. 8]

Extra-curricular training organisations and institutions, from beginners' orchestras to brass bands and jazz improvisation groups, were also described with great enthusiasm for the opportunities they provided. One drummer and vocalist explained,

"I was a musician. That's why I joined the army too. In that time of having drum lesson, I'd joined brass bands because I didn't have a drum kit. I was in the school brass band, and it was all reading and so I had to practice. So I was in school at 8'o'clock in the morning – everyday! I was really keen – really driven". [P. 4]

As suggested in the quotation above, reading music was seen as an essential part of formal training. This ability was referred to alongside the level of musicianship reached. These levels were described as ranging from amateur, associated with secondary instruments, which were learned for fun only, right through to explicit description as music professionals. In this section, analyses will incorporate discussion of Music Grades up to Music College. Grades where often mentioned as a matter of course. The general attitude to taking music grades is represented by this quote:

"I think the way you learn music in this country is like the way we teach people to drive in terms of there is an assessment of the skills you need to achieve in order to drive safely, or play effectively. And like they say, you learn to drive after you take your test because that is when you learn the flexibility and the reactions that would keep you alive should the situation pressure you. Whereas in music, a lot of what you learn in terms of performance happens outside of formal lesson and the examination system and I think you need both if you are going to be a fully rounded performer". [P. 21]

The approach to grading was not systematic with lots of people skipping some grades, or starting at Grade 3, especially on second instruments. Sometimes people stopped doing grades on some instruments in order to focus their time on others, or because they got bored or did not like their teacher. Grade 8 is the highest music grade level in the U.K. This was spoken of in a different way, as a stand-alone statement, for example *"I got Grade 8".* Associated with a sense of mastery, it was mentioned as a route to Music College or in regard to scholarships.

In contrast, informal learning focused either on learning by ear, being self-taught or having informal lessons from a family member. These were not mutually exclusive as this story demonstrates:

"…various members of me Mums family could play piano and guitar, and apparently one or two of me Dads, and when I was about eight, my Uncle, who had a two tier keyboard, and I started working out Spanish Eyes [a song] *going up and down the white keys, you know? And Mum was sitting in the front, sort of like,* [demonstrates a look of surprise] *'Is that my son?' sort of thing!" [P. 19]*

Being self-taught appeared to be acknowledged as something extraordinary but not linked with luck or privilege. It also appeared to be associated with an interest in patterns, numbers and either mathematical relationships and/or puzzle solving. This story aptly illustrates this style of learning:

"No, I was self-taught. Like I say, for a couple of years I used to muck about. Then when I was about 11, my Mum and Dad invested in two cheap guitars for me, this was before I knew about A, B, C, D, E, F and G were – I didn't know them until I was in my late teens. I worked out notes in a kind of mathematical system of 12, and I worked out that gaps of five were great, gaps of four were OK, gaps of three were [pause] *weird, gaps of six were exceptionally weird!" [P. 19]*

Whilst learning by ear appeared to be a default of being self-taught, a retired musician who reached professional level and received formal lessons suggested it was not exclusive and several people also described being able to read music at one stage, but explained that now they 'just use their ears'. An interesting perspective on formal lessons was provided by a successful drummer and music lecturer,

"I'm torn really because I didn't learn formally when I was young, well until I was 11, 12, 13? I <u>just</u> had enough reading so I could pick it up again when I started working here but, well as you know, you never really get given dots when you get jobs [as a drummer]. *More often you just get a chart, or just nothing. I'd really like them* [his children] *to read music, and we've got a book. But you can see already that they just can't make the link between the fun thing that were doing five minutes ago when they were making a noise on the piano with their fists and shouting, to you now saying, 'Ok,*

put your hands in this position and what you're gonna do is this. It's very hard for them to be gratified in the way I was as a drummer when I first played. It's very difficult to do that with a guitar or a violin. It's everywhere in our house, so she hears us playing music all the time and I'm sort of reluctant to go 'Right, formal lessons' because I know so many people who gave up". [P. 15]

Notions of talent and aptitude held by the parents and families, and schools and teachers, as well as held personally, were mentioned. Some people explicitly spoke of feeling, knowing or being aware of having a *"gift"* or *"natural aptitude"* but also felt it wasn't necessarily special to them, as this example illustrates,

"I think everybody can be a musician. I think everybody can be musical. Even people who are tone deaf can train themselves to hear in a prescribed way. I think to be musically gifted is when a part of the brain is very developed that is receptive and imitative. To me, that is what defines musical talent – to be able to hear and reproduce." [P. 12]

The idea of a natural leaning towards an instrument, based on ease of learning was also mentioned as this excerpt illustrates,

"I was one of those incredibly fortunate people who just found the right thing when I was young. It sounds like a dreadful cliché, but honestly, the minute I picked this thing up I thought 'This is for me! I love it. This is great, I LOVE this' and so I got pretty good pretty quickly". [P. 5]

Regarding training, there was a suspicion regarding a prescribed amount (i.e. 10,000 hours) being either necessary or useful, but that it was finding the right instrument for the right person that really mattered. One music teacher suggested that it is about a combination of aspects coming together at the right time,

"I think it's important that they do it for the enjoyment to start with and if they actually have talent, then you can push them and see them sort of achieve what they can do with that talent. If they don't enjoy it, there's no point in having the talent because it's just not going to work". [P. 25]

Whilst some people mentioned that the sonic nature of the instrument was important to them and others that they were influenced by the music of the time, several suggested that it depended on one's personality. This will be discussed more fully in the theme regarding Musical Identity.

Physical aspects often appeared to constrain the choice of instrument, with some people describing their learning experience as physically *"painful"*. More often though, multiple dimensions affected the choice, from family background, to availability of instrument, having dental braces on one's teeth, and because of associations with types of instruments and gender and/or roles within bands or music genres. Teachers also had an enormous influence on the redundancy of instrument learning with some described as *"aggressive"* and others as *"boring"*, although some were seen as inspirational, as were musical parents as this person recalls:

"I can remember singing virtually as soon as I could speak because my Mum was a singer – a trained opera singer. So my Mum always sung and I always sung." [P.8]

Difficulties with learning, and learning difficulties were also connected to the choice of instrument. Those aspects mentioned were as simple as using the wrong or non-dominant arms or hands, to more complex situations. For example one teacher explained they discovered the differences between moderate behavioural difficulties, and people with autism spectrum conditions and Down's syndrome only when he was asked to take a class of students with special educational needs. He explained that strategy of the school was to get those kids out of the classroom and see if they could do it [music], and that it worked for some children but not for others. Another teacher spoke of the frustrations of schools not explaining when children had difficulties and said that,

"...it becomes quite apparent if people have something going on with their attention spans, or excitement, or nervousness, but I think that comes with all different types of peoples and types of players. I've taught a guitarist with Asperger's and once you have the right information it actually helps, but a good tutor will learn how to deal with that and find a way to make sure they learn as much as everyone else. It's the way you deliver it." [P. 7]

Dyslexia was also specifically mentioned. Some musicians who taught explained they understood that it was hard for students with dyslexia to know, for example, the difference between bass and treble clefs. However, the overriding view is illustrated by this comment:

"I've met quite a few musicians who maybe are a little bit dyslexic or something like that but they're able to find a place inside music that works for them". [P. 27]

As one musician described of another they knew,

"Well, to be honest I think [he] *is somewhere on the autism scale because he can't do jigsaws. He just doesn't see how things are put together, yet he can put together a* [music] *score!"[P. 14]*

The second theme to emerge from the interviews was that within the formative stages of developing musicianship, there was a distinction between early musical experiences and developing as a musician. Theme 2 now describes this second stage. Figure 8.2 is a model of the musicians' experiences developing their musicianship.

8.4.2 Theme 2 – Development as a Musician

The model developed to depict this theme shows two levels on some nodes reflecting secondary levels for those core nodes. The title theme is represented by the large oval in the centre of the model. Core nodes are depicted as round-edged rectangles emerging from this. Sub-nodes are depicted by small ovals attached to round-edged rectangles where appropriate. The size of these ovals reflects the length of the name of the sub-node rather that it's relative importance to the core node. See section 8.4.3 for detailed description of the causal explanations for these relationships in relation to the literature.

Beginning at the top of the model, it is notable that Level of Musical Activity and Level of Practise are not linked and are depicted as separate core nodes. The participants seemed to view these as separate aspects of their musical lives. To the left of these is the Age core node. The sub-nodes emerging from this relate to the participants segregation how they perform music to others and how they experience their developing musicianship in themselves, as related to their age over their careers. For example, one participant speaks of the different impacts in performing to a school audience of peers, then to large festival audiences. Below this (also on the left of the model) the core node Formative Career has two sub-nodes (Beginning Career and Relationship with other Musicians). The former relates to the participants own aspirations and strategies, whereas the latter depicts the importance of social and professional networking at this formative stage. At the base of the model, four clear sub-nodes are linked to the core node Motivation. Finally, on the right of the model, the core node Performance has two clusters and one singular sub-node related to it. Performance Anxiety and Mental Approach are placed close to Motivation because of the positive and negative factors associated with these aspects of Motivation to perform. However, they are only linked directly to Motivation because it was at this formative stage that participants had to find some way to overcome these obstacles in order to continue to identify as a musician (Theme 3) and experience Being a Musician (Theme 4). The Developing Sense of Artistry distinctly emerged through performance rather than practice, which is why it is placed away from those core nodes and related to Performance. The three sub-nodes relating to the audience, playing solo or with others and notions of chemistry or energy are separate yet related concepts described by the participants and so are depicted as overlapping.

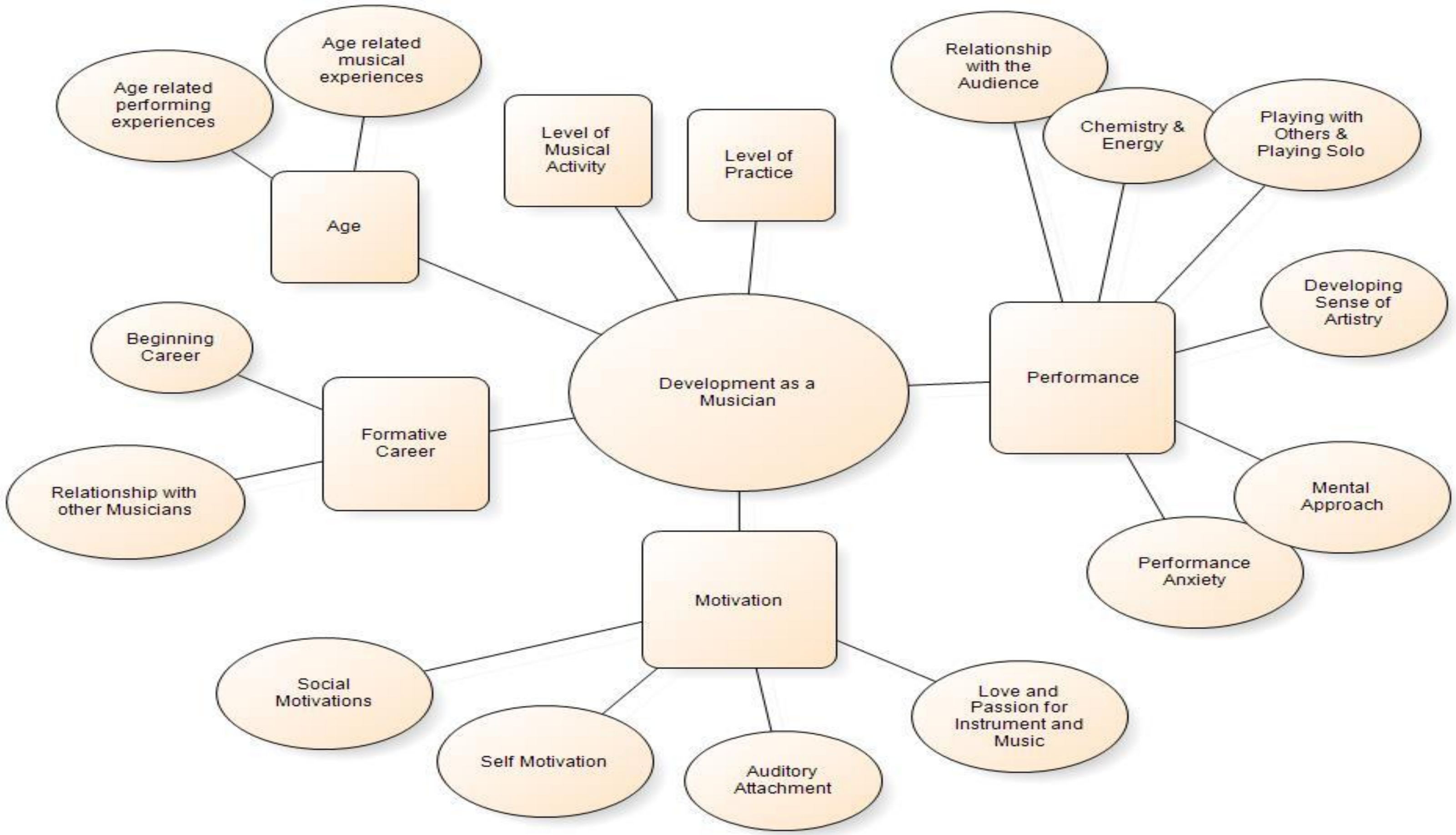

Figure 8.2. Model of Theme 2 – Developing as a Musician

In this sample of musicians there were three levels of current musical activity. These can be described as 1) Active, (which includes both playing for pleasure and in professional contexts), 2) Occasional playing and 3) Cessation of playing. For the first level, two aspects to playing for pleasure were evident. One centred on personal choice, for the type of music, and also included enjoyment and having fun with the music and the people and also sometimes trying to play instruments which were not the individuals first instrument; essentially musical playtime. The second aspects included a sense of passing on skills and encouraging amateur musicians. Not exactly teaching, more akin to self-affirming mentoring as this example illustrates,

"I just want to share with them what I've got really and what I'm experiencing. And I suppose I've been quite lucky in that everybody's said I have a really lovely voice so it's nice for me to share that and perhaps be appreciated". [P. 14]

As the musicians developed their professional identities, differences emerged regarding feelings about 'doing a job'. Some felt unease about taking work just for the money, experience, and prestige or for networking opportunities. Others were wary of 'getting lazy' by repeating the same music (for example playing the same show in the West End for years). Most desirable were jobs that enabled a creative contribution and this engendered a sense of personal pride. For example one person spoke of his session job, explaining how he gets booked to play what was recorded on the album but that the role has developed so that the artists now allows the space of improvisation. Another spoke of his role as a conductor, explaining how he had different expectations of his players, and they of he as so,

"You've got to inspire them all the time. I'm talking about professional musicians. Whereas amateurs, you've got to coax them in a slightly different way". [P. 13]

Several people had moved on in their careers from playing music all the time, to taking on other roles, from teaching to building their own businesses, or semi-retiring but they continued to play music in some form. In this there was a separation between people who wanted to continue to play music but didn't mind about not hearing it, and vice versa. As one person suggested, "*I think I could happily live the rest if my life without hearing music again as long as I could still be a music producer. As long as I could still sing, or play an instrument I would be fine." [P. 27]*

Whereas another, who had retired, but then started playing again spoke of his occasional playing as a "*fascinating process*" because *"if I didn't play the trumpet again it wouldn't bother me* <u>*but*</u>*,* [pauses] *I constantly set myself little tests, musical tests, all the time. I mean* <u>*constantly*</u>*!" [P.5]*

Some musicians however had ceased doing music completely. Reasons were described as being because *"that world wasn't for me basically" [P.11]*, or because *"I don't feel the same way about it as I used to"[P. 28]*. One question, which musicians appear to regularly ask each other, is 'Are you still working?' and this idea arose quite often. For some there was a sense of shame or loss about ceasing playing at the higher levels as one lady explained,

"Well, I don't sing much solo work anymore with the passing years. I wouldn't want to inflict it on anyone now, but I wouldn't want to be without music". [P. 14]

There were three distinct aspects regarding age and musicianship. These concerned either practice, performance or, attendance to the music or skills. For example, some older people described not listening so intently, or focussing on the words anymore. Similarly, the spirit of the youthful musician underwent some changes as touring became less fun and different priorities emerged, as one musician described,

"I seem to remember having a lot more time when I was younger, but I was a very different human being at a different age. I guess I was in that stage of life". [P.15]

Regarding practice, the sense of immersion in the early days was referred to in several ways as these examples illustrate,

"I did tuck my head down and I was never having to be asked to go and practice. My dad reminded me of that because I have to remind my kids all the time, but no, 'One thing I never had to do' he says!" [P. 23]

"I think I did immerse myself. It was a place to go in my mind and focus on something." [P. 7]

"I'd come home from school and I'd practice. I'd do my homework and I'd do an hour. Then I'd have my tea, then I'd do another. That was all I wanted to do. I had an old kitchen timer and every morning when I first got up I set this thing to five hours and I refused to go to bed, and I can look you in the eye and say that for the three years I went to university, there was not one time when I went to bed without doing that five hours practice. Not one! I mean, just the fact that I would, I mean four and a half hours, five hours – what's the difference? But for me, it had to be five hours. Had to be. And many times, there was a car park for a cricket club or something, and many times I'd get back from somewhere at half two and drive to the car park and get my trumpet out of the back and do that last half hour just to get to the five hours. And that's just a bit weird I think. In some respects, it's quite calculated – my approach to music. Four hours and 55 minutes doesn't quite cut it. Five hours, sometimes I'd go more. It's cool to go more, but not less." [P. 5]

The obsessive keenness of young players often became overridden by the practical constraints of working. However, inspiration was sometimes delivered in the form of competition as is described here by an army drummer,

"I'd been in the army for six years, was doing well, doing what I do – then I heard this drummer and went [pulls face] *'I've gotta practice!' because he really lit me fire again". [P. 4]*

Finally the demands of older adulthood seemed to take over,

"Well, I'll never be as good a pianist as I was a drummer, because it'll never feel as easy, because I just can't get the muscles and the digits to do exactly what they should do. And I don't know if that's to do with the brain, a kind of 'atrophication' [laughs], *or just lack of time? But I can't do ten hours practice now a day. I did ten hours a day when I was a kid on drums, but I can't do it anymore." [P. 15]*

The active musicians continued to enjoy being and doing music and continued to practice and perform regularly, as these quotes encapsulates,

"The lovely thing about being a musician is it's always ongoing. You never stop." [P. 13]

"I still play Bach most mornings to try to cleanse my thought patterns. I find Bach and Mozart have a way (well, Bach in particular), has a way of ordering you and settling you before bringing on the more 'spicy' stuff I guess". [P. 26]

Many continued to invest in their own practice as a matter of course,

"It's not a stamp you get on your forehead that sticks no matter what you do. You have to keep up with your practice. You have to engage in performance of some kind, even if it's just for the air around you. But without regular practice or performance, there is no musician." [P. 12]

Musicians spoke of forming their careers in terms of having a clear ambition and explicit aims, particularly regarding forming relationships that would later become important. Many moved to London in order achieve their goals in their late teens.

"In my mind I was always going to be a musician and that was that. I wanted to be in London and be amongst the proper musicians". [P. 27]

There was an explicit understanding of the stepping stones in their careers as explained here when a pianist speaks of his playing circles changing and describes playing with a well known artist,

"I mean he was, you know, a good player. So that was a step up for me and I suppose from that time onwards I was, sort of, professional." [P. 1]

Not everyone's journey was smooth. As one brass player who auditioned at The Royal Academy of Music described, *"So the Professor, the guy who interviewed me* [at the Royal Academy]*, he said to me, 'You know what son, you just haven't got what it takes to be a trumpet player', which is an appalling thing to say! 'Take my advice, go back up North and get yourself a job down the pit and you'll be in brass band and it'll almost be like being professional. Those guys have a great life.'" [P. 5]*

The majority of people mentioned getting paid as the turning point in their acknowledgment of turning professional, or of turning away from that career. As one violinist explained when being asked about the difference between being an amateur and a professional, amateurs have a semi-pro hierarchy but *"A professional is someone who makes their living out of it" [P. 23].* However, the level of payment did not appear to matter (£50 a gig being the lowest sum mentioned), as long as it was *"enough to live off" [P. 19].*

With regard to developing as a musician, personal pressures included a sense of ambition, excellence and mastery. Musicians described wanting to *"understand music",* wanting to have the *"mental energy to devote"* to their music projects, and spoke about managing their expectations and of *"being hooked".* Their dedication drove them to extreme levels of practice as has already been described, as well as often moving home and overcoming obstacles and having the resilience, or not, to continue. To complete the story from earlier regarding the professor at the Royal Academy and the trumpeter, he continued,

"So I went down the pit, and of course it took about [slight pause] 15 minutes for me to work out, there's <u>no way</u> I'm doing this for the rest of my life. <u>Forget that!</u> Thankfully I had a bit of Hutzpah as a kid so I went to night school, got some more [qualifications] *and went to Leeds School of Music" [P. 5]* where he learned jazz and pop and went on to be a very successful session player.

For him and others, the competition, and a drive for excellence really motivated them as this extract demonstrates,

"That's what I really get off on. Being the best. Hmm, that sounds a bit competitive. I mean internally. I'm not externally competitive. I'm genuinely not." [P. 5]

For some people though, this was the very essence of what they did not like as this quote illustrates,

"It's very very different trying to make a living out of it, and I just hated that aspect of it. Trying to get work you know, and it just wasn't…I just didn't buy into it. It wasn't why I'd studied music in the first place. So I was really unhappy with the way that all of this, trying to be a musicians and earn your living as a musician wasn't really working out for me." [P. 28]

Motivations for being a musician included love and passion for the instrument and/or music as well as a sense of auditory attachment, as this extract conveys,

"I love melancholy. I love gloomy and doomy but I like the quality of sound. I think the quality of sound for me is the key to what keeps me interested". [p. 23]

Sometimes the personal reasons for developing a musical life where associated with negative aspects of life. Several people mentioned using music as a way of specifically avoiding doing sports, but more often the motivations were to do with challenging oneself, as this quote demonstrates,

"Well, the music just leaves me cold, but the drumming leaves me even colder! It's just not my groove. You know what? I could just take the money, but I've got to enjoy what I'm doing on a cerebral level. It's got to challenge me." [P. 4]

Overwhelmingly though, the main reason people seemed to be motivated to become musicians were social, from family, to school to wider social circles and the community. The reasons ranged from being with like-minded people, to being able to communicate and included their relationship with other musicians. In contrast to the aspects of competition as already reported, the much discussed relationships with other musicians also included networking with people saying phrases such as "*everyone's there to help you"* and that everyone knew everyone and what they could do, swapping gigs here and there.

