

THE USE OF MUSICAL ELEMENTS TO INFLUENCE THE
LEARNING OF RECEPTIVE COMMUNICATION SKILLS IN
CHILDREN WITH AUTISM

Submitted by

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Statement of Originality

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signed: _____

Kathryn Mary Simpson

Date: _____

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Abstract

Individuals with autism demonstrate impairments in the area of communication, with many lingering in the prelinguistic stage of communicative development. Early intervention implementing evidence based practices is recommended. Current research indicates interventions for individuals in this stage of development have focused primarily on facilitating expressive communicative skills, with little research investigating interventions to facilitate receptive communicative skills. In typically developing infants, the prosodic and repetitive characteristics of speech and song directed to infants are viewed as features of the prelinguistic language environment associated with communication development. While there is a correlation between attending to infant-directed speech and language outcomes in children with autism, these children are less responsive to infant-directed speech than their typically developing peers. Increasing the salience of infant-directed stimuli for individuals with autism may assist them to acquire receptive language. There is some evidence to indicate that individuals with autism may be responsive to music interventions, although little research in this area has investigated a relationship between music and communication. The focus of this study was to investigate if the auditory input evident in the prelinguistic environment could be enhanced through the use of musical elements to aid receptive language learning and engagement in children with autism and severe language delay.

An experimental methodology with a cross-over design was used to compare the learning outcomes for children with autism and severe language delay in two intervention conditions: infant-directed song and infant-directed speech. The intervention was designed to teach children receptive labelling skills. Participants were recruited from Queensland State Special schools within a 50 km radius of the Brisbane CBD. Twenty two children (mean age 5.9 years) completed the research study. A computer-based intervention was

developed employing evidence-based instructional practices appropriate for this group of children. The children were asked to identify pictures presented on a touch screen monitor during an interactive song/story. Four pictures were taught in each condition. Each stage consisted of four training sessions and fifteen individual teaching sessions and generalisation training. The order of the intervention was counterbalanced across participants. Data were collected on participants' correct and incorrect responses. Video recordings were coded to provide data on participants' level of engagement across the sessions. Generalisation and maintenance data were recorded. Data were statistically analysed using SPSS 19.

Following the intervention there was a significant increase in learning the picture names in both the sung and spoken presentations, although no condition demonstrated superiority. Participants maintained learning at follow-up and generalised learning following both the sung and spoken condition. Children were more engaged during the sung presentation compared to the spoken presentation. Children's level of engagement was positively correlated with receptive language learning. Wide variability was reported between participants.

This study provided an initial investigation into the effect of the musical elements evident in the prelinguistic language environment on receptive language learning in children with autism, extending the theoretical knowledge base in this area. The findings from this research offer support for the use of the musical elements of melody and rhythm to be used within a multi-component intervention to create an engaging learning context to teach receptive labelling skills to children with autism and severe language delay. This study highlights the complexity of identifying evidence based practice and the need for researchers to analyse child characteristics and their relationship to learning outcomes.

This knowledge will assist in developing learning contexts that will benefit children with autism.

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List of Abbreviations

AAC	Augmentative Alternative Communication
ASD	Autism Spectrum Disorder
DSM	Diagnostic and Statistical Manual of Mental Disorders
EVT	Expressive Vocabulary Test
PCS	Picture Communication Symbols
PECS	Picture Exchange Communication System
PPVT	Peabody Picture Vocabulary Test
SCQ	Social Communication Questionnaire
SGD	Speech Generating Device
SIB-R	Scales of Independent Behaviour Revised
SMRS	Scientific Merit Rating Scale

Chapter 1: Introduction

Autism is a neurodevelopmental disorder that is characterised by impairments in the areas of social and communicative development, and repetitive and stereotyped behaviour (American Psychiatric Association, 2000). The presentation of these core characteristics and the degree of severity varies substantially between individuals. In recent years there has been an increase in the reported prevalence of autism with results indicating that early intervention addressing the core characteristics of autism aids in long term outcomes (Centers for Disease Control and Prevention, 2012; Fombonne, 2009a; National Research Council, 2001). In response to this the Australian Federal government has introduced a funding package “Helping Children with Autism” for children with autism to access evidenced based early interventions (Australia. Department of Health and Ageing, 2009). This has placed an increased demand on early intervention centres to identify and provide effective practices to meet the individual’s needs; however, it is less clearly defined what are effective practices to facilitate communicative development (Prior, Roberts, Rodger, Williams, & Sutherland, 2011).