However, within the nest of musical friendships and bonds, it was not only empathy but also a sense of segregation, which emerged, particularly in regard to gender and especially with regard to development within music colleges as this short quote observes,

"You can see that people who aren't part of any gang yet, or haven't found acceptance in the elite group, you can see that they're gonna struggle really". [P. 15]

As one musician suggested,

"It's all about approval, being a musician. It's about a smile from someone. Someone telling you you're good. I think life in general is about being accepted by your peers." [P. 4]

Another describes the sentiments of many when he said being a musician is about,

"Meeting like-minded people. Getting to play live. Getting to play music for other people, to other people, just getting to be creative. I think you can feel good just sitting down playing on your own. It's still going to feel good. It's better when you're playing with two other people, but – it's a way of life. It's just a way of life." [P. 24]

At the other end of the spectrum, the sense of hope that the teamwork from music making inspires was described in this way,

"It's just always great to work with musicians. I mean those big sessions with an orchestra are always inspiring to me, just having all those people in a room cooperating just amazes me. Always think, 'Wow, if only the world could be like this'. All these people turn up for three hours, read the music and they want to get it as good as we can get it, and then we all go home and non one's killed anyone else and everyone's had basically quite a good time and something good has come out of it. I always think, yeah – this is a really good thing, you know?" [P. 26]

The feeling was quite enduring as one musicians described,

"As my career has gone on, and as I've grown up, and I've done a lot of music now, loads and loads and loads of it, and I still like to do it, and in a way now I'm more interested in the social aspects. I mean, I do love music and it does affect me when it is

not right, but also it's a big part of my social life and a lot of my friends are songwriters, music makers – well, nearly all of them. And quite often making music is a way of socialising with your friends and it's a really big part of it." [P. 27]

The communication aspect of music was important to the musicians also for their own needs. As one person said summarised with this sentiment,

"It's just the story of expertise really in a way isn't it? Except that with music performance, there's much more emotional and, well probably intellectual, but there's a very emotional communicative aspect to music."[P. 7]

This leads into the performance aspect of musicianship, a subtheme that also appears in other sections. However, as so many musicians described aspects of their development alongside performing, it is explored as the final aspect of this section although not all musicians were bothered about this aspect as some were more interested in the *"channeling the music or having a musical conversation with the people around you. It wasn't really about the audience as such" [P. 12].*

However, as their musicianship developed, many people spoke of the *"incredible tension"* of performing in quite a negative way. For example, even people who said they didn't suffer from performance anxiety in general mentioned situations such as this,

"I know I'm feeling the pressure when I just can't find the spot, and it just doesn't feel comfortable and then I really start moaning about the monitors [on stage amplifiers so the musicians can hear themselves] *or whatever. It's everything except for what it is. For whatever reason, I'm not feeling good!"[P. 23]*

The biggest practical issue people faced was forgetting what they were supposed to be playing, trying to relax and trust that it would come back to them, in that their bodies would know what to do. However, no one spoke of performance anxiety in any way other than simply another obstacle to overcome. Their own critiques of their performances, an important aspect of their development, revolved around two axis which were paradoxically; being able to separate oneself, or not, from the performance, and playing well technically but not bringing anything more of oneself to the experience.

Being able to manage these conflicts was the essence of developing as a musician and becoming a professional. As one musician explained when discussing amateur choirs,

"...they think they've done it if they've got the notes right! They fail to realise that <u>*when*</u> *they get the notes right, that's when the music can begin." [P. 13]*

These two themes together describe the formative period of musicianship. That is, becoming a musician. The discussion of these two themes in relation to the literature is provided here so as to facilitate digestion of the rather lengthy data analysis stage by stage. (A discussion of each of the other three themes will also follow the descriptions of the data analysis and models.)

8.4.3 Discussion of the Formative Period: Becoming a Musician

Two core themes emerged as forming what can be described as the formative period of becoming a musician. Figures 8.2 and 8.3 illustrate Theme One: Early Musical Experiences and Theme Two: Developing as a Musician.

Focusing on the first of these, subthemes generated in the exploration of early musical experiences of the musicians include information regarding the average age of starting to learn, which was seven years old, ranging from four to 14 with most starting between six and eight. All participants knew how to play more than one instrument; for most this was the voice alongside a musical instrument, but for others multiple instruments were played at varying levels of ability. Opportunities and motivations and cultural inheritance in the form of family, community, geography and religion (singularly or in combination) affected whether formal or informal learning took place and choice of instrument.

The formal learning route was characterised by reading music, taking music grades (exams) and also a polarising effect of tutors (positive or negative impact). Parental and school impact was generally positive, and for some, taking music grades provided a route to transcend social boundaries. From the Midlands to the North of England especially, music streaming provided opportunities for social mobility. Luck, privilege and charity were discussed as enabling factors. Aptitude however was seen as more suggestive of natural leanings towards instruments or sounds enabling ease of learning as an important motivation. This is reminiscent of Irvine's conclusion that the notion of 'talent' requires opportunity, sponsorship and dispositional qualities and that we need to find out exactly how much of each is required and in what *"curious alchemy they combine"* (Irvine, as cited in Howe, Davidson & Sloboda, 1998, p. 419).

The informal learning route relied much more explicitly on learning by ear and working out relationships between sounds, patterns. The explicit enjoyment of working on those puzzles was described as highly motivational. Furthermore, as there was a lack of formal grading, it was apparent that rather than explicitly judging ability per se, a reputation was gained amongst family and friends that the developing musician had for example, 'a great ear' for music.

Finally, with regard to early learning and teaching, participants spoke of both difficulties with learning and of learning difficulties. The former was in relation to the wrong choice of instrument, for example the pain in fingers associated with trying to press on guitar strings. With regard to learning difficulties, those teaching noted that children were sometimes sent to them for music either because they were distracting their mainstream class peers, or because they were not able to keep up with their mainstream lessons. Here music was seen as a way to help such children find something they could do. There was a basic understanding of some specific learning and behavioural difficulties but in general these were not seen as disabling if the motivation to learn and play music was evident.

In core Theme Two, Development as a Musician, six main subthemes were generated. Of these the level of musical activity and level of practice were related but separate. They were also mediated by age, which further separated into age related performing experiences and other musical experiences. People who were active at this stage of development tended to have a job as a musician but were only beginning to manifest their uniqueness, which in the next theme became about their sense of creative agency. This developmental stage was sometimes influenced by implicit competition, for example, observing other good musicians motivated a boost in practice and a feeling of not being able to rest on ones laurels. More explicit competition and difficulties managing the conflict between the hustle for work and the passion for music seemed to be the main reason for cessation of playing at this stage, and in some cases these problems caused a complete change of heart. Practice at this stage was self-starting and immersive to the point of obsessive behaviour in some cases. These practice habits developed as a sense of self-discipline that was a source of pride. This was mediated by age in two ways; new skills were experienced as more difficult to master, and other demands on time meant investment in and devotion to continued practice was considered as indulgent rather than essential.

Two factors emerged from the subtheme focused on the musicians' formative career. These were the beginnings of their careers and their relationships with other musicians. The discipline of intense practice in the previous subtheme emerged alongside a very clear ambition to be a musician. This often involved moving, in general to London. Whilst this may be seen to be an artifact of the geography of the researcher, with regard to reflexive practice, it is also no coincidence that the researcher is also a musician who migrated towards London for professional reasons. Amongst the participating musicians, there was a high awareness that the starting point of their careers was marked by proximity to higher-level tutors and opportunities they had symbiotically created by seeking out a specific environment. Freeman (1991) had previously suggested musicians have an innate capacity to focus on a task and furthermore the teachers' sensitivity to the child's emerging needs was critical. Whilst her evidence was in the main positive, some musician's responses suggested that a teacher's negative behaviour, whether boring or aggressive in nature, could also have an effect. Whilst some students may be put off by the teacher's negative nature and/or behaviours in the early stages, it seemed other students were able to balance the value of the teacher (and their network of contacts) against their personal traits as the student moved towards the later stages of becoming a musician. This is contradictory to the evidence provided by Csikszentmihalyi, Rathunde and Whalen (1997) who suggested that the warmth of a teacher's personality was critical, though undoubtedly it might be for students who are less motivated. These possibilities and opportunities concomitantly created a sense of empathy, and segregation, as cliques emerged based on reputation, musical genres and sometimes gender. One striking aspect of this formative period is the sense of hope that developing musicians place, not only in what Plomin and Deary would term *"active model of selected environments"* (Plomin & Deary, 2015, p. 100) but also in the music itself. This leads to the two final subthemes of the developmental stage of the formative period, motivation and performance.

In the subtheme of motivation, four factors emerged. These were social, self and auditory motivations and an attachment (love and passion) for either the instrument and/or the music. The musicians explicitly spoke of attachment to their instruments. This manifested as a sort of love or passion for and intimate personal relationship with instrument. The musicians' descriptions of their instruments often included kinesthetic descriptions such as reaching for, touching and feeling the instrument in their hands or against their bodies. A slightly different attachment appeared to be auditory in nature. Musicians' described the comfort of the sound of their instrument itself, believing that the sound was necessary, rather than simply soothing. Instrumental sounds were believed to have their own existence rather than being purely embodied in the instrument. Continuing the theme of attachment, some musicians were motivated to increase their levels of engagement with other musicians, and reported an aversion to some other activities. This preference was strongly associated with their developing identity (Theme Five). However, whilst this stage did generate a feeling of kinship with other musicians, this was not always a positive experience. Moore, Burland & Davidson (2003) suggest that when peers are working towards a common goal, cooperation in the form of pro-social behaviour develops. They studied the social context of musical learning in order to investigate peer influences and found that the focus of motivation was different for those who succeeded as professional musicians and those who remained non-professional. The professional musicians had invested much more of their formative time playing with other musicians than in practising on their own. In this study we see evidence of this occurring as a creative social outlet develops through the opportunities afforded for the musicians to do music.

Performance generated six factors, which were the relationship with the audience, chemistry and energy, playing with others and playing solo, developing a sense of artistry, a mental approach and also performance anxiety. The musicians spoke of overcoming many obstacles and developing a resilience to reach the point where they could perform on stage. Actively performing musicians still felt the intense pressure of performing but had found a way to redirect it. The redirection appeared to manifest in two ways that depersonalised the situation. Either the musician experience a sense of being a conduit through which the music flowed enabling the audience to experience it, or they could adopt a stage persona which acted as a protective mechanism enabling them to behave in less inhibited ways which were more appropriate than their general behaviour would be on stage. Differences in the experience of playing solo, which was likened to feeling naked and vulnerable, and playing with others, were clearly described. Part of developing the mind-set of being a musician was to understand the artistry of managing the interaction between the feelings of connection with the other musicians playing and the connection with the audience individually and as a group. There was a sense that the transition from becoming to being a musician rested on this aspect. As one composer had claimed, when the notes are right, the music can begin.

As discussed in chapter five, learning to play a musical instrument provides a consciously accessible autotelic (*an end to itself*) value. Csikszentmihalyi (1975) suggested this theory in reference to human motivation behaviour in relation to wellbeing. In Lillemyr's study (1983) of 10-year-old Norwegian students, there was no correlation between the students' interest in school music and their general self-esteem, whilst there was a relationship between teacher ratings and pupil self-perception. There was a disordinal relationship between how a sense of musical achievement and success correlated positively with a measure of self-esteem, yet avoidance of failure correlated negatively with this, but not with the sense of self which was measured as a different construct. For music, a sense of satisfaction and achievement specifically meant playing an instrument. Lillemyr's finding from over twenty years ago is echoed in Themes One and Two of this study, which showed how learning a musical instrument supported a developing a sense of agency, and of overcoming obstacles to create a resilience through self-reliance but also understanding the possibilities offered by group interactions, such that the whole is greater than the sum of the parts. Moore, Burland and Davidson (2003) considered the importance of social environmental factors during critical developmental periods of children's musical learning. They described how the influence of parents, teachers and peers as changing over time. Their study followed up 20 children who had become successful adult musicians. They found that as these children had developed as musicians they had undertaken more performance (concert activities) and creative improvisations than less successful peers, and that their mothers had been at home with them during their early musical experiences. Manturzewska (1990) had emphasised the role of parents in facilitating children's spontaneous musical expression in their early years and this resonated with Bloom's (1985) claim that at least one parent must invest in their child's musical development. This may be a simple a willingness to drive their child to music lessons, rehearsals and concerts. However, Moore and colleagues (2003) suggest that whilst it is evident that parents have a significant effect on their children's developing musicianship, it is not yet apparent which aspects of parenting are involved in determining later musical success. The studies described in this thesis contribute rich data on parental influences on young musicians. In chapter two, qualitative evidence is presented regarding the parent's own experiences and investment in their children's musical worlds. Echoing some of the evidence presented in this chapter, this provides some context for the quantitative study as well contributing to this qualitative study. In an analysis of a questionnaire comparing parental attitudes of the value of music in their children's lives, 79% the EMT parents' signified that music was essential or important compared to 26% of the SSM group. The EMT parents were significantly more highly educated (the majority having undertaken post graduate study) than the parents of the children in the SSM group. When asked to provide information about their own musical backgrounds all 19 parents from the EMT group replied, contrasting the five responses from the parents of SSM group. Descriptions of their own musical activity ranged from dancing and enjoying music to playing the recorder and singing in the school choir. At least one of the parents in the EMT group was a professional musician. The descriptions given by the musicians interviewed for this study also suggests that parents play an important role in choosing the instrument and providing a supportive environment for development musical skills. However, the importance of opportunities provided by screening for musical aptitude in schools, as well as the richness of the musical environment was also evident. This was often explicitly in the form of cultural inheritance manifested in the community (for example with brass bands) and sometimes to a nation (such as Wales).

In the field of music psychology, Spychiger (in press, 2016) has suggested that the research of Dweck regarding students motivations and achievements in relation to their self-concepts regarding intelligence can be extended to beliefs relating to musical talent. Müllensiefen and colleagues (2015 and in prep 2016) intend to adapt and explore this using a self-report questionnaire called 'Musical Self-Theories and Goals'. For example, when an individual believes that intelligence is entity based, this can lead to helpless behaviour (Seligman, 1975). In comparison, when an individual believes that intelligence is malleable, this leads to mastery-orientated patterns of behaviour (Diener & Dweck, 1980). Müllensiefen and colleagues have applied an analogous scenario to musical learning and included questionnaires regarding both academic and musical self-concept and goals alongside measures of musical ability, fluid intelligence, and personality. The sample was single sex and included 312 ten to 18 year old girls (Mean age 14.14 years) from a private school. The findings from the initial cross-sectional study suggested that self-theories for music and intelligence are related via the personality construct of Conscientiousness. This was the second highest trait in this sample, with Openness to Experience being the highest. In their study, this trait was connected to a cluster of musical abilities indirectly through Extraversion, which was the third highest trait in this sample. The network model the authors derived suggested that melodic memory, rather than general musical activities, influence musical self-theory, though any evidence of causal effects will have to wait until the data from the second stage of this study is analysed and published. In the mean time, the results from this study suggests that differences may emerge according to whether musicians are self-taught, or more systematically or formally taught. Furthermore, this study provides strong evidence that musicians are aware that their success in learning depends upon overcoming obstacles, through determination to achieve mastery, and that this in itself is motivational and develops resilience. In turn this investment develops a sense of self, sometimes attached to their instrument or music, although this aspect may develop during the transition between developing as a musician and becoming a musician.

It is important to acknowledge that whilst the data in this formative section does not contribute novel material to the literature, it does provide further empirical evidence to support other studies (see e.g. McPherson, Davidson & Faulkner, 2012). In turn, this suggests that these data are reliable and valid.

The next section provides the results of the grounded theory research regarding the musician’s experiences of how they come to identify as a musician (Theme 3) and what factors involved in being musicians (Theme 4). The models for these two themes are explained, the results presented and then discussed in relation to the literature before the same process is provided in support of the last theme (Theme 5) of this study.

8.4.4 Theme 3 – The Emergence of Musical Identity

As with Theme 2, the title theme is depicted as a large oval and core nodes are depicted as round-edged rectangles, and sub-nodes as smaller ovals in the model of Theme 3. However, for the sub-node of Self-Identification, a tertiary level emerged from the data relating to the sub-node titled ‘As a musician’. Therefore that node is represented as an octagon to help clearly see the difference and third level. The description of this model therefore begins with this core node.

Self-Identification was split into three areas, as a Teacher (which is self-explanatory), As a Musician and Dissociation. The sub-node Dissociation describes when participants did not want to identify as either musical, or with a particular instrument or as a label (e.g. singer, rather than singer-songwriter or musician rather than multi-instrumentalist). The sub-node As a Musician shows the opposite specification of self-identification as a musician, in context, from a particular mindset or to do with a developing sense of self as clearly delineated by participants. Gender emerged as an issue for female participants in the main, though male participants who teachers or parents also noted these discriminations and spoke of their impact. To the left of this a separate core node depicts the issue of stereotyping or archetypes associated with either a particular instrument (e.g. brass players as 'brash boozers') or a particular genre of music (such as behaviours linked to classical, rock or jazz musical styles). Two single level core nodes shown below this relate to identification with either a specific time or place (such as the emergence of the Indie music scene in the U.K. in the 1990s), or by others such as being referred to as a drummer for one musical job (when in fact the participant saw themselves as something different). The final core node, Status is related to self and other perspectives again but also includes institutional differences, such as peer attributions in a learning context (Schools/Colleges), or outside of this in a professional context (Professional Admiration). The latter is next to the Approval sub-node that is turn to the Cultural Norms sub-node, and this in turn is beside (yet separated from) the Identification by Others core node.

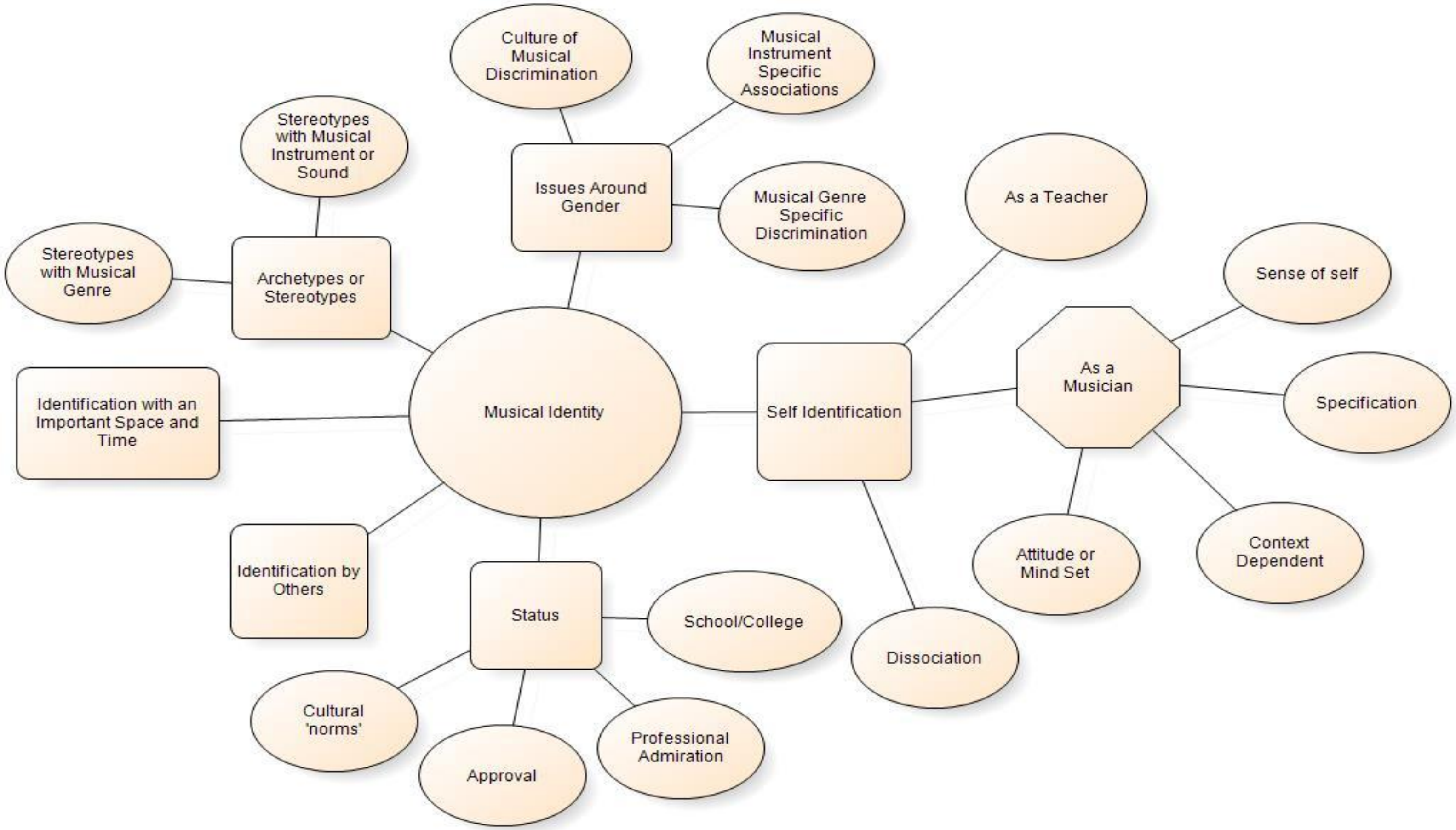

Figure 8.3. Model of Theme 3 – The Musicians' Model of Musical Identity

Identifying oneself as a musician relied upon actively 'doing' (performing and practising) music, rather than having done music. Two interesting examples are presented here,

"When I DJ, I don't consider myself a musician, and when I gave up DJing I did so because I felt like I was turning my back on my gifts as a musician and that I had to get them back". [P. 12]

"I would prefer to say I am a musician rather than a pianist, although piano is a very important part of what I do, but I do more than play piano" [P. 1]

However, how one described oneself was altered by context. For example, when speaking to other musicians, people described themselves in the context of their instrument, (such as, I am a drummer/pianist) whereas if they didn't know to whom they were speaking, they would identify more generally as a musician. Some people wanted to avoid being associated with certain instruments because of stereotypes held about them (for example, the trumpeter), or with certain types of music, or because musicians themselves were seen a *"dull, hypersensitive, or stupid pop stars" [P. 12].*

In contrast the multi-instrumentalists preferred to think of musical instruments as tools they used appropriate to the job in hand and did not like identifying with one particular type. However, overall it was the context that altered the description of self as this excerpt from a person who is most well known for playing drums portrays,

"I think it changes according to the situation. When it's billed, or I do interviews in Russia, it's like [puts on fake Russian accent] *'Yah, zis is da multi-instrumentalist…'. I think I do class myself as a multi-instrumentalist and with students I teach I try to make them understand that this is a very positive accolade. Musician I find too broad. I dunno, because I AM a musician. I feel with music. I communicate with music. So yes, I am a musician. Yes, I am a multi-instrumentalist but that doesn't go to the voice and I feel like my singing and writing words, hmmm, being a songwriter is more important than being a multi-instrumentalist maybe I think? It's confusing."[P. 7].*

The voice was seen as a kind of instrument but also as very personal mode of expression, though this depended upon the relationship between the person and the particular song itself, and whether the person had written it or not. One musician described it like this,

"I really think I'm a jack of all trades. I wouldn't say musician first. I probably would say singer first and I think a lot of singers say singer because of 'the voice' – you know, it's part of you!" [P. 13]

This lead into the idea that music formed part of the musicians' sense of self, as one person explained,

"Even though I carry on now operating more computers than I ever thought I would, the music matters because it's given me a reasons to be. Hands down. I live and breathe my job. Without music I wouldn't be anything" [P. 9].

Whilst one musician described how doing music was *"a way of life"* [P. 24] another struggled with this as this excerpt demonstrates,

"There's a strange dichotomy there is there? I don't consider myself to be defined by music but really, when you analyse it, you don't have to get too far, too deep below the surface to find that I actually am. I claim I am not defined by the trumpet and it's true. I wouldn't care if I never played the trumpet again. It wouldn't bother me in the slightest. And yet, scratch below the surface and everything I do is defined by it. It underpins everything I do! It's weird." [P. 5]

The mind-set of the musicians included a serious work ethic (based on their own commitment to practice) as well viewing the world from a musical perspective, often as a result of constantly having music on their minds, playing musical games in their minds or thinking about and creating music on the go. However, it was their openness to learning, to improving, to gaining new experiences that was the outstanding attribute of their descriptions of themselves. As one person summarises beautifully,

"Well, put it like, this. I think it's [being a musician] *a pretty essential part of who I am. I don't know what it would be like not to be a musician, but I might be surprised, pleasantly." [P. 1]*

Obviously the participants in this sample did identify as musicians to some extent, or at some point. Therefore, the next Theme explores how these musicians described being musicians.

8.4.5 Theme 4 – On Being A Musician

Figure 8.4 depicts the musicians' model of musical being. The title theme here is depicted as an octagon[26] to reflect the 8/9 core themes that emerged for this section. Musical Activity and Performance, were closely connected yet separate form one side of the octagon. Further research may help inform whether these should be merged or whether they remain differing concepts for musicians. The other core nodes reflect the musicians' relationships with their instruments and with music, aspects of socialisation, creativity, teaching and learning, professionalism and the psychological impact of their work. These core nodes are depicted using round-edged rectangles and the sub-nodes are associated (as in the other models) using ovals. Only two levels emerged from this analysis (core and sub). The clustering and positioning of the nodes, as with the other models, is particular and reflects the data as is consistent with the grounded theory method utilised.

Beginning with Musical Activity and Performance, the sub-nodes help demonstrate how these are difficult to disentangle. Musical Activity was related to the amount and level at which the musicians described themselves as practising and playing. The perception of others related to the perspective, for example, of the teacher, family, partner or other musicians. This had a professional aspect also in that it was for example seen as a positive accolade if one was seen as busy with musical work in terms of being 'in demand' as a musician. The Professional Criticism aspect was closely associated with Musical Activity but was actually discussed in regard to performance, which is why it is beside the other sub-node. This core node of Performance also had Artistry as a sub-node describing a professional development of this extended form Theme 2. In Theme 3 this related to how the musician had overcome difficulties with performance anxiety and now experienced playing 'in the moment'. This is the final sub-node of Performance and it is placed beside the next core node, Aspects of Socialisation because part of the discourse

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[26] Ideally one would have used a septagon. However, this shape is not available in NVivo. Nevertheless, the 8/9 issue does reflect the difficulty in separating these aspects in the data.

related to being able to enjoy this aspect as a function of social engagement in general. The construct of how being a musician was enjoyed however differed according with whether it was with in the context of a musical groups (such as a rock band or an orchestra), or friends outside of the participants musical circle, or family. Socialisation with family was also related to class and community. These were separate yet connected aspects for the musicians, which is why they are overlapping in the model.

Continuing clockwise around the model, being a musician also included separate relationships for the musicians with their instruments and with music. The first of these core nodes only has one sub-node that emerged; attachment to instrument. This became a sub-node because the language the musicians used to describe their relationship to their instruments included describing their instrument as a companion or a teacher for example. On occasion the relationship seemed to facilitate the feeling of being a conduit through which music flowed, hence the proximity of that sub-node to the sub-node associated with the musician's relationship with music. In a similar way, the sub-node beside that describes the musicians sensing a meaning or purpose in their relationship with music; that they understood to intent to affect. Affect was also something the musicians experienced though music however, so this is the next sub-node. Whilst that sub-node relates to emotional affect, the one beside it describes a more conscious cognitive process in which the musicians engaged in games and challenges with the music, for example trying to transpose it to keep their skills present.

Musicians also described listening to music at length as part of their lives. This differed form the formative stage that was immersive and consuming. At this stage, musicians explained a type of professional listening, even of music they didn't enjoy or did not respect. As it's placement suggests, this was related to yet separate from the next core theme, Creativity. The three sub-nodes for creativity explain how the sound source could generate creativity. Similarly, creativity could be facilitated the learning of new techniques, or by the style of music and freedom within the project to contribute and/or collaborate.

Continuing clockwise, the adjacent core node is Teaching and Learning because the two sub-nodes generated form this aspect of being a musician were related to creativity. Developing Methods refers to teaching and learning methods and Bi-directional Inspiration refers to the relationship between the teacher and student. The next core node, Psychological Aspects (on the right of the model) has a cluster of sub-nodes relating to musicians descriptions of their behaviour associated with being a musician. For example, the sub-node Obsessive Behaviour explains musicians' accounts of extreme amounts of practising and/or counting. Therapeutic Use of Music describes the use or avoidance of music to relax for example. The last of these, the musicians' Internal World describes how musicians spoke visual images evoked though musical practise such as escaping to 'a different place' for example. A separate sub-node, Confidence and Determination explains how musicians described that their belief in themselves grew from their resilience in overcoming obstacles.

The final core node, Professional Musicianship has two sub-nodes. The first of these, Personal and Professional Pressure relates to how the musicians manage those factors. The second, Reward and Recognition, relates to how successful the musician either believes themselves to be and/or this is impacted by how others relate to musician. For example, some musicians spoke of the respect of their peers as important, whereas others spoke of their artistry.

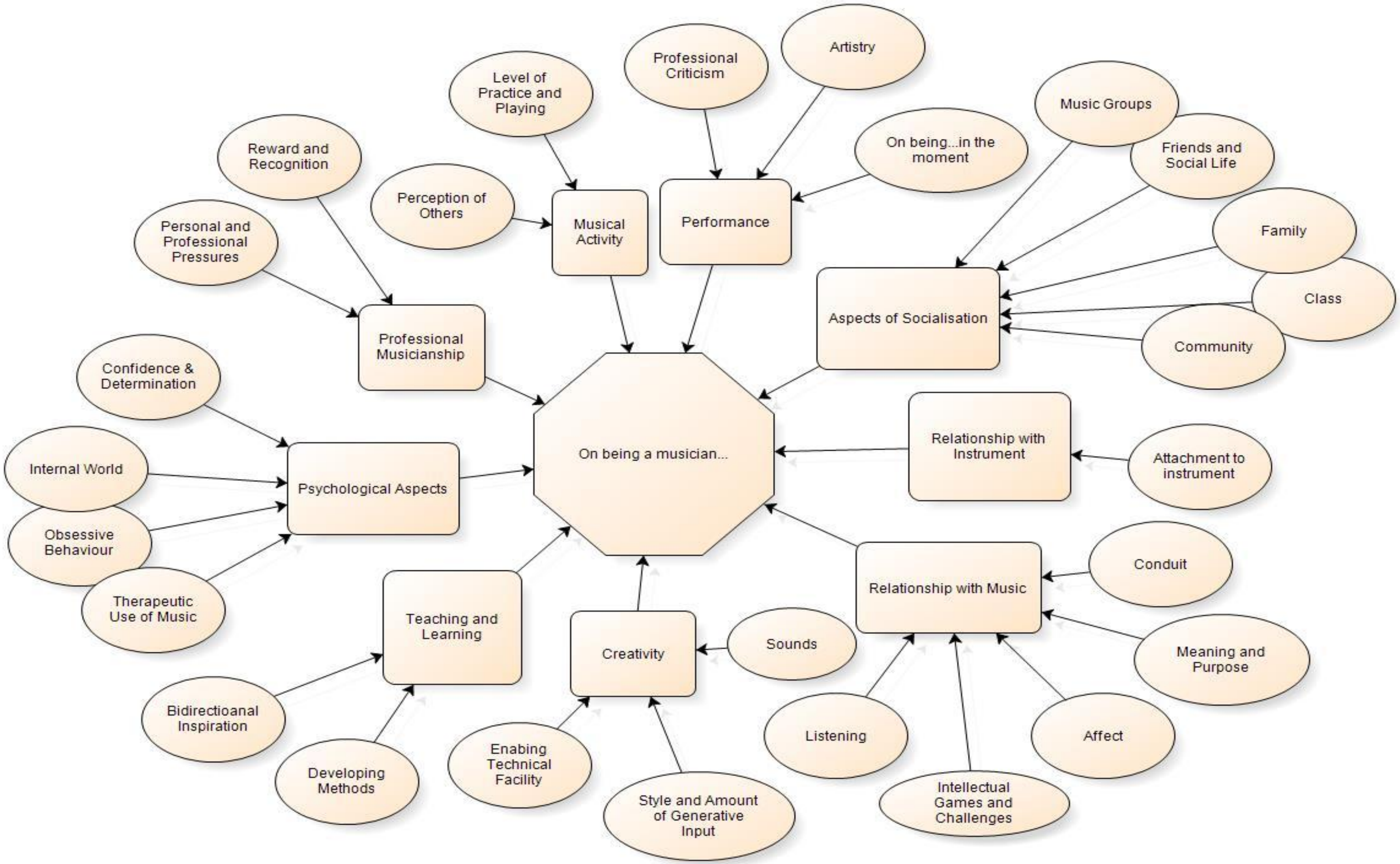

Figure 8.4. Model of Theme 4 – The Musician's Model of Musical Being

As the musicians became established, the variety and range of musical activities tended to increase. A sense of pragmatism was intertwined with an explicit professional pressure regarding whether or not the musician was 'working' and how busy the musician reported being. This was seen as a measure of professional excellence as the following comment captures,

"Time is money and there's no fannying about. Stick it [the music] *in front of you, you run through it once, on goes the light, bang* [click fingers]." *[P. 5]*

However, that did not necessarily mean that the sense of artistry suffered. The term 'artistry' was associated with creativity, style, and specialist knowledge that set some musicians apart from others for doing more than just a job, rather than about technical ability or experience. One person suggested that the way people are currently working in music is *"like a completely different set of rules, part of the new sound,* [about] *who's the best at manipulating sound. A lot of those people don't even play anything at all! They don't know one chord from another." [P. 27]*

In particular the relationship between the musician and the audience seemed to take on a new dynamic as this extract demonstrates,

"You cannot be a musician and just play notes and rhythm. It's impossible. It's how you express yourself. It's all the stuff that goes beyond, and it's what is so distinctly lacking in so much music – is character. And this guy had bags of it and I enjoyed working with him because of his character, and he knew how to talk to an audience. Talking to an audience. Part of bringing people in. It's important."[P. 23]

Musicians were explicitly aware in performance of having *a "state of power",* of "*drawing people into their world"*. Sometimes this was described as being transformative for the audience, and sometimes for the performer. One person, who described *"turning into a gibbering wreck"* when talking to girls offstage, found himself cartwheeling about on stage and surprised that people actually took him to be that way. He suggested, *"There is this theory, to which I subscribe incidentally, that people who go into entertainment are intrinsically shy. And I mean, that resonates with me." [P. 5]*

The showpersonship of body language was physically demonstrated and articulated quite vividly during some interviews. People also described eye contact with the audience as important, although playing solo or singing brought different challenges, as one person described, *"…when you perform you haven't got that barrier". [P. 14]*

From a different perspective, one conductor described the intimacy of the relationship on stage as much more engaging than the relationship with the audience.

"If you get a conductor who's very good then it becomes interactive. It becomes a kind of communal flow". He continued that in an intimate setting, *"…that's often when the magic happens, when the two of you really get into the flow together. And I really think it comes back to the music as well. It's the way you are both perceiving it emotionally. The meaning of the music is unfolding in a very similar way for both of you and I think that's a really magical experience and certainly for me, that's much more important than anything that happened with the audience." [P. 26]*

The experience of being in the moment when performing, of *"not being conscious of other things"* in the state of flow (Csikszentmihalyi, 1990) really seemed to be a quality of musical bliss that musicians enjoyed. As one person describes,

"The visual experience, but also the sound that's generated, there is nothing, as far as I am concerned, sexier than watching somebody make, a guitar for example, sing. Or drums, you know, they're just feeling everything they're doing". [P. 9]

Some people only found this place when they were really pushed to their limits, at which point they experienced a physical change, which was described as *"zoning out"* and making their eyes switch into staring mode. The descriptions suggested that it was as if the music had taken them over. As one composer describes,

"The powerful thing was never the voice, or the piano, it was always the music. That's always intrigued me that music has the power to elevate the consciousness to something more, as you say cosmic [the research had not said cosmic or anything similar]*, or, inverted commas 'spiritual'. I hate that word, but there you go. It can*

transport us, can't it, beyond ourselves". The same person described the experience as vital *"So being a musician for me* <u>*is*</u> *being alive". [P. 26]*

This experience was so important to musicians it is hard to underestimate. Another spoke of,

"...when you're mastering a scale, it was very much about getting the sound right so achieving a sense of mastery about something, a sense of accomplishment. The other part, when you're just playing a very beautiful piece of music, is about escape. And that becomes multi-sensory and that allows you to zone out from the sense of time, sense of what job you have to do next...you know?" [P. 21]

The seductive nature of this experience is encapsulated here,

"It's an incredible feeling when the composition, the performers, and the audience are all united in one thing. Something happens. A power takes over and I believe that and I think you aspire to that as a performer as well." [P. 7]

In terms of career, professional musicianship was explicitly described as 'doing music', from touring to playing to recording or networking. Whilst being paid was seen as important, the level of payment rarely reflected the amount of effort, training and hard work which had gotten the musician to that stage until the pinnacle of their careers. There was often a conflict between getting work and doing the work as this quote exemplifies,

"...the child that becomes very very engaged in the music, and loves music and then drives that acquisition of expertise – and then you want to get better because you can play better music. But the whole thing is completely uncorrelated with being the kind of person that can go and radiate confidence in front of people they don't know and, you know, hassle for work!" [P. 28]

It was a significant risk to give up the supplementary part-time jobs to go full-time as a musician, and then it was often in order to take part in a tour, which would then leave the musician with no job to return to.

Reward and recognition both personally and professionally were equally important, but not fame (though this sample specifically did not include people who could be described as 'household names'). The reward and recognition desired was more around a sense of caring about what one does, often to the point of being difficult to work with because of that drive for quality and excellence, but also the need for a wider understanding of what being a musician means. One female creative suggested,

"There is an ontology of musician – of being a musician. I think someone who fully recognises what being a musician is and honours that". [P. 12]

Part of being a musician related to a sense of creativity. When musicians were not allowed, or not able to contribute either because of the type of job or musical genre they seemed to feel a sense of loss. The hierarchies and etiquettes involved in session work and with classical music in particular prohibited the contribution of ideas. For example,

"I was taught from very small that you never sit down at the piano without holding your hands in the right position, holding your posture properly. You don't mess around on the piano. It's not good for your technique. Every time you play you play properly and carefully. I think it actively discouraged you from doing those kinds of improvisational creative things with music. It's very unfortunate" [P. 28]

This was seen as demotivating and frustrating. As one musician described,

"If I don't get enough opportunities to write music I go into a real hole, as if I've been cheated" [P13].

Sometimes finding another outlet, such as jazz music for example circumvented the problem. This type of improvisational creativity was different to generative creativity in terms of producing music in the moment or to be recorded. Having technical facility, or not, was also described alongside creativity. Talking of his successful song-writing partners' lack of knowledge of musical theory, one musician proposed that this lack of theoretical knowledge enabled his partner to explore melodies and musical motifs that really shouldn't work. When confronted by more knowledgeable musicians who said she couldn't do it, she simply replied that, well, she was doing it so it could be done. He found that sort of informal structure useful in creativity. Creativity was not necessarily associated with expertise. As one composer and conductor explained,

"There's as many ways of making music as there are people. Everyone's unique, yet it [music] *is a common language." [P. 26]*

Musicians sometimes found their primary instrument more difficult to improvise or create on or with, because of the learned associations as described earlier, although some found it the best place to return to when they needed inspiration, like going home. This was sometimes connected with affection for a particular sound. Knowing the sounds, being able to reproduce them in your head, to access them when needed, was a key part of musical creativity. For those who felt the need to be creative, the outlet did not necessarily have to be musical. Lyrical and visual artistry were also mentioned. So too was the use of drugs as this quote exemplifies,

"I hear music in my head all the time anyway and you can't take that away. It's like when you've listened to techno on 'E'. You can always replicate that. You can always reproduce in your head because you've heard it and become it at the same time." [P. 12]

Overall, creativity and musical being were closely intertwined with the musicians' relationship with music and with their instrument.

Regarding music, a range of relationships were identified from academic interest and intellectual challenge, affect, and a sense of meaning and purpose culminating in a identification as a conduit through which music passes for others. Academic interest from non-academics interviewed ranged from the science of sound frequencies to thoughts about intangible cultural heritage and community enrichment. The intellectual games and challenges mentioned included counting, transposing, sequencing, and problem solving. These seemed to be part of the fascination and longevity of interest as this comment encapsulates,

"I think that I was really quite hooked, and I still kind of like that kind of music. I think it's clever. It keeps me amused. It's difficult and it crosses that bridge nicely between classical and folk". [P. 23]

However, the relationship with music was affective as well as cognitive, though this experience was not solely positive. Some musicians spoke of turning away from music when feeling low, and of finding musical interaction too upsetting to engage with. As one stated,

"I think that the problem is that music is a demanding mistress and you have to put such a lot of yourself into it, and I think there can also be quite a lot of pain and negativity involved as well in the relationship with music. You know, you're striving and you might get to a stage where your technique won't go any farther and yet you long to perform that piece of music that you can't perform." [P. 27]

Similarly, there were many unfulfilled dreams and desires associated with music that made the musicians sad, especially the feeling that they never achieved what they might have done. Along these lines, musicians found that some jobs, mostly associated with advertising, jobs that they needed to do 'for the money', had an emotional cost associated. This led to them questioning the point of their role as a musician. The more the banal the music, the stronger the reaction, with many being motivated to switch off or find a way of never listening to that music again.

Noticing musical affect and being able to harness it appeared to be an important part of being a musician, a sort of busman's holiday as this producer explains,

"Well, it [music] *definitely has a massive effect on people. I mean you can notice that just the music that's playing in a bar or in a space. It can completely change the atmosphere in a millisecond. That's something that I find interesting. The music's really important to the atmosphere. It affects the way people feel, even if they don't realise it." [P. 27]*

Musicians tended to seek out a certain type of music because they were feeling a certain way, rather than to alter their mood and any incongruence between the music and the mood was described as unbearable. Conversely, sharing music in order to affect other peoples' moods was seen as part of the musicians' expertise. Knowing what would work, understanding the requirements and being able to match the music to the mood and the person or the context was a respected attribute and source of pride. This emerged from two aspects, understanding the meaningfulness of the music and having a sense of purpose as a musician and also of the importance of listening. The first two of these qualities emerged from the sense of craftspersonship involved in producing music and the latter from the intensity of perceiving music. Many musicians described hearing a song that changed their lives, as an almost evangelical experience. These discussions led to further questions exploring what the lives of musicians would be like without music. The answers were quite definitive as these examples demonstrate,

"Without music I wouldn't be anything. I would be nothing. I would just be a soulless person, just functioning. But music, music's given me a purpose, a reason to live". [P. 9].

"I can imagine thinking I would want to be making those sounds, those effects – and if you took it away from form, it would be a bit like…what would be an analogy…um, like being offered pornography but you can't have sex anymore." [P. 1]

There was quite a divide between musicians who would have been devastated by not being able to listen, and those who would not have been able to produce music. It was quite striking how listening was a complex and important part of the musicians' relationship with music. As one musician described forcefully,

"As a musician you need to listen, and I don't mean just hear it. I mean LISTEN!" [P. 4]

Quite often people described how in their formative musical life, listening had been intense and important, and that listening back to yourself play was of fundamental importance to your development. However, listening had since become more professional rather than revelatory as described here,

"Professional listening involves checking out musicians and performers that are of some conceivable relevance to what I'm doing. So, colleagues or people I don't know but have read a review of or something. I may not like it, but I'll do it." [P. 1]

Undoubtedly, being able to listen well was of central importance as encapsulated here, *"I think really good musicians, whether they are good readers or not, are very good listeners. That's part of being a good musician, being able to listen and react to and be sensitive to the music and the musicians around you on an extremely fine level. That's vital." [P. 27]*

There was also a sense of somatic awareness of music, and in particular of generating music with the physicality of touching something to express sound being part of the intrinsic experience of being a musicians. Stroking, touching, smelling, reaching for and hearing their instruments were all described in great detail and sometimes with a sense of wistfulness.