One of the core characteristics of autism is impairments in the area of communication. Communication is an essential part of human culture and being unable to participate in a shared communication system impacts on an individual’s social relationships and quality of life (Light, 2003). Considerable heterogeneity is demonstrated in the language profiles of children with autism (Kjelgaard & Tager-Flusberg, 2001), with abilities ranging from within normal limits to severe delays in development (Charman, Drew, Baird, & Baird, 2003; Luyster, Lopez, & Lord, 2007). Early language abilities are associated with later outcomes (Howlin, Goode, Hutton, & Rutter, 2004; Howlin & Moss, 2012; Luyster, Lopez, et al., 2007) highlighting the importance of identifying interventions to assist in language acquisition.

The implementation of evidence-based interventions to target communicative impairment has been recommended (National Research Council, 2001). The preponderance of research supports the use of behaviourally based interventions (National Autism Center, 2009). These interventions although sharing an underlying behavioural philosophy vary in presentation from the use of focused intervention practices to address specific outcomes to comprehensive treatment models that are multi-component approaches addressing core deficits (Odom, Boyd, Hall, & Hume, 2010). Gaps, however, remain in the knowledge identifying the relationship between components of interventions, child characteristics and outcomes (Magiati, Tay, & Howlin, 2012; National Research Council, 2001). Although the interventions are predominantly behaviourally based, the communication intervention focus comes largely from a developmental perspective. Educational intervention strategies for individuals with severe language delay have predominantly focused on developing intentional and symbolic communication primarily using Augmentative and Alternative Communication (AAC) systems (Ganz & Simpson, 2004). AAC systems provide an alternate mode of communicating that augments or substitutes, spoken language. Not all individuals with autism respond to the currently used evidence-based communication interventions. It is not clear whether this is due to the components of interventions or whether a critical element in the communication development of individuals with autism has not been addressed.

Limited research has been conducted in the area of receptive language development despite this being commonly more impaired in comparison to expressive language development in children with autism (Hudry et al., 2010; Maljaars, Noens, Scholte, & van Berchelaer-Onnes, 2012). Receptive language skills precede expressive language skills in typically developing children (Bates, Dale, & Thal, 1995). In order to identify and understand the nature of receptive language impairments in children with autism and how

to treat these impairments it is important to understand the language acquisition process during the prelinguistic stage of typical development by focusing on the prelinguistic language environment.

Prior Research

From birth (if not before) humans appear to be attuned to the sound of the human voice and not only can they detect and distinguish this sound from the bombardment of auditory sounds in their environment, they are able to distinguish between familiar and unfamiliar voices (Beauchemin et al., 2011; DeCasper & Fifer, 1980). During this period caregivers use a distinctive speech with infants, characterised by prosodic features which distinguish it from the speech directed to adults (Fernald & Simon, 1984; Fernald et al., 1989). This infant-directed speech is preferred by infants over adult directed stimuli and appears to serve multiple purposes including attracting the infant's attention, communicating meaning and aiding language acquisition (Fernald, 1985; Papoušek, Papoušek, & Symmes, 1991).

During the second six months of life, the prosodic characteristics of infant-directed speech appear to provide the infant with linguistic cues to facilitate native language acquisition (Thiessen, Hill, & Saffran, 2005; Trainor & Desjardins, 2002). The ability to discriminate between native over non-native infant-directed speech by infants at 7 months is correlated with their language outcomes at 2 years (Kuhl, Conboy, Padden, Nelson, & Pruitt, 2005). The prosodic characteristics of infant-directed speech continue to be utilized by caregivers during the childhood years and appear to support the typically developing child's language acquisition up to the age of 5 years (Liu, Tsao, & Kuhl, 2009; Song, Demuth, & Morgan, 2010).

An associative relationship between attending to infant-directed speech and language performance has also been reported in children with autism (Kuhl, Coffey-

Corina, Padden, & Dawson, 2005; Paul, Chawarska, Fowler, Cicchetti, & Volkmar, 2007; Watson et al., 2010). As seen in typically developing children, these prosodic features continue to be utilised by individuals commensurate with their developmental age. For example, teenagers with autism who function at a developmental age of less than 3-years-old show increased responsiveness to speech with these prosodic features (Santarcangelo & Dyer, 1988). This would suggest that the prosodic characteristics evident in infant-directed speech may serve the same facilitative function in children with autism; however, its effectiveness is in some way impaired or delayed. This requires further investigation to determine explanations for this impairment or delay.