Whilst making music did not necessitate the intimate relationship between the musician and their preferred instruments, the attachment was quite explicit. One ex-musician who had reached Grade 8 and taught before becoming an academic described the relationship with the guitar named The Professor as so,

"University life took over and serious study in other ways and The Professor became more and more part of my personal enjoyment and relaxation that something I was continually striving to get better. Eventually I'd spent so much alone time with him that it actually felt rather strange if anybody heard us." [P. 21]

Sometimes the instrument was imbued with powers that the musicians perhaps found difficult to own themselves as this person identifies,

"It's almost like the trumpet is this kind of shield, like a force field I'm behind. You know what I mean? It's not me they're seeing, it's something…it's this guy – trumpet star!" [P. 5]

At other times the musicians described finding their voice through their instrument, though with the voice in particular a sense of vulnerability emerged as the musicians had no barrier available between themselves and their listeners. This interconnectedness between the instrument, the music and the audience when performing is the source of musician's interpretations of themselves in their words as utilising their expertise, their emotional intelligence, their sensitivity to and reading of the context, as conduits through which music flows. This is encapsulated here, *"I like using music therapeutically, so that's where I channel it now. I recognise the ability that I have as a conduit, and the fact that I can use crafted sound as an energetic conduit that had a really profound impact on people around me". [P. 12]*

This feeling seemed to extend to teaching music, which was generally seen as part of being a professional, though secondary to performing. Everyone who taught mentioned the reward of seeing their students accomplish even the simplest of musical tasks with phrases such as *"faces lighting up"* and children *"shining"* encompassing the sense of joy, but also something more altruistic. This quote aptly demonstrates the general feeling,

"I just feel a huge sense of achievement if you're working with other musicians together and actually produce something that is very good. I do feel achievement teaching because obviously you get rewarded with the children, but it's a different sort of reward. It's more personal achievement than professional achievement." [P. 7]

Inspiration was bidirectional, with teachers mentioning being motivated and receiving energy form their students as well as encouraging them and being role models. Thinking about how to teach increased in importance as musicians reflected, with gratitude, on what they had learned and what they wanted to pass on. A sense of responsibility for their role in this dynamic heritance was palpable, especially when their relationships with their teachers had been problematic. Whilst the job of teaching initially may have been a financial necessity in order to subsidise other musical adventures, the relationships with their students, being able to impart wisdom or advice, was found to be worthwhile and often quite humbling. In some ways, musicians who fell into teaching found this to be an extension of their sharing of music.

For most musicians, sharing their music, and creating music, and playing and doing music had been part of a broad social experience. These aspects of socialisation really formed the musicians' family of choice, their bands/orchestra/musical friendships. Sometimes people mentioned constraints or mobilisation within the social aspects, such as class and community. For example, many people won scholarships that enabled them to move beyond their own perceived social class. Yet others perceived the community reliance on, for example, brass bands, was a limitation they needed to move away from.

However, the overarching theme of making music in the community was that it developed a sense of trust and togetherness. This was also true of families of origin when the relationships were positive and many of the musicians' earliest memories were of singing and playing music in their family, or church. Some did feel learning their instrument isolated them, or that their virtuosity set them apart from others, leading to a sense of *"being a bit of an oddity"* [P. 1]. However, most musicians interviewed felt that music was a way they communicated with other like-minded people, a way to connect and interact, and a way to be a part of something more than who they were themselves. Several musicians described music as like sending out an invitation to other people to do what you are doing and engage with each other to join another persons' world. The types of music groups discussed by the interviewees included brass and/or marching bands, choirs, folk music (bands and solo artists), jazz, and rock and pop cover versions and original materials bands, and classical ensembles and orchestras. As with other types of social groups, this type of ideal situation did suffer from the perceived status of certain individuals or hierarchies associated with gender and/or stereotypes aligned to certain instruments or genres of music. This is briefly touched upon in Theme 5, though it is not the focus of this thesis and instead informs a future research agenda. To summarise the musicians' feelings regarding the friendships however, this quote aptly described the sentiment and practical constraints,

"I think if you've got strong friends, whether they're musicians or not – well, maybe the musicians bond is stronger, but if you've got strong friends musically, I think you'll always end up playing with them again, you know, depending on diaries and things!" [P. 7]

The nature of musicianship also had a psychological impact with five subthemes in particular emerging. These were confidence, determination, and obsessive behaviours, therapeutic use of music closely connected to a sense of spirituality, beliefs or an internal world. The sense of confidence tended to arise as a result of resilience when overcoming the difficulties associated with either technical mastery or performance. This was also aligned with the determination to continue, often in adverse conditions and so was also associated with courage. This story, about a girl who received lessons funded by a charity at a state primary school in the Midlands of the U.K., encapsulates these two qualities, *"We had one girl who was learning trombone, and I do lunchtime music clubs as well, and she came very Wednesday and every Wednesday she played Hot Cross Bun on the trombone. We never got passed it. And you had to stand within two inches of her to hear her speak, and we had this talent context and she applied and I was expecting Hot Cross Buns, but she sang and my jaw just dropped because this voice came out! And it was playing Hot Cross Buns in font of her friends that gave her the confidence to do it and she had a major part in our new production and she's terrific and that's why it's so important". [P. 8]*

For some musicians, escaping to their internal world to practice and immerse themselves in the music enabled them to re-emerge as musical beings. One musician described it *"as a space for me, just for myself"* [P. 27] and others described their internal world as full of music, of sounds, a spiritual place in which the vibrations of music could resonate, where the power of music could exist without having to be made consciously explicit. As one composer described, after using and then pointing out that he hated the word 'spiritual' *"...but there you go. It* [music] *can transport us, can't it – beyond ourselves". [P. 26]*

This type of escapism could also diverge into obsessional behaviours such as counting, spending money on music, practising or becoming fascinated with certain sounds or phrases (in a different way than ear worms) and/or be directed to more therapeutic usage. These included doing music for relaxation, especially singing in choirs with friends for fun, or playing music for a sense of release. The percussive instruments seemed to be more associated with release, whilst the melodic instruments (or singing) with relaxation. The healing and cathartic aspects of music were multifaceted and could be derived from creating, listening to, playing or dancing to music. Musicians variously described these activities as *"keeping them sane"* [P. 19], being *"a safe place to go. It's your own world, you know what's in it and nothing bad's going to happen in that world"* [P. 27].

At this stage it became clear that musicians were talking about the effects of being musicians beyond their purely musical lives. In order to differentiate these aspects from transfer effects as previously discussed in this thesis, I have referred to these as efferent effects. Here efferent effects describe the outwardly spreading nature of living a musical life that the musicians spoke of.

8.4.6 Discussion of Being A Musician, including the Emergence of Musical Identity

Theme Three, the emergence of musical identity was a separate yet connected theme to Theme Four, which described what it is to be a musician according to musicians. There is a wealth of literature regarding Musical Identity (the most relevant of which is referred to below where appropriate). However, here the focus is on the novel elements of how musicians experience and describe being a musician as a novel approach to understanding the nature of musicianship. It is relevant to this to note that Teaching and Learning almost emerged as a separate theme, but as it appeared to be part of the core value of being a musician, it is included here as a component factor as well as being present in the formative themes. This also reflects the statistic from the Musician's Union (van der Maas, Hallam & Harris, 2012) survey in which only 20% of musicians working as music teachers identified as teachers rather than musicians.

The core theme generated eight or nine subthemes. These were Professional Musicianship, Musical Activity and Performance (which were related but separate hence the eight or nine subthemes), Aspects of Socialisation, Relationship with Instrument, Relationship with Music, Creativity, Teaching and Learning and finally the Psychological Aspects of 'Being a Musician'. Relating these findings to the literature, when musicians were asked to identify important factors of their job, 71% identified practical skills such as singing and playing an instrument, 32% identified listening and understanding, 28% identified aural skills, 24% identified the importance of appreciating music, 15% highlighted the importance of being responsive to music and 9% mentioned the importance of integrating these skills (Hallam & Prince, 2003).

The musicians understanding of Professional Musicianship included two aspects; a sense of pragmatism regarding doing jobs that paid and kept them busy, and also a sense of the artistry involved in doing the music. Doing music, rather than playing or making, music was commonly referred to in the discourse. There was a certain level of acceptance of the precarious 'hand to mouth' financial existence a dedication to doing music required. Whilst it was preferred that musical jobs involved individual artistry and paid well, this was seen as an ideal combination whereas recognition of the amount of care and effort involved in being a musician was a necessary aspect to making the choice of profession fulfilling. Professional criticism was accepted generally only from other professionals with popular shows such as X Factor or The Voice seen only as something you would do if you wanted fame rather than a life as a musician. Describing oneself as being busy seemed to be acknowledged as a code for having work and being successful. However the codes and etiquettes were also acknowledged as a minefield to navigate both personally and professionally. For some the experience of unfulfilled dreams and desires in their musical careers seem more akin to expressing sorrow at an unrequited love affair than something describing a career. Similarly, the experience of playing banal music (such as advertising jingles) was felt to be so demeaning that it could lead individuals to questioning the point of being a musician.

Two subthemes, ‘Musical Activity’ and ‘Performance’ illustrated the intimate experience of a three-way connection loop between fellow musicians, the audience and the music. For some, a blissful state was experienced on stage through the interaction between the musicians ‘doing’ the music, whilst for others it occurred when the audience was drawn into the world of the music. The transition in focus, from being internally directed (on one’s own technique for example) to being able to externally directed, for example being able to focus on other musicians, or the audiences experience, seemed to be a major difference between becoming and being a musician. Two ways of transcending the limitations of self appeared to manifest. In the first, the musician saw her or himself as a conduit through which music flowed. Here the musician merely facilitated the audience’s musical experience. In the second way, the musician assumed a stage persona possibly to overcome inhibitions. Sometimes this was an exaggerated version of themselves, and others a different type of character that enabled performance appropriate to the genre or situation. The musicians in this sample spoke freely of the sense of being in the moment as a blissful state. The importance of creativity to musicians was intertwined with these feelings of flow, described as bliss, and the sense of loss when opportunities for creative exploration were either not available or not allowed. However, two types of creativity were notably differentiated; generative creativity and improvisational creativity. Repression of the expression of the former (generative creativity) was experienced as frustrating to the point of leading to maladaptive behaviours. Musical expertise however was not necessarily associated with this type of creativity whereas the manipulation of sounds was. This ability, to hold sounds inside ones’ mind and manipulate them or progress them in some way was central to the experience of being a musician. As seen in chapter three, Gordon described this idea as *audiation*. The findings from the quantitative child study suggested that Gordon's PMMA measured a musicality that was not associated with other measures of cognitive ability. Perhaps in this study of musicians there is some support for the importance of this aspect of musicianship. The musician's reported thinking about music, rhythms, melodies, motifs and patterns. This is a very different endogenous experience than for example 'earworms', or involuntary musical imagery for example, which is associated with high levels of Neuroticism (see e.g. Müllensiefen et al., 2014; Williamson et al., 2012;). Future study of the similarities and differences between conscious musical audiation in musicians and involuntary musical imagery may provide an alternative direction for understanding the nature of musicianship, in comparison to Gardner's theory of musicality as an autonomous intelligence.

For musicians, the importance of listening was central to their relationship with music. Their ability to harness musical affect developed during their early and intense emersion in musical listening, which matured into an ability to observe musical effects more objectively. Discussion around this subject led to a line of questioning regarding how the musicians would feel if they could no longer listen to music. There was a strong divide between musicians who would be devastated not to be able to listen to music anymore and those who would be devastated if they could not do music anymore. This journey, involving listening seemed to evolve until some musicians admitted to never listening to music and preferring either silence, or Radio 4 (a predominantly talk station). This did not seem to be a feeling of saturation, but rather the choice to provide some internal space. For some, music was quite a distraction and this led to thinking obsessively about musical puzzles and patterns, or practising difficult transpositions or unusual melodies, which pushed the limits of their musical knowledge. These musical imaginings as mental activities were described as both enjoyable and irritating. They seemed to be occasionally triggered in response to non-musical stimuli. For example, a synergy experienced between the rhythm of windscreen-wiper blades in a car in the rain and the sound of an emergency siren in the distance. However the ability to listen and react with sensitivity, noticing the fine or subtle changes, was seen as an essential characteristic of being a musician. For their own purposes, musicians tended to seek out music that was congruent with their moods rather than to alter it. In fact, incongruence between mood and music was expressed as intolerable, further supporting this ability to harness musical affect.

The relationship with music was related yet distinct from the musicians' relationship with their instruments. Some musicians described experiencing music in a somatosensory way. This ranged from experiencing an internal beat to wanting to move in synchrony with the music. However, nonmusicians also describe these experiences. The factor that really distinguished musicians was their descriptions of their intimate relationship with their instrument. These descriptions included touching, stroking, reaching for, knowing the feel of the keys, the wood, the valves. There was a comfort in the intimacy experienced between the musician and their instrument, not just in the musical sound that the instrument makes when expressing notes or tones, but in the individual foibles of the instrument, like the way you had to press a button or key or valve for example. The attachment between musicians and instrument was enduring and often involved a long sense of developing togetherness. Even if the musician no longer, or never, owned the instrument they were attached to, the wistfulness in recalling the specific touch or sound was evident in their descriptions.

The sense of connectedness with their instruments also resonated with the aspects of socialisation experience of being a musician. The creation of a family of choice (not always at the exclusion of the family of origin) enabled a musical life journey experienced through friendships. The shared purpose or the musical project, the invitation to become a part of that world, seemed to generate a strong sense of trust and togetherness. The bond of music from a musicians' perspective was temporal relating to the concomitant experience of doing music in the moment, which often required the cooperation of others. This description contrasts to the experience of receiving or sharing music in a more passive state.

Interestingly, when musicians took on the role of teaching, they spoke of having a sense of gratitude for their experiences and their desire to pass their insights along to the next generation, which is part of the idea of cultural heritage. The musicians seemed to feel a responsibility to pass on their knowledge and experience, though this may be true of all professionals who have a passion for their subject and gravitate towards teaching. For musicians, teaching was often a necessary part of being a musician because it provided some source of steady income. Whilst the joys of teaching were not always immediately realised, the developing ability to teach beyond the basics, and relationships with students sometimes made teaching a reciprocally inspiring experience.

Finally, with regard to the Psychological Aspects of being a musician, it was apparent that a sense of confidence arose from overcoming difficulties. It was this resilience and determination to master something, in this case, playing their instruments, which enabled feelings of wellbeing. However, unless the musician was lucky enough to find the right instrument for them immediately (which some evidently were), any measure regarding personal feelings of confidence in the early days of learning would not scored highly as the musicians struggled to gaining the necessary skills for their instruments. Even then, practice alone did not provide a sense of wellbeing. Rather it was the togetherness and friendships formed and adventures experienced through doing music that later gave rise to feelings of confidence. The opportunity to explore an internal world of sound and music also seemed important with regard to creativity and application of ability. It is this rather than a measurement of transfer effects relating to IQ that may be the important factor in the provision of music for young people.

Overall, when musicians spoke of being a musician they described being able to harness their abilities effectively to affect others in a nonverbal way. Some described themselves as vessels through which music flows to other individuals and communities. This experience of acting as a conduit through which music can flow, was associated with technical mastery and was described in terms of an internal experience of freedom and an immersion into an external and powerful source. The sense of flow was harnessed with feelings of hope, connectedness, trust and togetherness, binding between the musician, the music, the musical instrument and audience. The musicians believed that such experiences enabled them to become readers of people. This they achieved by understanding their emotions through nonverbal signals, enabling them to provide a match between the music and the experienced affect.

8.4.7 Theme 5 – Efferent Effects of Being a Musician and Musical Learning

As can be seen in Figure 8.5, this theme generated eight subthemes under the core theme of efferent effects of being a musician and musical learning. An octagon shape is used as a centre point to reflect the eight core-nodes of this theme, which as in previous models are depicted using round-edged rectangles. These core-nodes are depicted clockwise beginning with Determination and Discipline. In Theme 3 the musicians described Confidence and Determination as aspects of being a musician. It was interesting that they described Discipline (and Determination) as efferent effects of being a musician. This will be discussed further below. The adjacent core-node to the right describes a way of being routed in the literature regarding personality, Openness to Experience. Whilst this describes a attitude (for example to learning, travelling etc.), the next core-node, Pleasure describes a more hedonistic aspect of enjoyment. The sub-node Socialisation is important in that it reflects the musicians' separation of this as facilitating the pleasurable aspects extending from being a musician. Continuing clockwise, the core node Developmental Benefits has three sub-nodes. These were Emotional, Physical and Cognitive and reflect the musicians' perspectives regarding for example, the health benefits of playing an instrument. The next core node is Confidence and Self-Belief. This is placed directly opposite Determination and Discipline because there seemed to be a direct link for the musicians between these two even they seemed valenced in opposite directions. However, this was not the same direction for all participants (some preferring the confidence of self-discipline more than self-belief). Therefore, I have placed them in as aligned but in conflict at this stage of investigation. Travel opportunities, Altruism, and Music and Culture for the last three core-nodes. Travel is placed opposite Openness to Experience for a similar reason as the one described above. That is because whilst Travel was often described as a positive benefit, it was also described as limiting of experience in that the musicians were often unable to see much of the places they visited. Altruism, and Music and Culture are placed next to each other to reflect the separate yet connected ideas form the musicians that one efferent effect was that one could provide something which helped people (Altruism), but this was not always appreciated in terms of expectations. Fir example, the public were often seen as expecting Music and Culture to be provided 'for free' which often meant the musicians were expected to pay for little or no money. In turn they felt this had an impact of their beliefs surround Music and Culture, which separated it form Altruism. Whilst it could be argued some of these could be consolidated, as this is the first study of its nature it is important to understand the differences that emerged from the musicians before simplifying these terms as part of the grounded theory methodology.

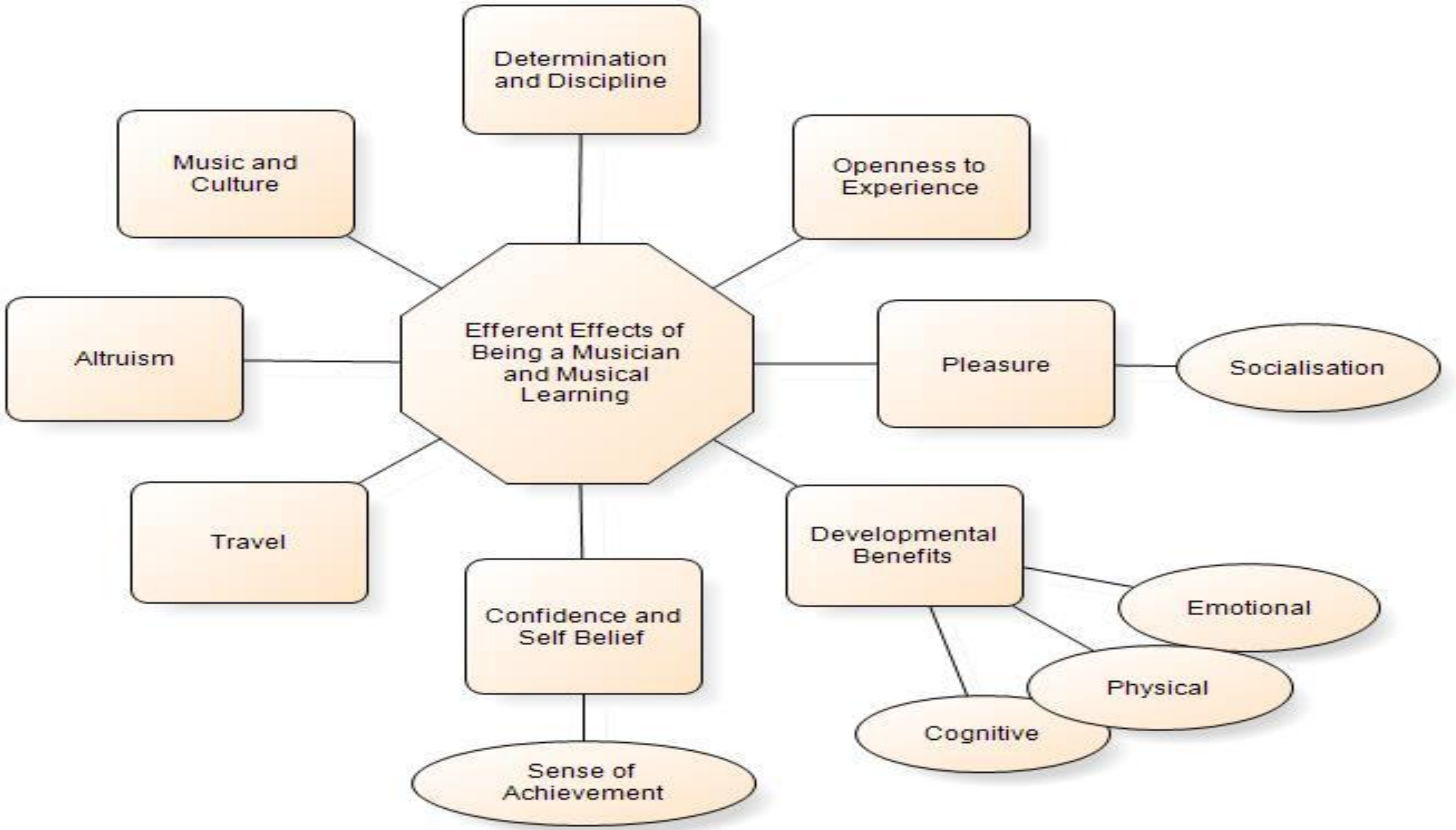

Figure 8.5. Model of Theme 5 – Efferent Effects of Becoming and Being a Musician

Beginning with the developmental benefits, these could be categorised as an awareness of cognitive, emotional and physical advantages associated with musical learning. Several musicians mentioned ancient systems of education that included music as important, such as the Greeks. Their understanding was that musical training was undertaken in ancient systems of education in order to train both sides of the brain [P. 13 and 14]. One musician felt his mathematical ability helped with his music [P. 19], another with their logic and memory [P. 11], and two felt it enhanced their emotional intelligence [P. 12, P. 26]. One person explicitly felt being a musician enhanced communication skills, sensory perception, and problem solving ability [P. 27]. Three musicians believed that music helped manage breathing difficulties [P. 3, P. 13, P. 14] and several felt that musical learning enhanced their whole development [P. 5, P. 7, P. 25].

"It's all in the mind. All in the mind. You know what I mean? Those things that I've learned from being a musician, I think they transfer to everything." [P. 5]

Musicians also spoke about their determination and discipline with practice in particular. This was closely linked with confidence and self-belief and tied to the individuals' sense of achievement. One female vocalist spoke of how learning her parts for Orpheus was really difficult and that her mother worried it was taking her focus away from her school work. However, she was really determined and worked hard and by the end of the term she rose from the middle of the class to second highest, and performed well. She reflected on this experience, explaining that not having that self-confidence is a barrier to learning,

"You have this sort of inhibition that you're not going to be any good at that, then you will be because you have all these obstacles in front of you that you feel you have to overcome" [P. 14].

Another described the task with great pride suggesting, *"There's got to be all this passion as well as being technically assured to deliver a damn good fine musical performance. It makes is some of the highest art you know." [P. 23]*

This sense of mastering something was also observed in others as this musical father demonstrates when he describes the sense of agency his daughter is generating through learning to play the piano,

"Watching my daughter learn the piano, she has a sense of achievement that empowers her and it will do for the rest of her life, the idea that she's mastered a piece of music. She's thinking 'This sounds amazing. I am making these sounds. These sounds! Nobody else. I'm not putting a CD on and listening to someone else play this – I'm playing this. I'm not having someone else reading this music – I'm reading this music'" [P. 9]

With regard to this type of approach, several musicians spoke of wanting to know, wanting to learn, to understand, to try something new. The mother who was hearing impaired said of her daughter who was learning to play drums,

"...And you listen all the time and you like drumming along to the music you like. Whereas before you played drums you didn't really listen to music at all and now you've gotten into the whole world of music and Brian[27] [her stepfather] *has been doing music with you and you've got into singing and all sorts. Because I'm deaf, music not part of my life, so I think it's something that both children, once they started learning the drums, then they both got into music as a concept that hadn't been a part of their upbringing before."*

Leading from this aspect into the concept of altruistic behaviour, as one person described,

"The thing about making music is that it does give creative agency to everybody, or it can." [P. 12]

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[27] Name changed for purposes of anonymity

Several musicians mentioned their work, and/or teaching in the context of providing some kind of tangible cultural heritage, a cultural lineage to pass on, a way of enriching the community and giving something to share. One pianist describes the sentiment,

"For me, playing music, creating music, is about creating for other people, maybe not for yourself, or for yourself, well certainly for other people – the sort of cathartic experiences I've had, because ultimately for me, that's why there's music. Without that, why bother?" [P. 1]

And this extended from affect to hedonic unity as this composer and conductor explains,

"I've seen it [music] *give a lot of pleasure to audiences. It's an incredible feeling when the composition, the performers, and the audience are all united in one thing". [P. 26]*

Many musicians spoke of how music provides the opportunity for people who were not necessarily sporty, or 'clever' to shine in other ways, to have fun and be sociable. There was a sense of music acting a positive mode of communicating and connecting, and providing a pleasurable environment as one music engineer describes when discussing how the family might talk about issues surrounding gender and politics via the latest music video. The final aspects of being a musician that impacted on their lives beneficially was the opportunity to travel and all that that entailed, such as meeting new people, experiencing other cultures, making friends all over the world. Playing music enabled new horizons to be explored both physically and figuratively as this musician regaling the story of his first tour offer demonstrates,

"It was just an amazing opportunity. It was sold to me as 'Do you want to come and join us for the U.K. tour?' which was only ten dates in December, and so I thought that was it. And then I got the call. I think it was the week between Christmas and New Year. I got the phone call from the office asking if my passport was in order. I was like 'For what?' and they were like, well Japan and Australia!" [P. 7]

The four themes described so far combine to form a musicians' model of modern musicianship. The final theme to emerge was specific to musical identity (Figure 8.6.) Although this is of great interest, and will be followed up with further research, for the purposes of this thesis only the section concerning the identification of self as a musician will be discussed in the final section of this grounded theory analysis as the other aspects of this theme could form a thesis of their own.

8.4.8 Discussion of Efferent Effects of Becoming and Being a Musician

The emergence of Theme Four suggested an alternative way of conceptualising transfer effects to that proposed in published studies (such as Forgeard et al., 2008; Hyde et al., 2009; Schellenberg, 2004; 2011). In the child study described in chapters three to six, transfer effects were conceptualised and operationalised as either near, i.e. domain specific and direct (such as fine motor skills), or far; i.e. domain general and indirect (such as IQ). This GT study showed that whilst musicians have some notion of secondary gain from musical engagement, these are not necessarily those that have been investigated in studies of transfer effects. The musicians spoke of the eight subthemes as extra-musical benefits which where extensions of being a musician. The subthemes were Altruism, Determination & Discipline, Confidence & Self-belief, Developmental Benefits, Music & Culture, and Openness to Experience, Pleasure, and Travel (see Figure 8.5). Whilst it will undoubtedly be possible to refine these, at this time, it is important to consider carefully what each subtheme offers as insight.

Some musicians suggested that it was important to understand how music learning occurred in other cultures and cited the Ancient Greek way of teaching as an example[28]. Others considered that musical learning was important for developing both sides of the brain, for thinking, for working things out and for understanding how things related to each other. Music was considered important for the development of an analytical mind. Whilst the participants' addressing and acknowledging the researcher's role as a psychologist may have influenced these suggestions, two other potential advantages of being a musician also emerged. One of these concerned the physical

[28] This is the quadrivium which included arithmetic, geometry, music and astronomy

benefits of musical learning, such increased breath control, and psychological benefits, for example developing emotional awareness. Related to this, the musicians described their practice as a safe place to go, inside their minds, a place for themselves. The musical world inside their minds was quite private, and perhaps provided a place of solace. Whilst musicians readily acknowledged the emotional costs of being a musician, they highlighted a second set of advantages associated with learning music. These concerned the development of determination and self-discipline. This determination and self-discipline, applied in the music context resulted in increased confidence, self-belief and the resilience that enabled them to deal with such setbacks as poor performances and adverse working conditions. For musicians the development of musical skills was strongly associated with their sense of agency.

The musicians themselves did not use the term ‘openness to experience’ but they spoke of wanting to learn and wanting to know, and listening in order to develop their abilities. They spoke explicitly about the opportunities to travel, to meet other people and to see other cultures and share their own culture and music. Part of this experience was pleasurable and provided a sense of hedonic unity with others. The musicians described an idea of sending out an invitation for others to come into their world, and the sense was that this could be more than a temporal musical experience, but it did not have to be. This sense of providing a space to be, or of giving, leads into the final two subthemes, the notions of Altruism and of Music and Culture. These themes identified more outward facing aspects of what it is to be a musician. The reason they are separated here is to demonstrate that the first aspect reflects the musicians sense of giving in terms of playing concerts for charity and using their skills for the benefits of others in more individual, therapeutic or financially altruistic ways, whereas Music and Culture reflects the musicians’ experience of passing on something important either as teachers of music or as musicians within a community or society. A distinction was made by the musicians between the importance of cultural heritage and the importance of using musical skills for the benefit of others, although these may reflect two aspects of a similar idea.

8.5 Discussion

Musical learning has been associated with changes in cognitive, behavioural and socio-emotional development and these aspects were considered in child study in chapters three to six. In particular, the topics of pre-existing differences in aptitude (talent) and acquired skills (ability) were considered with regard to the notion of near and far transfer effects. However, research focused on the process of learning musical instruments in children has been disconnected from research regarding musical expertise. Whilst this is because studies of a quantitative nature cannot directly compare children and adults, in order to understand how and why musical skills develop to a high levels in some but not in others, there must be some consideration of what these bodies of literature offer. Taking a bottom up approach, the research question in this chapter asked what insights might contemporary adult musicians be able to offer with regard to the becoming and being a musician with regard to process, development and transfer? To explore this subject matter, grounded theory analysis was chosen as a qualitative methodology to explore the musicians' response to a series of questions (see section 8.3). This methodology was chosen to enable the generation of new hypotheses.

Having discussed the themes developed through the analyses in the context of relevant literature, a hypothesis is offered alongside an agenda for future research in the conclusion to this chapter.

8.6 Emerging Theory and Derived Hypotheses

These five core themes are linked together as depicted in Figure 8.6.

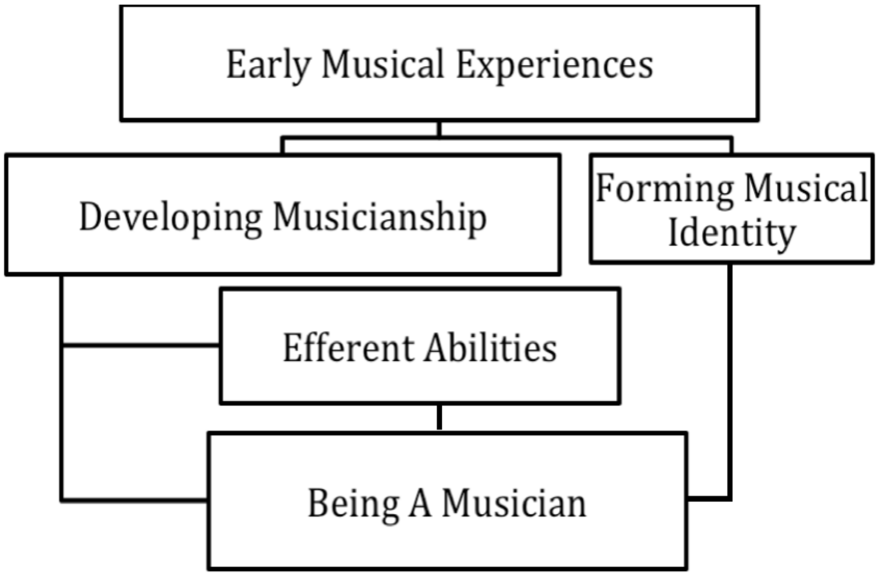

Figure 8.6. Overview of Five Themes of Musical Life

Models generated through the grounded theory approach meet the criteria for an explicit specification of a conceptualisation. The musicians who participated in this study spoke of a way of life, of musical being, and even explicitly of there being an ontology of musicians. From the philosophical perspective, referring to 'musicians' as ontological requires the ability to categorise types of being, which in scientific language is synonymous with the process of systematically describing related attributes, i.e. creating a taxonomy. Contemporary Basic Formal Ontology (known as BFO: Arp, Smith & Spear, 2015) has developed as a strategic response to dealing with 'big data' as a way of organising scientific knowledge. The benefit of adopting an ontology of musicians is that it would enable exploration of complex co-emerging skills across a more accurate range of qualities than the current professional/amateur–musician/non musician dichotomies.

Through this grounded theory analysis evidence emerges which is suggestive of an ontology of musicians. The history of ontology began with Aristotle's exploration of 'metaphysics', a word used to describe the study of what goes beyond the physical. The associated phrase *'being qua being'* is taken to consider the conditions of existence. Aristotle argued that the property is intrinsic to the form and cannot exist separately. The logical extension of this concept is that music cannot exist without musicians. In the 20th century, the German philosopher Husserl, who believed that certain branches of mathematics were partial realisations of the idea, first derived the term 'formal ontology'. From a phenomenological perspective, a formal ontology requires an object of experience (Overgaard, 2004). In this, the genera of music by musicians is realised in multiple ways. For example music can be imagined (audiation), composed (written in notation), improvised, played, heard, felt and embodied as an experience. The formal construct of music has been extensively analysed by Lerdahl and Jackendoff (1983; 1987; 2006). However, in a more contemporary framework, Smith (2004) writes that where concepts are universals, a good ontology is a *reality representation*. According to Smith there is an increase in ontologies at the interface between the empirical sciences and the informatics disciplines. Here it is applied because the term 'musician' extends beyond description and encompasses 'a way of being' that has both a material truth and a structure that is logical and universal (Smith, 2004).

8.7 Limitations

This study attempted to address the paucity of evidence about what it is to be a contemporary musician. Whilst the method of investigation chosen was an appropriate choice, Glaser and Strauss (1967), the founders of Grounded Theory (GT), suggest that findings derived from GT should always be considered provisional as they have yet to be tested.

Allen (2010) suggests the terms dependability, credibility and confirmability might be more useful than direct comparison with the terms associated with quantitative studies terms such as reliability and validity (Lincoln, & Guba, 1985). Allen describes dependability of theory derived from GT studies as findings, which are consistent and could be replicated. In the current study, 21 of the 28 transcribed interviews were analysed. However, there are seven remaining interviews that could be analysed by another independent researcher. This would establish not only the dependability but also Allen's second and third points. These relate to credibility via the provision of confidence of truth of findings and confirmability that the findings shaped by data rather than researcher bias, motivation or interest.

The choice of participants, which was part of the dynamic reflexive process of GT, was influenced by the researcher's circle of musicians although care was taken to also recruit and interview musicians not previously known to the author. The sample was quite large for qualitative research and the participants were drawn from a wide range of musical backgrounds and disciplines. The diversity of the participant sample increases the possibility that the findings are generalisable.

Furthermore, whilst the author transcribed all interviews, the participants were invited to read and confirm the accuracy of the transcripts, and all confirmed that this was the case. A future research goal is to identify a collaborator who will analyse the remaining seven interviews in order to test the models presented in this chapter. Future research could also address the limitations of this study, and refine the findings potentially by considering each theme separately with another sample, or by comparing for example, classical with popular or alternative musicians, or with musicians from another culture.

8.8 Chapter Summary

The study described in this chapter utilised a qualitative research methodology known as grounded theory to investigate how musicians develop and live their musical lives. Five themes emerged in the analysis. The first two themes described the formative period of Early Musical Experiences (Theme 1, Figure 8.1) and the experience of Developing As A Musician (Theme 2, Figure 8.2). The musicians' descriptions of their experiences within these themes were broadly consistent with the results from empirical studies investigating the development of musical children. Theme 3 (Figure 8.3) described the emergence of Musical Identity. This theme described the musicians' discovery of new modes of expression, and developing artistic agency. Theme 4 (Figure 8.4) described being a musician. This theme provides a novel and detailed description of musical life by musicians and makes a new contribution to the field of music psychology. Finally, Theme 5 (Figure 8.5) described the efferent effects of being a musician. These were defined as an extension of the primary benefits of being a musician. These effects only tacitly reflect the concept of transfer effects as studied in this thesis and by other researchers. The use of the word 'efferent' rather than 'transfer' with regard to the benefits experienced as a result of musical learning is important. The two are distinguished conceptually as musicians described these benefits as extensions of their musical lives whereas the concept of transfer conveys a relocation and potentially conversion of a skill or ability that the musicians did not communicate.

The five themes that emerged in the study suggest a hypothesis that there is an ontology of musicians that extends beyond description towards a musical engagement that reflects a way of life.

Chapter 9 – Final Discussion

9.1 Abstract

This chapter summarises the studies described in the thesis and discusses the results in the context of the research questions outlined in chapter one. The studies in chapters three to five utilised a quasi-experimental design to investigate the effect of musical learning on a range of cognitive, behavioural and socio-emotional in order to obtain a holistic perspective on the development of concomitant abilities. This approach provided a critique of the notion of transfer effects as a linear approach to evaluating the effects of musical learning. Interpreting these studies gave rise to a case study that considered how two different children receiving the same musical instrument lessons might vary yet still benefit in their response to musical enrichment. A further qualitative study considered what musicians understand being a musician entails, from their initial interest and learning to the present day. This research provides an alternative perspective on the effects of musical learning and suggests new directions for future studies. Limitations of the research are considered before a final summary concludes the thesis.

9.2 Introduction

During the last 20 years there has been an explosion of interest in the psychology of music. Work in cognitive psychology and neuroscience has shown that the acquisition of musical skills cause structural and functional changes in the brain. However, the extent that such effects will be universal, or limited to individuals with a propensity to engage in music, is not currently well understood. Advances in genetics have suggested some phenotypical traits associated with musicality and this is consistent with ideas about self-selection in samples (see e.g. Plomin & Deary, 2015; Schellenberg, 2011). The extraordinary ability of musicians to process multiple streams of auditory, visual, kinaesthetic and intero/extero/proprioceptive information within an affective environment has also led researchers to consider the psycho-socio-emotional function of music within our society.

Whilst there is a widely held belief in the concept of musical enrichment, a difficulty that was considered in chapter one is that there is no clear consensus amongst researchers about how this should be studied. Therefore, one objective for this study was to explore an alternative research design that would be ecologically valid but that was not a randomised controlled trial. A second objective was to address the conceptual problems regarding the types of musicians that are considered experts and suitable for scientific study. A notion of musical self-concept has recently developed which attempts to consider a shift in the experience of music and developing musicality of non-musicians but also the production of music in contemporary musicians within society (MacDonald, Hargreaves & Miell, 2002; Müllensiefen et al., 2014; 2015). The studies carried out in this thesis aimed to address some of these limitations by exploring what it is to be a musician in a sample representative of contemporary working musicians in the U.K. Nested within these two objectives were four key questions that are outlined below:

1) By measuring musical aptitude over time in a musical training study, is it possible to understand how pre-existing differences affect learning trajectories and outcomes, or whether the effects of training are innately constrained?
2) By concurrently measuring the development of musical, cognitive, behavioural and socio-emotional abilities, can we reveal any relationship between them?

3) If so, what are the theoretical implications regarding domain specific or domain general mechanisms for transfer of learning?
4) How can our understanding of typical and atypical musicianship be enriched?

In the following section the two research objectives that motivated the studies described in the thesis will be discussed. The research questions are then considered in light of the findings from the studies. Future directions are then considered before a final summary of this thesis is presented

9.3 Research Objectives

Whilst several well conducted studies have identified positive and multiple cognitive and behavioural effects of musical learning (see e.g. Forgeard et al., 1998; Hyde et al., 2009; Norton et al., 2005), a number of methodological limitations in studies investigating musical enrichment were outlined in chapter one and were discussed in the context of the results from the child study described in chapters three, four, five and six. Parsimoniously, these criticisms concern reliability and validity and will be further discussed in the following section.

Firstly, the choice of the gold standard of randomised control trials (RCTs) as a research design is problematic where musical programmes have been provided as interventions. The design requires the randomisation of participants and ordinarily this enables generalisability of an effect by providing a sample representative of the population. However, the tension arises because in music education studies this process negates two important variables involved in taking up any musical instrument. These are; a) personal motivation (for a variety of reasons) and b) the provision of a supportive environment in which exploration rather than directly measurable achievement might be enabled. Whilst RCTs may directly address the issue of privilege inherent in these aspects of initial musical learning, that choice of an RCT design creates a paradox by excluding two necessary (though not sufficient) components of success. In this study, ecological validity was considered of primary importance. This included the authenticity of the musical training, and the selection of an appropriate sample. The sample reflected children who chose to take music lessons across a range of backgrounds and provisions. Unlike an RCT, the participants in this study were not randomly assigned to a treatment group. However, this process observed the fundamental principles of RCTs, that the sample should reflect the population, enabling the extension of the findings to a general population of children who would be motivated to learn a musical instrument. Pupils were recruited from state and private schools. The state schools offered music lessons subsidised by local charities and provided by the local government music hub. Parents had to contribute £1 towards the lesson. The private schools offered music lessons for which the children's parents paid the peripatetic music teacher directly, approximately £18 per lesson. An appropriately comparable active control group was also recruited from these different types of schools. Although these children did learn music, it was in groups in the classroom rather than as extra-curricular individual tuition. This naturalistic contextual design also considered variables that may confound the quasi-experimental study, and therefore gathered data regarding the amount of time the participants' engaged in other activities that potentially influence cognitive, behavioural and socio-emotional development. Examples of such activities were sports, arts and crafts or computer games. The age of the participants reflected the average age at which children begin to play musical instruments. Importantly, they were younger than the age at which musical aptitude is believed to plateau (Gordon, 1986; Hargreaves, 1986).

The design, recruitment and characterisation of the sample in the children's studies in chapter three, four, five and six, was described extensively in chapter two. The sample included 38 children recruited via multiple methods. The mean age of the children at baseline (Time 1) was approximately seven and a half to eight years old. Analysis of the amount of time per week the participants spent doing music revealed a statistically significant divide. Children doing music for less than one hour per week were receiving statutory school music (SSM) and formed the active control group. The extra-curricular music-training (EMT) group included children who also participated in the statutory school group classes, but additionally received either individual or small group musical instruments lessons for the first time. According to parent reports, the children in the EMT group practised and played for more than one hour per week. Seven children were learning keyboard/piano, three were learning guitar, two were learning trumpet/horn, one was learning drum kit, and six were learning more than one instrument. Of these six, two were simultaneously learning piano and drums, two were learning piano and violin, one was learning piano, violin and singing, and one was learning piano and guitar. Other studies considering transfer effects of musical learning in children of this age have tended to focus on only one or two instruments with participants either all learning keyboards or violins, with some aspects of voice (either Kodály method or Suzuki training; see e.g. Costa-Giomi 1999; 2005; Forgeard et al., 2008; Hyde et al., 2009; Schellenberg, 2004). However, these studies were funded and the musical training was provided as a treatment variable. As previously discussed, this does not necessarily reflect a sample of a population of children who are motivated to chose and learn a musical instrument. However, these studies do control for socio-economic status in terms of the apparent advantage of highly educated parents providing musical instrument lessons for their children because they perceive it to be an important aspect of their development. Interestingly however, they often do not desire that their children become musicians (MacDonald, Hargreaves & Miell, 2002). In this sample, whilst no significant differences between groups were revealed for SES (using postcode analyses) or school type, a significant difference was evident for the parental education achievement. Eight EMT parents had continued to post graduate level whilst no SSM parents had. Similarly there was a significant difference between groups regarding how the parents valued music in the life of their children. Only 26.3% of SSM parents thought that musical learning was an essential or important component in their children's lives. In contrast 78.9% of the EMT parents though that music was essential or important. The parents also provided data on the nature of and amount of time their children spent engaging in musical, physical and leisure activities. The data analysis showed that the EMT and SSM groups only differed significantly on the amount of time spent engaging in musical activity.