Infant-directed speech uses elevated pitch and wider pitch range (Fernald & Simon, 1984). Individuals with autism have demonstrated preserved or enhanced identification of pitch compared to matched controls (Bonnell et al., 2003; Heaton, 2005; Heaton, Hudry, Ludlow, & Hill, 2008). This would suggest the impairment is not due to auditory perception. Children with autism are less attentive to infant-directed stimuli compared to typically developing peers and language matched peers (Kuhl, Coffey-Corina, et al., 2005; Paul et al., 2007; Watson et al., 2010). Attention to infant-directed speech is correlated with the child's concurrent language skills and is predicative of language outcomes in children with autism (Kuhl, Coffey-Corina, et al., 2005; Paul et al., 2007). This would suggest that children with autism are able to attend to infant-directed speech and utilise the relevant linguistic cues but are less predisposed to this form of auditory stimuli. There is some evidence to support this concept. Communication occurs within a social context. Not only are children with autism less responsive to auditory stimuli in the form of social compared to non-social stimuli (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998) they spend less time engaged in social over non-social activities compared to peers (Kishida & Kemp, 2006; Ruble & Robson, 2007). In view of this it would not be

unreasonable to conclude that the reduced attending to infant-directed stimuli was influenced by the child's reduced responsivity to the presentation of this form of auditory stimuli within a social context.

Language acquisition, however, requires more than attending to the appropriate auditory stimulus. It requires the child to be actively engaged with the material in order to gain the relevant linguistic cues (Poll, 2011). It could be surmised that by increasing the engagement of children with autism with the relevant auditory stimuli this could potentially facilitate language learning. Infant-directed songs are available in the prelinguistic language environment and display similar prosodic features to infant-directed speech (Bergeson & Trehub, 1999; Trainor, Clark, Huntley, & Adams, 1997; Trehub, Unyk, et al., 1997). In addition melody facilitates language memory in typically developing infants (Thiessen & Saffran, 2009). There is some research to support the use of songs with children with autism, although there has been no research investigating the use of infant-directed songs.

Individuals with autism appear to have intact musical processing skills at both the local and global levels (Heaton, Williams, Cummins, & Happé, 2007; Mottron, Peretz, & Menard, 2000) with a bias towards local processing when absolute pitch is used for discrimination (Mottron et al., 2000). In addition, some children with autism demonstrate a preference for music as auditory stimuli over verbal stimuli (Blackstock, 1978; Buday, 1995). Although these results would indicate the addition of music may increase engagement in children with autism there has been limited research in this area. The use of music has demonstrated effectiveness in facilitating engagement in children with autism in the area of social communicative behaviours (see review Chapter 3) and some support for increasing engagement in class activities (Carnahan, Basham, & Musti-Rao, 2009). To

date there has been no research using music to increase engagement for the purpose of facilitating receptive language development.

Research Problem and Purpose

Communication impairment is a core characteristic of autism that demonstrates variability in its presentation. Significant language impairment in both expressive and receptive forms of communication is displayed by some individuals, with language skills ranging from within normal limits to limited to no functional language skills, and limited nonverbal and verbal communication skills and gestures (Charman, Drew, et al., 2003; Lord & Paul, 1997). Receptive language skills are viewed as more impaired than expressive language skills in individuals with autism (Charman, Drew, et al., 2003; Hudry et al., 2010; Luyster, Lopez, et al., 2007). It is recommended that interventions to address communicative impairments commence early using evidence-based practices (National Autism Center, 2009). Current interventions have focused primarily on expressive communication and have demonstrated effectiveness for some individuals with autism. There has been little research in the more impaired area of receptive communicative development to understand the nature of this impairment and to identify effective interventions to facilitate receptive language skills in children with autism.

A review of previous research identified that infant-direct speech is an auditory stimulus in the prelinguistic language environment that appears to aid typically developing children with language acquisition. A correlation has been reported between attending to infant-directed speech and language outcomes in children with autism; however, children with autism are less responsive to this speech compared to typically developing children (Kuhl, Coffey-Corina, et al., 2005; Paul et al., 2007). Potentially increasing the child's engagement with this speech may affect language outcomes. Infant-directed speech shares similar characteristics with infant-directed song. To date there has been no research into

the use of infant-directed song with children with autism. There has been some support for the use of music to target skills in interventions for children with autism, but there has been little research into the use of music to facilitate receptive language. There is a widely purported view that children with autism find the use of music an engaging and positive experience; however, there is little research substantiating these claims. Furthermore, there has been no research to date investigating whether the use of music to increase engagement in a learning context correlates with learning outcomes in children with autism. The purpose of this research is to compare the use of musical with non-musical elements evident in the prelinguistic environment in terms of receptive language learning outcomes and levels of engagement for children with autism and severe language delay.

Research Question

The identification of the research purpose as stated in the previous section guided the formulation of the research question.