Chapter two also described the battery of measures administered in the study. These tests measured cognitive, behavioural and socio-emotional change over time. As some of these tests have been used in previous studies of musical enrichment, their inclusion increased the robustness of the study. The test battery included the Primary Measure of Musical Aptitude (PMMA; Gordon, 1986); the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler 1999); the Children's Memory Scales (CMS; Cohen 1997); and the Beery Visual Motor Integration (VMI), Visual Perception (VP) and Motor Coordination (MC) tests, (Beery 2004). Two novel measures were also included. These were the Movement Assessment Battery for Children (MABC-2; Henderson, Sugden & Barnett, 2007) and the Behavioural Assessment System for Children (BASC-2; Reynolds

& Kamphaus, 2007). The analysis of the data from this battery of measures was used to compare the findings from the current study with previous studies and to contribute new evidence to the field.

A second methodological issue that was addressed in the current study, concerned the length and type of intervention. Whilst adult studies have shown that duration of learning has an important effect on outcome (e.g. James et al., 2014; Schlaug 1995), previous studies focusing on musical learning in children have been compared without attending to the variable time scales and amounts of the musical training 'treatment'. For example, the study by Rickard et al. (2010) included 142 eight-year-old children who were allocated to learn the violin, viola or cello. Over two and a half to three years, they received (based on a 30 week academic year) 90 hours of extra-curricular musical training. In a study in Germany by Roden, Kreutz and Bongard (2012) the children learned an instrument of their choice (including guitar, violin, cello, flute, drums, clarinet and trumpet) for 45 minutes per week in groups of five over three academic years. Although the German academic year is longer than either the U.S. or the U.K. (44 weeks compared to 30-36 weeks), this amounts to a comparable 99 hours of total music instruction over the experimental period. However, Mehr and colleagues (2013) provided music-based activities between parent or carer and child totalling a mere 4.5 hours of intervention. Schellenberg (2004) provided approximately 16 hours of musical intervention for small groups of six-year-old children. Costa-Giomi (1999) trained nine-year-old children over three years on the piano, for 15 hours per year amounting to 45 hours of tuition in total. Moreno and colleagues (2011) provided a listening only group music-learning programme to four to six year old children twice a day for five weeks. This amounted to 32 hours of musical intervention presented over a short period of time. These interventions were variously compared to visual arts, drama, extra science, and/or no activity control groups. In the study, presented in this thesis, the children in the extra-curricular music training group received an average of 15 hours individual or small group tuition over the academic year. This group was compared with an active group music training group who received approximately 15 hours of additional musical intervention.

In summary, the child study described in chapters three, four, five and six attempted to address the methodological limitations of previous studies in five ways.

Firstly by providing a sample that reflected the population of children who had chosen to start learning an instrument of their choice. This enabled an ecologically valid research design that attended to the principles of generalisability in RCT's but used an alternative methodology to reflect a real world reliable sample. Secondly, the length of the study reflects real world validity by providing a duration of musical learning comparable to other studies of first time musical learning in children in this age group. Thirdly, the choice of standardised measures for this age group enables replication allowing for comparison with previous studies, extension of that research, and ensuring replicability for future studies. Fourth, including qualitative data regarding the parent's beliefs about musical learning, including their own experiences provided a context (heritance and environment) for the children's learning and finally, including measures of both near and far transfer enabled further investigation of this conceptualisation with regard to evaluating the efficacy of musical learning.

The adult study presented in chapters seven and eight also addressed the issue of generalisability by reconsidering the somewhat narrow operational definition of a musician as a professional earning their income from playing music. The sample recruited for the mixed methods study reflected a survey commissioned by the Musician's Union (*The Working Musician*, van der Maas, Hallam & Harris, 2012). This demonstrated that contemporary musicians commonly supplement their incomes with musically related work reflecting the contemporary concept of a portfolio careers. MacDonald, Hargreaves and Miell (2002) had also raised concerns regarding a potential bias towards classical training in studies of musicians. Therefore, a range of contemporary working musicians was recruited to strengthen the ecological validity of the adult study. This sample included formally trained composers, producers, classical and popular musicians as well as alternative musicians from the underground music scenes. The sample included individuals who were self-taught, individuals who teach music and retired musicians (some of whom still actively play) who had chosen to pursue other musical activities (such as music psychologists and music business people). 17 males and 11 females (age ranging from twenties to sixties) played guitar and bass, drums, strings and brass, voice, piano and some were multi-instrumentalists. The sample, therefore included musicians from a wide range of musical backgrounds, and was representative of contemporary musicians working in the U.K.

Having considered the ways in which this study addressed methodological and conceptual problems limiting previous music psychology studies, the extent that the findings have addressed the four research questions will now be discussed.

9.4 Addressing The Research Questions

9.4.1 By measuring musical aptitude over time in a musical training study, is it possible to understand how pre-existing differences affect learning trajectories and outcomes, or whether the effects of training are innately constrained?

Chapters one and three considered the heritability of musical aptitude and questions about the extent that pre-existing differences might constrain, or present an advantage during musical learning. The wider issue of musical propensity, and opportunity for expression through environmental interaction and provision is one of great interest to the author of this thesis. As a teacher of music, and in agreement with Sloboda (2000), the notion of talent can provide obstacles as well as rewards. The idea that one has a natural ability, or not, can be very limiting especially in the early stages of musical learning.

Whilst Macnamara, Hambrick and Oswald (2014) have suggested that musical aptitude is 21% heritable, other studies have suggested a heritable genetic disposition towards musicality of between 40 and 70% (Mosing et al., 2014b; Ullén et al., 2014). Mosing et al. (2014a) provided some evidence showing that whilst the propensity to practice is between 40-70% heritable, musical practice does not causally influence music ability. However, the propensity to learn and /or practice must also be supported by opportunity and temperament in order to be realised. Plomin and Deary (2015) described a process of self-selection as an active model of selected environment, in which genotypes can develop into phenotypes. Schellenberg (2011) also offered a theory of self-selection that is both genetic and environmental. According to this model, children who are musical derive pleasure from musical engagement and their intelligent musical parents provide a musically enriched environment that scaffolds their children's musical activity and development.

However, these models are deterministic in that they attempt to maintain a reliance on measureable (and therefore controllable) factors. However, McPherson (1993 study, in McPherson, Davidson and Faulkner (2012) see Figure 1.2, p. 8) provides a theoretical model of the relationships between musical skills and conditions of study. The evidence provided herein is more in line with this model, which focuses on the interaction between aspects such as enriching activities and playing by ear, or from memory. As was seen in the ontology study, these relationships are dynamic throughout the individual's musical life. Indeed the evidence suggests that notion of musical aptitude, and therefore any future measures of such a notion, should in build parental, family and community experience and expectations as these influence the development of musical ability over the course of lifelong learning. In chapter two, the qualitative data gathered from the parents attests to this (see Tables 2.15 and 2.17). For example, one parent (of the EMT group), when asked about their own musical background wrote,

"Father – self taught guitar as youth – in a band – talent but not training as a child (no money). Church choir (scholarship but not taken up) – currently takes bass lessons as an adult, sings and plays in a work band – music playing in the house a lot – general love of listening to music. Mother – recorder and clarinet to very low level – just basics, no exams (tone deaf!) But love music – wanted to be good and learn piano – but not enough money when young."

However, the current measurement tools for children are limited to the extent of previous research. For example, Gordon (1986) suggested that the development of musical aptitude reaches a plateau at around the age of nine. Consequently, the current child study sought to incorporate a specific measure of musical aptitude for children under the age of nine years. Gordon's PMMA (Gordon, 1986) provided a measure of tonal and rhythmic aptitude and a composite score that encompassed both aptitudes. At Time 1, the Gordon's PMMA scores were higher for EMT group than the SSM group, although the difference was not statistically significant, suggesting no pre-existing differences between groups at Time 1. This finding is consistent with Forgeard et al.,

(2008) and Hyde et al., (2009) who also found no differences in musical aptitude at baseline in their studies. However, whilst both groups significantly increased their composite scores at Time 2, only the SSM group showed significant increases on the individual tonal and rhythm components. Further analyses confirmed that the weekly number of hours spent in musical engagement did not predict scores on Gordon's PMMA, either for the groups, or when the whole sample was entered into the analyses. These results suggest that musical training did not significantly increase this measure of musical aptitude significantly in this sample over one academic year. Hargreaves (1986) and Sloboda (1985) suggest the development of an understanding of musical rules, in terms of tonal hierarchies and rhythmic groupings, is partly due to a process of enculturation up to the age of approximately seven years. However, training as a process of consciously directed effort (as opposed to spontaneous acculturation) tends to take place during these years. Part of musical training is to develop discriminating listening skills. This might include an understanding of the concept of higher or lower with regard to pitch or tone and also similarity and difference for sound groupings, or the derivation of an underlying beat or tactus. Therefore, it would be reasonable to predict increases in measures of musical aptitude that focus on such concepts. Studies that have shown transfer effects of musical learning and also used measures of musical aptitude have generally shown an advantage for the musical training group over time (see e.g. Forgeard et al., 2008; Hyde et al. 2009). In this study, both experimental groups did increase their scores over time. There are several reasons why these increases were not statistically significant for the EMT group. For example, early learning tends to focus on motor skills specific to the instrument. Without data describing the context of all the musical lessons, it is not possible to know whether these concepts were addressed in this sample. Furthermore, these concepts may have been addressed in the group music lessons as the scores of the PMMA did increase significantly for the SSM group. The other studies do not mention levels of musical training with regard to active and passive control groups. Therefore, it may be that musical learning focusing on listening tasks is effective as was suggested in the Moreno and Bidelman (2014) paper.

The findings from chapter eight adds an interesting perspective as they suggested that some musicians not only felt drawn to music, but enjoyed a musically rich environment in which parents, teachers and the community supported their development as musicians. The environmental mechanisms seemed to be centered around providing non-judgmental opportunities for musical exploration and modeling good practice habits which foster autotelic value. This transformation of motive into drive is a process known as *functional autonomy* (Allport, 1961). Studies of adults have suggested the propensity to practice is a separately measureable heritable factor, which affects the development of musicality (e.g. Mosing et al., 2014a and b; Platz et al., 2014). It may be that over a longer experimental period, the children in this study would have developed their practice habits and consolidated their learning, which in turn would have impacted further upon the measures of musical aptitude. However, the composite measure of musical aptitude of the groups was quite comparable throughout. Future studies might compare the content of Gordon's primary and intermediary measures of musical aptitude between the ages of seven and eleven in order to understand and compare the developmental trajectories of musical aptitude in children learning musical instruments individually, or in groups, or through listening, or not at all if some schools in future choose not to teach music. A study such as this might help disentangle which aspects of musicality are developed through training, as well as measureable by testing, especially if genetic testing could also be incorporated. Mehr et al., (2013) also measured parental musical aptitude. In this current study data on the parents' music learning experiences and attitudes to musical learning were obtained (see chapter two). This data confirmed that the parents of the children in the EMT group placed a significantly higher value on the importance of musical learning than the parents of the children in the SSM group. Furthermore, most the of parents in the EMT group had learned a musical instrument for a period of time at some stage and the qualitative data suggested they had believed this to have been beneficial in terms of learning how to apply themselves and developing self-discipline. These parents also reported increases in self-confidence, which they attributed to their musical learning. In part this was due to the social forum provided by participating in musical activities. For example, school choir tours to other countries, or music festivals for which schools combined orchestras. This social aspect of musical learning is also reflected in chapter eight. MacDonald, Hargreaves and Miell (2002) suggest this development of a musical identity is a fundamental function of music in society, especially considering the way in which technology has made musical experience and production more accessible in recent years.

The exploration of this research question by using one measure of musical aptitude over time does not reflect the complexity of the relationship between gene-environment interactions. However, the child study has shown evidence of a positive developmental trajectory of musical learning overall in this sample (chapter three). Furthermore, qualitative data gathered about historical and current musical environment has enriched the understanding of individual differences regarding the positive affects of musical learning in both the short and long term (chapters six and eight).

9.4.2 By concurrently measuring the development of musical, cognitive, behavioural and socio-emotional abilities, can we reveal any relationship between them?

Chapters three, four, five and six considered the effects of musical learning within the framework of near and far transfer effects of learning. Klingberg (2010) suggested that one difficulty for studies is to ensure that test are not measuring directly trainable effects as these are inherently biased and do not provide evidence of transferable skills. Forgeard et al., (2008) suggested that in order to be able to attribute the effects of musical learning to extra-musical abilities, (i.e. far transfer), the establishment of near transfer effects must be first be present. In their study increased motor ability was measured using a tapping paradigm and cognitive ability was measured using Raven's matrices.

In the current study a battery of measures that tested multiple domains was used to investigate both near and far transfer effects. Chapter three described the results from Time 1 and 2 group comparisons using a measure of general intelligence (the WASI) as well as a measure of musical aptitude (the PMMA). Previous studies, have reported that musical training increased intelligence (Forgeard et al., 2008; Hyde et al., 2009; Schellenberg, 2004). The results reported in chapter three replicated findings by Schellenberg (2004) showing a significant increase of 7 IQ points. The results also replicated findings by Forgeard et al., (2008) and Hyde et al., (2009) showing an increase in fluid intelligence and vocabulary in response to musical training. The PMMA and WASI were significantly correlated either at composite level. This has also been reported in previous studies (see Shuter, 1968 for review of 65 studies). This suggests that some aspect that the PMMA measures is related to intelligence, in spite of Gordon's claims otherwise. Gordon suggested *audiation* is separate from the construct of general intelligence, or *g*. Whilst the evidence suggests that there are aspects of musicality which are unrelated to *g* (as $r = .35$ is the highest reported figure, leaving 65% unaccounted for), the construct of the PMMA, relying on a same/different paradigm as it does, must be prevailing upon some aspects of auditory perception at the very least. Returning to the idea pertaining to musical intelligence being one of the independent multiple intelligences, Gardner (1983) had noted that composers experienced sounds in a unique way. Gardner suggested that this suggests that auditory imagination might be innate. Whilst the literature reviewed in this thesis suggests that at least some aspects of auditory ability can be learned, the idea of audiation remains intriguing. The results from chapter eight offer some support for the idea that this unique way of thinking about and/or imaging music is an important aspect of musicianship. Several musicians described an internal world of music and musical games. This appears to be an auditory analogue for eidetic imagery, and is quite different to the relatively common experience of involuntary musical imagery, or 'ear worms'.

An alternative way of considering and testing an innate advantage for musicality is employed in many measures of musical aptitude as these rely on auditory discrimination ability. Research has shown that musical learning enhances early brain stem auditory functions, which suggests that auditory acuity is trainable (Fujioka et al., 2006; Kraus et al., 2014; Slater et al., 2014). Auditory memory is one aspect of cognition that might link intelligence and musicality through auditory discrimination and acuity. Therefore, chapter three also explored previous evidence of an association between musical learning and auditory memory within the context of transfer effects (e.g. Lee et al., 2007; Rickard et al., 2010). The results described in chapter three failed to reveal an overall group difference on measures of auditory memory over time using the Children's Memory Scale (CMS; Cohen, 1997). However, both groups improved significantly over time on the Sequences subtest. In contrast to memory tests that simply measure memory capacity, this subtest places a heavy load on working memory and also measures focused attention (Cohen, 1997). One interpretation of this finding is that musical training impacts on specific memory components rather than on overall memory ability. It is also possible that some of memory components of are more susceptible to training than others. For example, the CMS might not have measure aspects of memory that are specifically affected by musical training. Groussard and colleagues (2010) collected qualitative data in their study of semantic memory. Their evidence suggested that the meaningfulness of the material to be remembered was more important to the musicians than to the non-musicians in their sample of adults. In the current child study, the children's form teachers reported that tasks similar to those included in the Sequences subtest were being practised as part of the national curriculum. Therefore, the significant improvements are likely to be a direct effect of training. This is useful because it does suggest that an effect of direct learning was present, but there was no effect of far transfer of musical learning for this sample of these measures of memory. However, individual differences emerged in the data analyses and will be discussed at the end of this section.

The results from the child study provided some evidence of far transfer for fluid intelligence, and also suggested dissociation between direct learning (Sequences) and far transfer (other measures of auditory memory). However, Forgeard and colleagues (2008) suggested that evidence of near transfer skills substantially contributes to claims of far transfer effects of musical learning. Therefore, chapter four investigated the acquisition of near transfer skills. Musical performance requires high levels of motor ability, sequencing and control and there is strong evidence that musical training causes structural changes in brain. For example, in adults, increased grey matter volume has been observed in musicians in comparison to non-musicians in left inferior frontal gyrus in the prefrontal cortex. This area is known to inhibit inappropriate motor responses in musicians (Mahncke et al., 2006; Sluming et al., 2002; Swick, Ashley & Turken, 2008). The depth of the central sulcus, which is an indicator of the size of Primary Motor Cortex is larger and more pronounced in the right hemisphere in musicians than non-musicians (Amunts et al., 1997; Bangert & Altenmüller, 2003; Lotze et al., 2003; Schlaug, 2001). Furthermore, the age of onset and amount of time spent learning a musical instrument is positively correlated with measures of grey matter volume in premotor cortex, the superior parietal lobe and left cerebellum (Amunts et al., 1997; Gaser & Schlaug, 2003; Grodd et al., 2001; Hutchinson, 2003). Specific neural adaptations to specific instruments have also been shown (see e.g. Bangert et al., 2006; Elbert et al., 1995; Pantev et al., Ragert et al., 2004). In children, Hyde et al., (2009) found significant differences developed over time between children learning, or not learning musical instruments in the left posterior peri-cingulate and left middle occipital region. Their study of children suggested multimodal sensorimotor integration. Also in a study comparing musically trained and untrained children, Forgeard and colleagues (2008) found an association between the development piano/keyboard learning and motor tapping skills. However, Sloboda (2000) offered a compelling critique of the use of tapping paradigms that do not have musical intent in studies of musical enrichment. In order to address Sloboda's criticism fine and gross motor skills were tested in the child study using the MABC-2 (Henderson, Sugden & Barnett, 2007). The analysis of the data from the MABC-2 showed that musical learning significantly increased performance on the aiming and catching component of the test. This finding was novel and contributes new knowledge to the field.

The aiming and catching (A&C) test comprises of two tasks. One requires participants to throw a ball against a wall and catch it (either with or without a bounce depending on age). The second requires the participant to throw a beanbag onto a marked target at a prescribed distance (approximately two metres). Both subtests consist of ten trials and five practice attempts. Scores are then standardised according to age. The results showed that the EMT group significantly increased their performance on this task over time. The SSM group score decreased on this task over time, although the magnitude of the change was not significant. In contrast, the SSM group improved on ball throwing and catching over time whilst no change was observed for the EMT group. This bean bag task required hand-eye coordination and judgement regarding velocity, distance and target focus. The young musicians seem to be developing their sense of themselves in relation to space and time. This finding may have significant implications for music therapy. Being able to show an increase in a measure of near transfer is potentially beneficial in general for individuals, but may also help towards evaluating therapeutic programmes and increase the likelihood of funding for future studies. Whilst replication of this finding is necessary, the task is easy to reproduce with minimal cost (although the MABC-2 in itself is quite expensive).

Penhume and Steele (2012) described the process of learning a musical instrument as a process of optimisation. This requires the planning, organisation and execution of complex motor sequences with simultaneous coordination and control of movements from multiple body parts. The feedback/feedforward loops rely in turn on the integration of the auditory, visual and tactile receptors. Sherrington (1906) provides a detailed description of the different mechanisms involved for example, when individuals throw a beanbag onto a marked target. He suggests *proprioception* specifically refers to muscular, tendon and articular (joint) sensitivity; *exteroception* refers to afferent information regarding the mouth, eyes and skin; and *interoception* refers to information gathered from internal organs, such as the inner ear for balance. The changes observed in this study suggest that the children in the EMT group fine-tuned their perception of velocity, time and space. This may have improved their command of their physical movements and enabled them to show enhanced performance on the beanbag task. Bremner, Nicholas and Holmes (2012) suggest that embodied representation of peripersonal and extrapersonal environments is under-researched in middle childhood. The results of this study suggest a potentially rich source of future research. Furthermore, this finding of behavioural change contributes to new findings to the literature on musical enrichment. Schlaug et al., (2010a) and Zattore, Chen and Penhune (2007) have provided evidence for neural meta-plasticity and the beanbag task may offer a reliable behavioural measure that could be used in future studies.

Musical notation reading has been associated with an increased ability to understand that particular visual-spatial shapes are associated with particular sounds and/or musical actions (Jänke, 2006). As a previous study (Orsmond and Miller, 1999) had reported post-training improvement on the Beery test, this too was included in the tests battery for this study. The Beery (2004) tests included three separate measures including one of visual-motor integration (VMI), visual perception (VP) and motor coordination (MC). However, the data analysis failed to reveal group differences at either times of testing. Initially this was a surprising result. However, closer analysis of the Orsmond and Miller study (1999) revealed they had reported post musical-training improvement on the Beery test based on raw scores, rather than age normed standardised scores. Since the publication of their paper, age-normed standardised scores have been made available and, as was seen in the child study, these do not appear to show improve in response to musical training. Furthermore, as the scores generally decreased on all three measures for all participants, one explanation of this phenomenon was that the children were reluctant to complete the tests. Indeed during testing several children claimed to find the test boring and did not seem willing to engage in the testing process.

The study described in chapter five investigated potential socio-emotional benefits associated with musical learning. Studies have shown increased personal motivations towards pro-social behaviours and emotional intelligence, an increased sense of self-confidence and self-esteem, and due to the social aspects and increased sense of belonging and positive productivity with regard to contributing to a group outcome (see e.g. Kokotsaki & Hallam, 2007; Petrides, Niven and Mouskounti, 2006; Weinstein et al., 2015). One criticism of previous studies evaluating musical enrichment is that they have relied on self-reports to measure wellbeing (see Hallam, 2010). In response to this criticism, the child study utilised the parent and teachers scales of the BASC-2 (Reynolds & Kamphaus, 2004). The rationale being to consider the perspective of the people and places (e.g. parents, schools, teachers), who could be described as stakeholders in the children's socio-emotional development. For example, increases self-esteem may have positive effects at home and/or in school. If observable changes over time could be associated with musical training, this could contribute towards future funding, especially for children who might otherwise not receive musical training. The BASC-2 adaptive and clinical scales based on 150-170 item questionnaires. Whilst no differences between groups were revealed over time on any of the different scales for parents and teachers, some systematic differences were revealed between the groups. Analysis of the teacher report revealed that the EMT group scored lower than the SSM group on the composite measure of Internalising Problems as well as for the scales of Aggression, Anxiety, Conduct Problems, Depression and Hyperactivity. However, due to the number of scales overall, these findings did not remain significant once alpha level p was adjusted for multiple comparisons. Similarly, analysis of the parent report revealed no significant change over time and only one systematic difference between groups. This was that the EMT group scores for the scale of Aggression was lower than the SSM group scores. This finding also did not remain significant once corrected for multiple comparisons. As the sample was derived from mainstream schools, it is not surprising that typically developing children would score in the mid range percentile for the parent and teacher scales. The McPherson (2005) study demonstrated that participants within study groups may show large individual differences and patterns of progress that were not necessarily linear. For example, the early stages of musical learning may be characterised by highly variable patterns of stagnation and retrogression. This may then have impacted on the different scales, for example those measuring adaptability, functional communications, or study skills in a highly variable pattern over time. Another explanation may be that the socio-emotional benefits were experienced equally between groups but in different ways. Broh (2002) suggested the increased one-on-one contact time is beneficial to early learners, whereas Kirschner and Tomasello (2010) suggest it is group work and shared goals that increase pro-social behaviour in children. At this stage in their musical learning, it may be that these benefits have not yet differentiated. Although the measure did not reveal any group effects, it was sensitive over this period of time as large individual differences were observed when profiling participants for parent reports. This process directly contributed to the decision to consider atypical and more typical cases in a case study (chapter six) in this thesis.

Chapter six compared the learning experience of two children who were sharing tenor horn lessons with the same tutor at the same school. The quantitative data from chapter three to five was enriched by a detailed weekly report written by the horn tutor. The data from a boy (Charlie) with complex neurodevelopmental difficulties that potentially impacted upon learning capacity were compared with data from a typically developing girl (Michelle), and data from the EMT group as a whole. The results showed that whilst Charlie and Michelle obtained above average intelligence and musical aptitude test scores, Charlie's concentration difficulties did affect his ability to learn. However, it cannot be assumed that he did not benefit from his musical tuition. In spite of high levels of recorded anxiety and depression (BASC-2 parent and teacher report) suggesting that Charlie was not coping with his emotional difficulties, he did join the school band and played at the end of year concert. Although his progress was slower than Michelle's, and he required specifically attuned teaching methods, Charlie appeared to be gaining a positive sense of agency through his horn playing. For example he played a solo in assembly and joined the school orchestra even though his BASC-2 scores suggested he was struggling emotionally with high levels of depression reported by both parents and teacher. The tutor notes provide evidence that Charlie was beginning to identify himself as a musician. He was willing to play a solo in school assembly and also met the challenge of working in a group with the school orchestra club. Although Michelle was initially selected as a typical case to contrast with Charlie, it became apparent that she also presented with some difficulties. Michelle's parent and teacher both reported lower than average social skills and higher than average levels of depression. The qualitative notes of the tenor horn tutor described a quiet but dedicated student who consistently practised and only once refused to play her instrument because something was wrong and she didn't feel like it. Whilst the two children showed different learning journeys, they both joined the school band and played in the end of year concert, an event that appeared to provide additional motivations to practice and make progress towards the end of the year. This study provided several insights that were not apparent from the group studies. It contributed to the overall picture of how the children in the study developed over time, by describing learning difficulties that could be overcome and suggesting ways in which a musical environment (such as an orchestra) might offer some stability and/or social structure.

In summary, to answer the question in this section, this study identified only one of many potential effects of musical learning as near transfer; the aiming and catching component of the MABC-2. Similarly, this study showed evidence of only one of several potential measures of far transfer; fluid intelligence as measured by the WASI. These two measures were not correlated. However, that is not to say the concept of transfer effects is redundant, as the next section will discuss.

9.4.3 What are the theoretical implications regarding domain specific or domain general mechanisms for transfer of learning based on the results of these studies?

This research question assumed a positive effect of musical learning on measures of near and far transfer that would be related to each other in some way. Whilst no direct linear affect was found, other more potentially rewarding avenues of investigation were pursued as a result. For example, participants in the EMT group showed significant improvements on the matrix reasoning subtest of the WASI, a test which is very similar to the Raven's matrices tests which were used in some previous studies of musical enrichment (Forgeard et al., 2008; Hyde et al., 2009). These findings offer some insight into potential mechanisms of transfer as the tests are very similar in construction and format and both measure non-verbal fluid intelligence through a process of pattern analysing and deductive reasoning. Learning a musical instrument relies on a huge number of complex cognitive processes, including processing multiple perceptual information streams in a continuous feedback/forward loop. This is a global, rather than domain specific, perceptual 'tuning up' process. One suggestion might be that this type of cold cognition (i.e. not under pressure) requires keen analytic skills, which in the early stages of learning, before automaticity become evident, can be observed in measures involving pattern analysis. During the time frame in which musicians develop their skills, different types of independent and associated cognitive skills are emerging in order to process incoming information and relate it to stored procedural templates and other long-term memory associations. The adult qualitative study provided rich insights into early musical development and its cognitive correlates and will now be discussed in the context of the results from the child study.

Firstly, the results from the adult study highlighted the importance of environment in early learning. The analysis of Themes 1 and 2 provided strong support for previous studies highlighting the importance of parental support during early musical training (see e.g. Davidson, Slobada & Howe, 1995; McPherson 2006). The results also highlighted the importance of the wider family, schools and communities in providing an enriching environment and opportunities for musical exploration during the early formative period. The qualitative data obtained from the child participants' parents (reported in chapter two) was consistent with the data from the adult study and further suggested that a merger of Schellenberg's (2011) theory of self-selection and Plomin and Deary's (2015) active model of selected environment would provide a stronger account of musical disposition and development. The investment of at least one adult or educational/social group is important in creating an environment within which the child can engage in musical exploration. This environment may incorporate specialised music lessons, but its primary value is in providing a musically enriched environment where self-directed and initially non-competitive learning is supported.

The development of good practice habits may be an important variable in understanding why some children go on to become working musicians (McPherson, Davidson & Faulkner, 2012). This is the phase of learning when the child begins to understand the value of consistent practice so that that practice in itself had autotelic value. This in turn leads to the development of functional autonomy where the original motivation turns into a drive, in this context, to be a musician. The adult study showed that many of the working musicians either did not need to be encouraged to practice as they already were highly engaged with this process, or that practice was scaffolded by at least one parent or carer who was invested in this process as a matter of acquiring self-discipline and application. Whilst consistency in supporting positive practice habits, and opportunities for further group music making for children who are interested in music is also important, interesting differences between formally tutored, and self-taught musicians emerged in the data analysis. The data suggested that process of coming to understand the relationships and hierarchies of notes within a harmonic system was an engaging aspect of musical exploration. It may then be the case that interest in musical structure and organisation is an inherent aspect of the musical predisposition and that formal music theory teaching limits the extent that the developing musician can engage in self-directed investigation. Whilst this is somewhat speculative, it does appear that musical activity enhances structural analytic thinking and that such change can be measured using matrix reasoning tasks.

Although the teacher and parent reports did not show any change over time with regard to socio-emotional benefits of musical learning, the adult study suggested a strong psychosocial benefit of leading a musical life. Trevarthen (1999) suggests socialisation and coordinated companionship is a basic motivation towards music making in humans. He considers that communicative musicality begins in infancy with babies displaying an intrinsic motive pulse by engaging with musical sounds and nonverbal communications. The differences between the child and adult study in this thesis, in relation to the literature suggests that musical engagement impacts upon wellbeing over a much longer period, perhaps even a lifetime. Probing the idea of transfer effects with musicians by asking about other benefits they might experience as musicians (chapter eight, Theme 4) provided evidence that musicians considered opportunities to travel, for socialisation and the experience of altruistic behaviours as efferent abilities enabled though their musicianship. This was an unexpected but exciting finding, especially in light of the finding of the AVPR1A gene polymorphism associating musical engagement with pro-social behaviour and altruism (Knafo et al., 2008; Ukkola-Vuoti et al., 2009).

Taken together, the results from the child and adult studies have implications for assessing the ecological validity of researching transfer effects, and for considering musical learning as a treatment effect. Perhaps music does make us smarter, but in ways that we have yet to fully understand. Knell & Taylor (2011) suggest the arts need to radically reassess how they create value in order to combat the effects of austerity measures, yet Hetland and Winner (2004) warn against valuing music for transfer rather than for it's own value. However, as Sloboda suggests (1999) these apparent misalignments of intent are due to not understanding how we value music as a society. In fact music is valued in society in arrange of ways. For example, memorable advertising jingles create increase sales of products and therefore profit. In the U.K. currently there is a large increase in contemporary music colleges offering degrees in many aspects of musical engagement from event management to contemporary composition. In a culture based on capitalist ideology, this is seen as a positive motivation for the use of music in contemporary society. In other places, historically music of the people has been repressed in order to deny the opportunity for cultural diversity (e.g. Japan) or music had grown in order to preserve a cultural heritage (such as with the enforced migration of Africans to the Americas). This thesis has contributed evidence that the benefits of musical learning unfold over time as a result of opportunity, application and dedication both individually and as a provision we must now chose as a society. The investment is long term. MacDonald, Hargreaves and Miell (2002) suggest there are four levels in understanding the function of music; an ideological level, a social-positional level, and inter and intra individual levels.

With regard to the intra-individual level of developing musicianship, the evidence of structural changes in the brain associated with the real time multiple sensory processing in the two-way (feedback/forward) loop has led to suggestions that musical training supports the development of metacognition (Ragert et al., 2004; Wan & Schlaug, 2010). Johnson (2011) has provided evidence pertaining to a domain-general framework of interactive specialisation for functional brain development. Luo and colleagues (2014) have found evidence of increasing functional connectivity in salience networks of musicians. Both structural and functional specialisations can be conceptually combined with Koelsch's (2014, Box 2, p. 175) explanation of music-evoked emotions with regard to musical learning. Chapter eight provided preliminary qualitative evidence mapping the musician experience of being. Musicians operate in conditions requiring multiple sensory information processing through both feedbackwards and feedforwards loops. If the emotional valence experienced through music is combined with enhanced sensory development, this suggests that one way in which musical learning might affect cognition is the ability to makes decisions during intensely affective conditions. This has been described as hot cognition, a factor thought to contribute to creativity (Abelson, 1963; Rothenburg, 1971). In comparison, the increased performance on the matrix reasoning tests (chapter three) shows an enhanced development of analytic thinking associated with early musical learning. This was referred to as a measure of cold cognition, which may precede automaticity of musical ability. That is, be evident during the stage of learning when one still has to think about what sequences and procedures are necessary in order to produce a certain sound, effect or series of musical events. This supposition, emerging from the findings of the thesis as a whole, has both educational and theoretical implications.

Finally, Theme 5 observed the importance of developing and assuming a musical identity. The adults described how being a musician defined them, although their explanation of what they actually did was quite context dependent. For example, the specification of instrument was only generally disclosed amongst other musicians and they generally described themselves as musicians regardless of income or professional status. They all felt they were musicians from an early stage and they actively devised a life that incorporated being musical or being involved with music as a way of life. Chapter six provided evidence that the emergence of a musical self was developing in Charlie and Michelle. Despite Charlie's difficulties with self-regulation and Michelle's difficulties with confidence and depression, both sought to fit into their school band, and Charlie found a new mode of self-expression in his solo performance. Michelle's appeared to fit in well during band rehearsals, and she may have found that the hierarchy and boundaries inherent in orchestras/bands provided her with a comfortable social niche. The adult musicians in chapter eight provided many examples of the importance and function of social groups of musicians. For example, they described a sense of belonging when using terms such as their band being their families of choice. This sometimes had negative associations too and could be exclusionary. However, the child case study offered an insight into the early stages of this developing social function specific to emerging musicianship.

These observations regarding developing identity, musical potential and types or styles of adapted learning which enables individuals to overcome adversity, brings to mind a study analysing the development of Louis Armstrong as a musician (Sloboda, 2005). This study demonstrates how Armstrong grew up in a very rich musical environment, in which vocal harmonising play on the streets where he lived provided early systematic exploration of his voice and the language of music, without the negative consequence, that sometimes occur during formal musical training. He had a strong motivation to engage with music and rarely experienced any distinction between practice and performance. Instead he learned to be a musician by meeting the challenge of increasingly demanding opportunities with higher-level musicians. There are comparisons between Charlie; the boy with neurodevelopmental difficulties (chapter six) and the enigmatic trumpet player (P5, 'Max') described in chapters seven and eight. Max appeared to enjoy playing games with the patterns of music inside his mind. These included difficult transpositions and unusual time signatures or key changes. When he spoke of them he seemed to be imagining the sounds and working them out. Furthermore, he seemed to have some difficulties socially, which he circumvented on stage. He also displayed an attachment-aversion-indifference relationship with his trumpet and had an obsessional practice routine (five hours a day, without compromise). Yet these factors (which may in another time have afforded him a complex diagnosis not dissimilar to Charlie's) undoubtedly contributed to his success as a musician. It was interesting that he railed against his stereotype of a brash 'larger than life' hard drinking brass player. He seemed to find it an uncomfortable fit, even though it afforded him a space to explore his individual needs within several contexts. One cannot help but wonder if Charlie, given continued support and opportunity could follow in Max's footsteps and find his own success through his musical being.

Of course we don't yet know whether all the children in the study will end up leading musical lives, but what of the people who do? Chapters seven and eight provided a different perspective on the process of becoming, and the reality of being a musician. The final research question explores these revelations in the next section.

9.4.4 How can our understanding of typical and atypical musicianship be enriched?

Chapter seven established that the adult sample was representative in terms of reflecting a range of contemporary musicians as described by the Musicians Union survey of 2012. Previous studies had shown that the personality trait of Openness to Experience appears to be higher than general population norms (Corrigall et al., 2013; Gibson et al., 2006; Kemp, 1996; Müllensiefen et al., 2015). In this study, the sample of musicians scored significantly higher than the general on the personality trait of Openness to Experience using the short version of the Big Five Inventory (Rammstedt & John, 2006). Also consistent with previous studies (Kemp, 1981) were results showing that the female musicians scored significantly higher than general U.K. population norms (for females) on the trait of Extroversion. Furthermore, this sample also scored significantly higher than the U.K. population on the personality dimension Openness to experience. This is important with regard to the validity of the study and it is an important contribution to the field. Cook (1998) has argued that studies of musicians are not authentic as they hark back to a hierarchical value system which places classical composers (such as Beethoven) on a higher plane to musician who simply reproduce/perform the music. MacDonald, Hargreaves and Miell (2002) concur and suggest these generic roles are outdated. Therefore, the establishment that this sample of an extraordinarily broad range of musicians, who are engaged in a diverse variety of musical engagements, is in line with other studies suggests that Openness to Experience may be an essential component of musicianship as Müllensiefen and colleagues (2014) supposed.

Chapter eight presented the results of a qualitative study of these musicians' experiences using grounded theory analysis of the transcribed interviews. This method is uniquely applicable in areas where prior research is sparse and where an exploratory approach is appropriate to the research question addressed. In this case the purpose was not to evaluate musical learning as a 'treatment effect' but to understand the formation and nature of the musical being of musicians. Five themes emerged in the data analysis of the interviews. These were 1) Early Musical Experience, 2) Developing Musicianship, 3) Emerging Music Identity, 4) Being A Musician, and 5) Efferent Effects of Musical

Learning as a result of becoming and being a musician. Themes 1, 2, 4 and 5 were discussed in relation to the findings of the child studies and the notion of transfer effects in the previous section.

Themes 4 and 5 are most pertinent to the research questions addressed in this section because it provided new insights into the nature of musicianship and transfer effects. Of particular importance was the description of musicians experiencing a sense of embodied flow. This was manifested in a three-way relationship between the music, the musicians and the audience in which the musicians acts as the conduit. The model of musicianship presented in chapter eight reveals more homogeneity than expected regarding cognitive, behavioural and socio-emotional modes of being. Cognitively, there is a way of thinking that is dominated by an internal musical world of abstract patterns and relationships that fascinates the musician. In line with Plomin and Deary's (2015) active model of selected environment, this may be one of the motivations that contribute towards musical exploration. Part of this environment is a social world based on non-verbal exchange of ideas and a sense of connection. MacDonald, Hargreaves and Miell (2002) reflect on Mead's (1934) interplay between self and society with regard to musical self-concept. They relate a social constructivist view expressed by Bahktin (1981) that being is only possible at a conscious level through communication. However, rather than a set state, they suggest that musical self-concept can be contradictory as well as dynamic and continually evolving. These ideas are consistent with the high levels of the personality trait of Openness to Experience found in musicians as previously discussed.

Many people in many walks of life have to find a balance between their need for money and how they desire to live. However, the musicians in this sample revealed low tolerance for incongruence between their art and how they choose to live their lives. Sometimes this is detrimental to the individual, in that it can result in maladaptive behaviours and in extreme cases a rejection of their chosen career. However, others types of artists and professionals also seem to be motivated by a love of their work, often to a degree of obsession which could be considered to have undergone the process of functional autonomy whereby the initial motivation has become a drive with autotelic value. Many artists and professionals also delight (or suffer) within the challenging combination of being competitive, needing wide social approval as well as the respect of their peers. Yet, musicians are different still to similar vocations such as dancers, or athletes, researchers or entrepreneurs. Musicians exist productively in a mode of being that relies on additional real-time sensory action-perception skills. This necessitates concurrent abilities to hear, produce, react and project music, which no other role requires. Hearing in music requires the development of acute auditory discrimination abilities. To produce music the acquisition of complex motor and memory sequencing is built up over years practice and performance. Musicians must be able to react to the perceived music and/or other musicians in temporal situations where visual and auditory cues are experiences in an affective state yet related to multiple tasks and decisions. And musicians must project their performance to generate further affect, via not only the music but often also in nonverbal expressional cues embodied gesturally or via facial expression. It is the very essence of being in the moment, both endogenously and exogenously, that separates musicianship from other callings, and this is why the findings in this study suggest a unique blend of characteristics, including personality traits, which supports a hypothesis that there is an ontology of musicians.

At group level, the findings replicate previous studies in suggesting that there is an association between musical learning and intelligence and extends the literature by showing evidence of an increased ability in aiming and catching for children receiving extra-curricular individual music training. Through a case study, the thesis provides evidence of individual differences that both supports and extends previous evidence with regards to the importance of a supportive environment enabling children with special educational needs to benefit from musical instrument learning. Furthermore, a study of adult musicians showed that there are consistent personality traits in musicians and a distinct way of being that suggests there is an ontology of musicians. Taken together, blending evidence relating to neuroconstructivism with a deeper understanding of developing musicianship, this thesis offers a supposition. Musical learning encourages interactive specialisation supporting the structural and functional development of the brain recruiting cognitive and affective systems enabling enhanced hot cognition that may be reflected in discrete cognitive, behavioural and socio-emotional psychological measures.

9.5 Limitations of Studies

The largest limitation of the child study is that we do not yet know whether children will go on to become musicians and so the premise that these two perspectives are complementary could be false. It would be interesting to follow these students over a number of years. 24 of the 38 parents agreed to further or continued contact so a longitudinal study is planned. Appendix E provides up to date information on the progress of the children in this study. As chapter two provided qualitative data that helped to characterise the child participants, giving context to the nature of parental involvement and their investment in the children's learning and musical lives, continuation of this study would increase the ecological validity of the current findings.

One criticism of the decision to avoid using a randomised control trial design (RCT) could be that ecological validity was gained at the expense of scientific rigour. However, as discussed in section 9.3 of this chapter, the RCT design may not be optimally suitable for studying musical enrichment. Motivation is a key variable in determining musical outcomes and removing this by randomly assigning participants to musical training they did not desire, or if they did perhaps on an instruments they did not chose, is ultimately detrimental to the research agenda.

There are two limitation associated with the type of statistical analyses conducted in this thesis. Firstly, the large number of variables meant correcting for multiple comparisons, which whilst reducing the possibility of Type I (false positive) errors, also increases the possibility of Type II (false rejection) errors. Secondly, post hoc power analysis revealed that for this sample size effect sizes above .5 would be necessary to avoid type two errors. This does have implications. For example, it may be possible that extra-curricular musical training did have an effect in the PMMA scores of musical aptitude but there simply was not enough power in this study to detect this. This is a serious limitation on the potential claims of the findings in this study and reduces any claims of causality.

A replication of this study should seek to obtain funds that enable a larger cohort of participants to be recruited and the effects of musical learning studied over a longer period of time. Ideally, genetic sampling would also be included in order to increase understanding of theories of environmental self-selection. The findings across studies showing increases in vocabulary, fluid intelligence, motor and memory skills merit further development of this test battery.

Finally, whilst the association between scores from the PMMA and WASI suggests that these measures were testing some related constructs. However, questions about Gordon's construct of audition were not addressed. Also, the narrow range of participants in the child study meant that it is difficult to determine whether developmental effect in musical aptitude was in turn affected by musical learning at around nine years. However, this cannot be tested because at the age of nine years, the use of the PMMA is considered no longer suitable and the IMMA (Gordon, 1986) and then the AMMA (Gordon, 1989) are recommended as alternative tests. As it was not possible to test the parents' musical aptitude in this study, qualitative data was collected and used to assess relative investment in their children's musical lives. Though this is not an ideal proxy for quantitative data in this situation, it was nonetheless useful in establishing context.