What effect does the use of musical elements compared to non-musical elements in a receptive labelling task have on learning outcomes and engagement levels of children with autism and severe language delay?

This central research question was broken down into two specific areas of enquiry identified in the sub-questions.

Sub-question 1. What effect does the use of musical compared to non-musical elements in a receptive labelling task have on the learning outcomes of children with autism and severe language delay?

Sub-question 2. How does the use of musical elements compared to non-musical elements relate to engagement and learning outcomes for children with autism and severe language delay in a receptive labelling task?

The identification of the research question and the sub-questions followed a review of the literature investigating the influence that the prelinguistic language environment has on the acquisition of language in typically developing infants and language learning in children with autism. The literature to date indicates a correlation between attending to this auditory input and language outcomes; however, children with autism are less responsive to this form of auditory stimulus than typically developing peers. The impairments in language acquisition in children with autism would therefore be consistent with the view that language development is facilitated by the type of auditory input plus the active engagement of the child with that input (Poll, 2011). The current research questions investigate not only the type of linguistic input the child receives but also investigates the child's engagement with this input. The identification of the linguistic input comes from a review of the prelinguistic language environment of typically developing children (Chapter 2). To determine if engagement and learning can be increased musical elements have been added to this linguistic input. This decision was based on the emerging support for the use of music to engage children with autism (reviewed in Chapter 3).

Significance of the Research

The increased prevalence of autism has created greater demands on intervention resources. This has coincided with a rapid increase in the availability of programs and interventions many of which are implemented with little or no scientific evidence of their effectiveness (Prior et al., 2011). Autism is a complex disorder and many individuals are receiving multiple interventions (Bowker, D'Angelo, Hicks, & Wells, 2011; Goin-Kochel, Myers, & Mackintosh, 2007; V. Green et al., 2006). Not only do the individual interventions selected demonstrate varying levels of effectiveness, there is a dearth of research investigating whether the combination of these practices has complementary or counterproductive effects on outcomes (Bowker et al., 2011). In addition, interventions

incur financial costs and time demands on families and providers. The Australian funding packages addressing interventions for individuals with autism require the identification and implementation of best practice using evidence-based practices (Prior et al., 2011). This demands the efficient and effective use of the limited resources in this area and reduces the potential for individuals to be exposed unnecessarily to interventions that are non-productive or potentially harmful. Many interventions, however, are not sufficiently researched to establish effectiveness creating a demand for researchers to identify the key components of effective interventions and strategies (National Autism Center, 2009; Prior et al., 2011).

Communication is a fundamental aspect of our society; therefore, interventions focusing on facilitating communicative development in children with autism are not only targeting a core diagnostic impairment they are essential to improving an individual's quality of life. Furthermore early language development is a crucial factor associated with adult outcomes (Howlin et al., 2004; Howlin & Moss, 2012) highlighting the importance of targeting these skills with children as early as possible. There is still much to be learnt about the development of communication within this heterogeneous population in addition to identifying effective interventions (Carpenter, Pennington, & Rogers, 2002). This study targets receptive communication skills. This area has been the focus of limited research in this population.

By incorporating linguistic input evident in the prelinguistic language environment of typically developing children, and evaluating the child's engagement with this input, this research has the potential to inform intervention practices to facilitate communicative function in young children with autism, and to improve understanding of communicative development in this population. Continuing research is required to build on current knowledge about effective intervention practices. Developing and constructing an

intervention that clearly defines the materials and instructional procedures used will contribute to our current knowledge base.

The use of music has been identified as an emerging intervention practice that requires further investigation (National Autism Center, 2009). Research in this field has been plagued by limitations within the research studies. By addressing these limitations, this research will add significantly to the body of literature investigating the effectiveness of music interventions with children with autism.

A number of challenges are faced in evaluating the effectiveness of learning based interventions with children with autism due to the heterogeneity of this population and the access to participants. As a result there is a need to identify effective and innovative research designs to address these issues. In this study a cross-over design is used which addresses the issue of heterogeneity and small numbers. Findings from this research will contribute to the knowledge of methodological choices available to be used with this population.

In summary, this research will expand the current theoretical knowledge on the relationship between environmental input, the engagement of the child and language learning in children with autism and severe language delay. Investigating receptive language skills in children with autism provides an understanding of the course of receptive language development in this population that can guide the development of interventions to assist children with autism. It will provide scientific evidence to assist in informing parents, caregivers, and service providers of the effectiveness of particular practices to facilitate communicative development.