9.6 Implications of Findings

This research has several implications for the literature related to musical learning. Previous research has indicated that musical learning has shown near and far transfer both cognitively and behaviourally (Forgeard et al., 2008; Hyde et al., 2009; Moreno et al., 2011; Norton et al., 2005; Schellenberg, 2004). This thesis has demonstrated that is it possible to demonstrate such effects in an ecologically valid sample and design studies enabling the holistic investigation of concurrent changes potentially associated with musical learning in a naturalistic context. The present research found simultaneous changes in measures of intelligence and measures of aiming and catching using a replicable design and incorporating standardised measures. These findings suggest that research focusing on individual measures should take care to describe the motivation for the study in order to provide context and enable appropriate comparisons to be made. Whilst the concept of transfer in musical studies may be well motivated, the concept does not always transfer across disciplines and potential inconsistencies arising from this may be detrimental to the aims of providing evidence for the benefits of musical training. If transfer effects are seen as evidence of learning, yet RCTs are required to provide robust evidence of the efficacy of musical learning, the problems of motivation and provision (points a and b from earlier) remains. Furthermore, the apparent lack of evidence of transfer effects (e.g. Mehr et al, 2013) may be due to the inappropriateness of the research design. These issues are inter-linked issues and may increase the likelihood of lesser public investment in musical learning, ultimately increasing the issues of privilege, which the RCT's seek to address. The concept of transfer effects, used as a mechanism for understanding the potential efficacy of musical learning seemed promising, but is highly problematic. The overall findings from this mixed methods study of children and adults musicianship suggests any alternative methodological framework in which theoretical suppositions about near and far transfer effects are replaced by propositions that consider, as part of the metacognitive effects of musical learning, the notion of hot cognition. This would be based on a conceptual combination of Johnsons' (2011) framework of interactive specialisation and Koelsch's (2014) understanding of the social function of music-evoked affect to provide a framework for investigating the structural and functional benefits of musical learning.

Research into music learning has both educational and therapeutic applications and the child study made a new contribution to this literature. For example, the finding from chapter four showing improved aiming and catching ability implicates multiple proprio-, extero- and intero- ceptive systems (Sherrington, 1906) which supports the notion of neural meta-plasticity (Schlaug et al., 2010a; Zatorre et al., 2007). This finding provides behavioural evidence that musical instrument learning supports the development of motion perception and spatial trajectories and coordinated action sequencing. In turn this increases justification for using music with children who have different kinds of motor and spatial impairments. Similarly, as Charlie's horn tutor demonstrated, teaching can be adapted to the individual learning and/or behavioural needs increasing the likelihood of a positive outcome. However, it is important that teachers and parents have more information available to help them understand the nature of the difficulties faced in order to be able to provide appropriate methods of support. In chapter eight several professional musicians who taught mentioned that they had been sent students with learning and/or behavioural difficulties. The children's teachers apparently felt they might take to music or find it a useful outlet in an environment that would be less disruptive to other students. Charlie's teacher developed a personalised strategy of colour coding notes, and whilst it was not clear which part of Charlie's complex diagnosis motivated this choice of strategy, it certainly seemed to be successful. It may be that people with high levels of Openness to Experience may be ideally suited to teaching children with complex needs and findings ways to engage them in music and be engaged with them. It was certainly clear that Charlie appreciated the efforts his teacher had made, especially when he was encouraged to choose which notes were aligned with his favourite colours. As a memory strategy, we know from Groussard and colleagues (2010) that the meaningfulness of the material they work with helps musicians remember music stored in long term memory. One-to-one teaching and learning situations offer unique opportunities for relationship building. Whilst chapter eight also provides evidence that this can be a negative as well as positive experience, it is also an undoubtedly social one. People with various handicaps can be very involved in music and this can provide special social value for them, especially if their condition implicates social communications problems. For example, blind, autistic, and dyslexic musicians may present an unusual trajectory of learning, where perceptual, cognitive and /or motor deficits create constraints. However, personal motivation and good support networks frequently enable these individuals to overcome difficulties and develop a range of musical skills. In addition, results presented in chapter eight, suggests that there are mental health benefits associated with socialisation and altruistic behaviour for typically developing musicians. The benefits of musical learning and teaching appear especially strong with atypical child learners as was seen in chapter six and chapter eight. The adult musicians described a sense of hope that living a musical life provides. Perhaps this sense of hope is bidirectional as the musical teachers develop a special relationship with individuals with complex needs that are often difficult to convey. It is a complimentary exchange often based on nonverbal communication that provides and derives a sense of hope in both the recipients and the contributors are both benefactors.

9.7 Future directions

This investigation of the effects of musical learning in children and adults offers a variety of avenues for future exploration. A longitudinal study, following the musical development of the participants in the child study is planned. Specifically further research regarding the bean bag task, but also further development of this battery in order to assess which aspects of musical development could potentially help people with developmental coordination disorder to increase their motor skills. Based on the findings of this study and others, one prediction would be that children who are motivated to learn and who have a good support network would be most successful. Therefore, these data should be carefully controlled.

Future studies could also probe this desire to learn in children, perhaps resulting enabling predictions about who will continue. Perhaps this is related to individuals for whom the process of learning has autotelic value. This is the component that appears to facilitate the transformation of early motivation to learn into a drive to be a musician in the process of functional autonomy. A study of this process would further enhance understandings of the benefits of learning to some degree, and also provide reasons for discontinuing that may have less negative connotations than those who have reached a higher level. For example, the parents of the children in this sample had not all gone on to have careers in music but there was something that they appreciated about the application of their time and effort to learning music which resulted in their providing this opportunity for their children. Rather than focus on transfer effects per se, studies such as this could refocus efforts on understanding other extra-musical effects.

Furthermore, it would be interesting to probe the social structures of school bands and/or orchestras. Whilst some excellent work is currently in place along these lines (for example with the El Sistema/In Harmony programme) understanding more about the development of the stereotypes, and/or the social hierarchies and etiquettes observed (or not) may provide a deeper understanding of whether these do they provide framework in the way that seemed apparent for Michelle and Charlie. For these individuals and some of the adults, the studies in this thesis have shown how a child with problems can use music as a mechanism to overcome these difficulties, to find an identity, to develop a sense of belonging, and develop a sense of agency or personal autonomy.

One very interesting question concerns the extent that grounded theory as a research method can be used to test other groups of individuals working in the arts. A second question concerns the extent that any findings can be adapted to account for the results of qualitative studies of other groups. Given these questions it would be interesting to carry out a survey of conceptual artist and theatre graduates from Goldsmiths. This could be compared with an analysis of the remaining seven interviews from chapter eight as these have already been transcribed.

A question that was motivated by the adult musicians concerned the possible outcomes of self-directed exploratory learning and potential differences in analytic skills differentiating self-taught and formally tutored musicians. If a large enough sample of musicians could be recruited, which would also need to include an evaluation of music notation reading and/or playing by ear, with regard to analytic thinking, this may enhance understanding of this aspect of how musical learning enhances cognitive development. Comparisons between adults and different age groups of children (and between types of instruments) for example, may reveal which aspects of fluid intelligence are developing at which stages. It would be interesting to compare samples stratified according to the Goldsmiths Musical Sophistication Index. In comparative samples of adolescents, this could establish whether some level of musicality (primarily musical listeners in comparison to producers) would result in different personality profiles. For example, a personality study by Roberts and colleagues (2006) suggests the development of personal warmth towards others is critical at this stage and this might be one factor embodied in the development of the musical self if the idea of a being a musical conduit (chapter eight) has merit.

It is a failure to understand human development to misrepresent the effects of musical learning as discrete or linear paths of transfer. These two different kinds of studies have raised important questions about how we interpret effects of music studies with children. In order to move forward it will be important to conceptualise motivation as an intervening variable, which may require validating alternative ecological research designs such as in this thesis. This will help extend the currently limited understanding of process of becoming and being a musician.

9.8 Conclusions

The studies described in this thesis attempted to investigate the effects of musical learning holistically. By exploring the effects of musical learning from a holistic perspective incorporating cognitive, behavioural and socio-emotional factors in a mixed methods study of musicianship this research approach addressed the observation that isolated research strategies in music psychology were not facilitating the needs of music educators (Hargreaves, 1986). The child study provided evidence that musical training increases the near transfer measures of aiming and catching and the far transfer measure of nonverbal fluid intelligence. The study of adult musicians showed that there are consistent personality traits in musicians and a distinct way of being that suggests there is an ontology of musicians. Taken together, blending evidence relating to neuroconstructivism with a deeper understanding of developing musicianship, this thesis offers a supposition. Musical learning encourages interactive specialisation supporting the structural and functional development of the brain recruiting cognitive and affective systems enabling enhanced hot cognition that may be reflected in discrete cognitive, behavioural and socio-emotional psychological measures. Future directions include suggestions for further child and adults studies exploring the typical and atypical developmental trajectory of musical learning, developing musicianship and the impact of musical being in relationship to teaching and learning.

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Appendices

Appendix A: Short Recruitment Abstract

Goldsmiths
UNIVERSITY OF LONDON

If learning music can alter the structures of our brains, how else does it help our children? Researchers at Goldsmiths, University of London, are investigating how the latest neuro-scientific findings apply in the classroom and at home. Local drum teacher and PhD candidate, Dawn Rose explains.

"By measuring the cognitive, behavioural and emotional effects of learning types of musical instruments, we hope to be able to identify how best to use this knowledge to inform future interventions helping children and parents choose instruments most suited to individual learning needs."

In the past this research has been restricted to one type of instrument over either a very short or very long period of time. The Goldsmiths team would like to measure children between the ages of 7-9 years old who are just starting to play an instrument, or sing, or who are not going to learn at the start of the coming school year and again at the end to see how they progress. This will involve their teachers and parents too and we need 80-100 children. All data would be anonymous. The testing will take approximately 1.5 hours and would be arranged to suit you, either at school or at home. This research has been ethically approved by Goldsmiths, University of London, 2013.

Please contact *UNDISCLOSED in thesis*.

Appendix B: Participant Briefing and Consent Form

GOLDSMITHS
UNIVERSITY OF LONDON

Dear Participants

Thank you for taking the time to read this information. It is very important that you feel fully informed of the nature of this study and that you feel confident that your rights as an individual are respected and protected before you agree to take part. Be assured you can withdraw from this research at any stage should you so wish and your decision to do so will not be questioned.

This observational study forms the final part of my doctoral thesis which researches the potential benefits of learning to play a musical instrument. These effects are known as near and far transfer effects and relate to the physical, cognitive, behavioural and emotional domains of being a human being.

Research has shown that long term musical learning can structurally change our brains and this evidence is being used for rehabilitative therapy in areas such as Alzheimer's and Parkinson's diseases. As approximately 6% of children suffer with difficulties in movement and coordination, this work will measure changes over time when first learning an instrument and how different instruments help typically developing children. Hopefully this will help further inform future interventions designed to help many aspects of children's development. This is known as empirical evidence and provides the scientific information for future 'evidence based practice' with objective peer reviewed consistency.

By taking part, you are agreeing that your data can be used anonymously. You must either be over 18 years old to make this decision, or have fully informed parental consent. Your voluntary participation is much appreciated and your answers will be treated confidentiality and in accordance with the Data Protection Act of 1998. Please contact *UNDISCLOSED in thesis.*

Thank you for your valuable time and your support.

Dawn Rose

Informed Consent:

I agree that I have been fully informed about the nature of this research.

I agree to that my data can be used anonymously and may be published in scientific journals.

I understand that I have the right to withdraw my participation at any point.

I appreciate that my rights as an individual are protected by the Data Protection Act 1998.

Name of Participants

Child____

Adult____

Signature of Parent____

Date__________________________

Appendix C: Teacher Briefing

Goldsmiths
UNIVERSITY OF LONDON

Dear Teacher,

We greatly appreciate your time and support as this research could not be done without your help. As you will have read on the briefing information sheet, this work is potentially important for the children we teach, but also for our profession. On a national level, the future of musical learning is now a political issue and we hope the implications of these findings will help towards safeguarding musical learning for our children's futures. Accordingly, the research must be scientific, objective and consistent so we ask you please to take great care with your testing, reporting and form filling. We appreciate this can be an arduous task but we have tried to design the tests so that they are possible to complete within a lesson (30 minutes) as the parents have agreed to their child's participation. The test is known as Gordon's Junior Test of Musical Aptitude. You will have a CD, or MP3 of tonal and rhythmical pairs that the children will indicate either match, or do not, on the sheet I will provide you with. You are welcome to use this test in future for other children in order to indicate to parents areas in which your students need to, or have improved beyond the scope of their musical syllabus if you wish. The questionnaire is from the Behavioural Assessment System for Children (BASC-2) – which needs to be filled out within the first month (within 4 lessons) of knowing the child, to the best of your knowledge – and again at the end of the academic year. Furthermore we ask you to keep a weekly record of the child's progress, areas of concern and levels of practice on a form that I will also provide. This will essentially be a reflection of the records you keep anyway and if you wish to simply provide your own notes they are also completely acceptable. Please do not worry if you child decides not to continue with their instrument or feel any undue pressure to give them special attention. We would prefer it if you could treat the participating students as you would any others as this gives us a more realistic indication of how musical lessons are helping overall. However, in order to try to keep standards to a similar level, please could you indicate which board and grade level you would be attuning your teaching to for the student.

Many Thanks for your time and support.

Please contact me if you have any further questions: *UNDISCLOSED in thesis*

Appendix D: Background Information Questionnaire for Participants' Parents

Thank you in advance for your time and support of this study that investigates how musical learning may benefit our children through skill acquisition, cognitively, behaviourally and emotionally. Please kindly answer the following questions for your participating child and tick the appropriate boxes as so ☑

Section 1A - General Information regarding participating child's parents

1) Name____

2) Contact Telephone and/or E Mail____________________

2) Status (delete as appropriate): Step/Mother ☐ Step/Father ☐

2) Level of Education (circle as appropriate)

O'Level/GCSE **A**'Level/Highers **U**ndergraduate **P**ostGraduate **D**octoral

3) Post Code: __________________

4) Please note if <u>you</u> have any suspected or diagnosed learning difficulties – for example with reading, writing, vision, hearing, memory and/or movement and coordination.

5) Please note if <u>you</u> have any suspected, or diagnosed, psychological difficulties – for example anxiety, lack of confidence, issues with bullying, mood changes or behavioural issues.

6) Please note your musical background including any instruments you grew up with, learned yourself (and to what level) and the general importance of music as part of your daily life

7) Do you see music/musical activity for your child as (circle as appropriate)

Essential **I**mportant **A** pleasant pastime **T**ake it or leave it **L**ittle or no value

Section 1B - General Information regarding participating child

1) Gender of Child: Male ☐ **Female** ☐

2) Date of Birth of Child: ________________

3) Age of Child: __________________(Years)

4) Is your child learning a musical instrument? Yes ☐ **No** ☐

5) If so, please name the instrument (e.g. voice, drums, trumpet) here ___________________

6) Please note if your child has any suspected or diagnosed learning difficulties – for example with reading, writing, vision, hearing, memory and/or movement and coordination.

5) Please note if your child has any suspected, or diagnosed, psychological difficulties – for example anxiety, lack of confidence, issues with bullying, mood changes or behavioural issues.

Section B – Physical Activities These questions are about your child's physical activities in and out of school. Please circle the appropriate answer for your child.

1) How many hours of physical activity does your child participate in <u>at school</u> each week on average?

None Under 1 Hour 1-2 Hours 2-3 Hours Over 3 Hours

2) Does your child enjoy this physical activity?

Yes definitely **Most** activities **Some** activities **Only** a few activities **None** at all

3a) Does your child take part in extra-curricular activities i.e. outside school time (e.g. swimming)

Yes ☐ **No** ☐

3b) If so, in total, for approximately how many hours per week?

None Under 1 Hour 1-2 Hours 2-3 Hours Over 3 Hours

Please indicate types of activities and time spent doing these in the box below (e.g. 1 hour of tennis, 2 hours of football, ballet etc.)

4) How did your child come to take part in these activities?

a) It was their decision and initiative ☐

b) Parental encouragement ☐

c) Because their friends attended ☐

d) Joint decision between parents and child ☐

<u>Section C – Musical Activities</u>

1) How many hours of musical activity (such class lessons) does your child participate in <u>at school</u> each week on average?

None Under 1 Hour 1-2 Hours 2-3 Hours Over 3 Hours

2) Does your child enjoy this musical activity?

Yes definitely **Most** activities **Some** activities **Only** a few activities **None** at all

3a) Does your child take part in extra-curricular musical activities i.e. outside school time (choirs or dancing, for example)

Yes ☐ **No** ☐

3b) If so, in total, for approximately how many hours per week?

None Under 1 Hour 1-2 Hours 2-3 Hours Over 3 Hours

Please indicate types of musical activities and time spent doing these in the box below (e.g. 1 hour of dancing, 2 hours of music listening)

4) How did your child come to take part in these activities?

a) It was their decision and initiative ☐

b) Parental encouragement ☐

c) Because their friends attended ☐

d) Joint decision between parents and child ☐

Section D – Creative Activities and Hobbies

1) How many hours of creative or hobbyist activity (such as arts and crafts, computer game playing) does your child participate in at school each week on average?

None Under 1 Hour 1-2 Hours 2-3 Hours Over 3 Hours

2) Does your child enjoy this creative activity/hobby?

Yes definitely **Most** activities **Some** activities **Only** a few activities **None** at all

3a) Does your child take part in extra-curricular creative activities i.e. outside school time (after school chess club for example)

Yes ☐ **No** ☐

3b) If so, in total, for approximately how many hours per week?

None Under 1 Hour 1-2 Hours 2-3 Hours Over 3 Hours

Please indicate types of activities and time spent doing these in the box below (e.g. 1 hour of drama club, 2 hours of computer games)

4) How did your child come to take part in these activities?

a) It was their decision and initiative ☐

b) Parental encouragement ☐

c) Because their friends attended ☐

d) Joint decision between parents and child ☐

Thank you for answering these questions. We will ask you to fill in this form again at the end of the academic year. Please return the form to: UNDISCLOSED in thesis

Appendix E: Addendum

Of the 19 children who received music lessons during the experimental period, the following (Table Appendix E) reports have been given of their progress during that time and since.

Table Appendix E. Extra-curricular Music Tuition Group Progress

ID	Instrument	Update
NT	Drums and Piano	Reports unavailable as teacher doesn't provide them but he took Grade 1 piano in Autumn 2014 and Debut Grade drums in July 2014, both of which he passed.
ZN	Gave up Keyboard and tried Flute	Has since given flute up as well as she just did not progress in either instrument. Her flute teacher said she had problems with regular attendance and punctuality and with remembering her flute. However she could assemble her flute correctly and play short and long notes using her tongue to start each note.
RP	Keyboard	Was described as a keen student, who enjoys his lessons, has a good practice schedule and completes set tasks well. His technical skills have improved but his recall is poor. He has just taken (January 2016) his Grade 1 Keyboard exam and passed it.
SB	Keyboard	Was described as enthusiastic during lessons. He showed a good understanding of the basic skills required o perform simple pieces and could play to tempo and with accompaniment. His notation reading was becoming more fluid. He continued Keyboards until he left the school at the end of the summer term (2014) to go to a private school.
JW	Tenor Horn	His music tutor reports he can play and recognise the notation for five notes but his lack of practice is holding him back. He is aiming to take his Grade 1 next year as a target focus. He continues to be tested for a lot of different conditions according to his school and there is a lot going on at home but Mum is very supportive and the school are doing all they can to help him.
RS	Tenor Horn	She is the schools' star pupil. Took her Grade 1 Tenor Horn last summer (2015) and passed with distinction, she is taking her Grade 2 later this term (Spring 2016).
DP	Drum Kit	He was very keen during lessons and worked well, but often seemed a bit embarrassed that he had forgotten about his drumming in between. He needed encouragement at home to help him practice regularly as he had good rhythmic skills but was a little disorganised and unfocused. Continues to play drums, though he changed teacher,

		as he did not progress far in the first year (2013-14).
IP	Guitar	Mother confirms that she started guitar lessons in September 2013 and continued for two years.
OG	Guitar	Progressed once she got a smaller (half size guitar) though practice was not consistent. By the end of the year could play several chords and songs but was struggling to read the notation. Teacher changed to auditory learning and she improved though still found it hard to piece together parts of the songs.
JB	Guitar	Rarely practised which affected progress, particularly at the start. Changed from electric guitar to acoustic, which helped motor development/technique but struggled to read notation. Much preferred auditory learning and was highly motivated by parental involvement but still rarely practised his instrument.
DC	Piano	Father reports he continues doing piano lessons, though he enjoys playing more than practising. He passed his Grade 1 last summer (2015) with a merit. He has expressed an interest to try the violin and guitar but parents have been reluctant for him to take on more instruments on top of schoolwork
FS	Piano and Violin	Did not continue with piano but now studying towards her Grade 3 violin having passed her Grade 2 with merit last year (2015). She is now house music captain in year six at school and very active with the school choir and orchestras so has continued with her singing. She also takes part in the West End experience shows that come to [her home town] twice a year and has had a couple of solo singing parts on those too.
LW	Piano	Achieved distinction in Preliminary Contemporary Piano Playing Associated Board of the Royal School of Music (ABRSM).
RF	Piano	Achieved distinction in Preliminary Contemporary Piano Playing (ABRSM).
LL	Piano and Clarinet	Mum reports she is really blossoming musically and it seems a real passion. She went on to pass her Grade 1 Piano with distinction and has since taken up singing and more recently the clarinet. Her Mum reports that she now really enjoys playing and singing, so it is not just another part of her education; she considers it an enjoyable hobby.
RL	Piano	Achieved distinction in Preliminary Contemporary Piano Playing (ABRSM).
JG	Piano and Drums	Report states he plays with enthusiasm, pays attention, can stop and start in time with music and recognises different melodies. Coordination proves challenging for him and he struggles to recall

		and replicate longer rhythms but has improved throughout the year.
KM	Piano	Achieved distinction in Preliminary Contemporary Piano Playing (ABRSM).
FM	Piano	Achieved distinction in Preliminary Contemporary Piano Playing (ABRSM).