Structure of the Thesis

A Thesis by Publication incorporates a series of scholarly journal articles that are embedded within the document. This thesis contains two journal articles which have been

accepted for publication and one journal article under review. These articles are part of the student's research and the contributions of others in regard to these publications are outlined in the student's research portfolio (Appendix A). The remaining chapters of this thesis serve specific functions. A chapter by chapter outline of the content of the thesis is provided, detailing the inclusion of the journal articles within the overall structure of the thesis.

Chapter 2 explores the literature on children with autism in relation to communication development in particular language acquisition. This literature is discussed in the context of the current knowledge of typical communication development. In this chapter, current approaches that are used to facilitate communicative development focusing on the individual's strengths are reviewed. This highlights that research to date on communication interventions for children with autism and severe language delay are focused primarily on expressive communication skills with relatively fewer studies investigating receptive communication skills. The review leads to the identification of auditory input from the prelinguistic language environment of infants that is associated with language learning outcomes in typically developing children. Based on the view that language acquisition requires active engagement with the auditory stimuli (Poll, 2011), the review of the literature identifies the potential music may play in increasing the salience of this auditory input.

Chapter 3 builds on the literature discussed in the previous chapter. It includes Paper One which was published in the *Journal of Autism and Developmental Disorders*. This paper provides a comprehensive coverage of the literature relating to the use of music as an intervention with children with autism, during the period 1990- mid 2010. This published review of music interventions is supplemented with an additional review

updating the research findings to the end of 2012. The chapter concludes with a summary of the literature presented in Chapter 2 and 3 and identifies the purpose of this research.

The theoretical framework underpinning this research is outlined in Chapter 4. Given the nature and focus of the research question, and in line with the researcher's objectivist position this research is situated within a positivist paradigm (Sarantakos, 2005). To address the research question requires systematic, evidence based, empirical research. A clear explanation and rationale for the selection of an experimental methodology using a cross-over design to address the research study is presented. The cross-over design allows for the investigation of individual responses to the two intervention conditions and in doing so controls for individual variability. As each participant serves as their own control then only half the numbers of participants are needed to obtain the same data as required in randomised controlled trials. The use of an experimental design highlights the need to develop an intervention that demonstrates experimental control in order to investigate the research question. This intervention is described in the following chapter.

The development and construction of the intervention, based on a review of the literature identifying evidence-based strategies, is described in Chapter 5. This intervention was designed to be used in Study 1 (Chapter 7) and Study 2 (Chapter 8) to provide the data to address the research question. A detailed description and rationale for the presentation and selection of the materials are provided. The instructional procedures in relation to previous research are described in this chapter. The construction of the intervention is explained.

In Chapter 6, an overview is provided of the method to be used to gather and analyse the data for this research study. A detailed description of this method is contained in the two published papers in the subsequent chapters. Chapter 6 includes a

comprehensive account outlining the purposeful selection of the participants and an explanation of the flow of participants through each stage of the experiment. A description of the participants based on information gathered from standardised tests is provided. To conduct a cross-over design requires the random allocation of participants to a sequence of intervention conditions. This chapter includes a description of the random allocation of the twenty two participants to ensure participants would be counterbalanced across conditions. Details are provided in this chapter outlining how the observable and measurable data are to be obtained. Statistical analysis provides an accepted method for evaluating the treatment outcomes for a group design. The data analysis and reliability measures to be used in this research are also explained.

Chapter 7 comprises the journal paper currently under review for publication. It provides a detailed description of the method used to compare the use of music and non-music conditions to facilitate receptive labelling in children with autism. This paper reports on the research findings related to this first study and discusses the findings in relation to the literature presented in Chapters 2 and 3. The paper identifies the limitations of this research study and highlights future areas for research.

The third scholarly paper which reports on the results for Study 2 is presented in Chapter 8. This paper has been accepted for publication in *Research in Autism Spectrum Disorders*. Chapter 8 focuses on the influence of musical elements on engagement, and the relationship between levels of engagement and receptive language learning. The findings from this research and the implications of these findings are discussed in this paper.

In Chapter 9 the theoretical significance of the research findings as it relates to the literature is discussed. In this chapter the distinct contribution this research makes to current knowledge is highlighted. The implications of these findings relevant to

interventionists and researchers are included. This chapter concludes with an outline of recommendations for future research.

Chapter 2: Characteristics of Autism and Communicative Development

Current research in communication intervention for individuals with autism tends to draw on literature from the areas of autism, communication development and communication interventions. The proposed research will draw on two additional areas of research literature to provide the context for the study in examining the possible influence of musical elements on receptive communication development in individuals with autism. The identified research literatures are displayed diagrammatically in Figure 1. The intersections between these bodies of literature and how they interrelate will underpin this thesis.

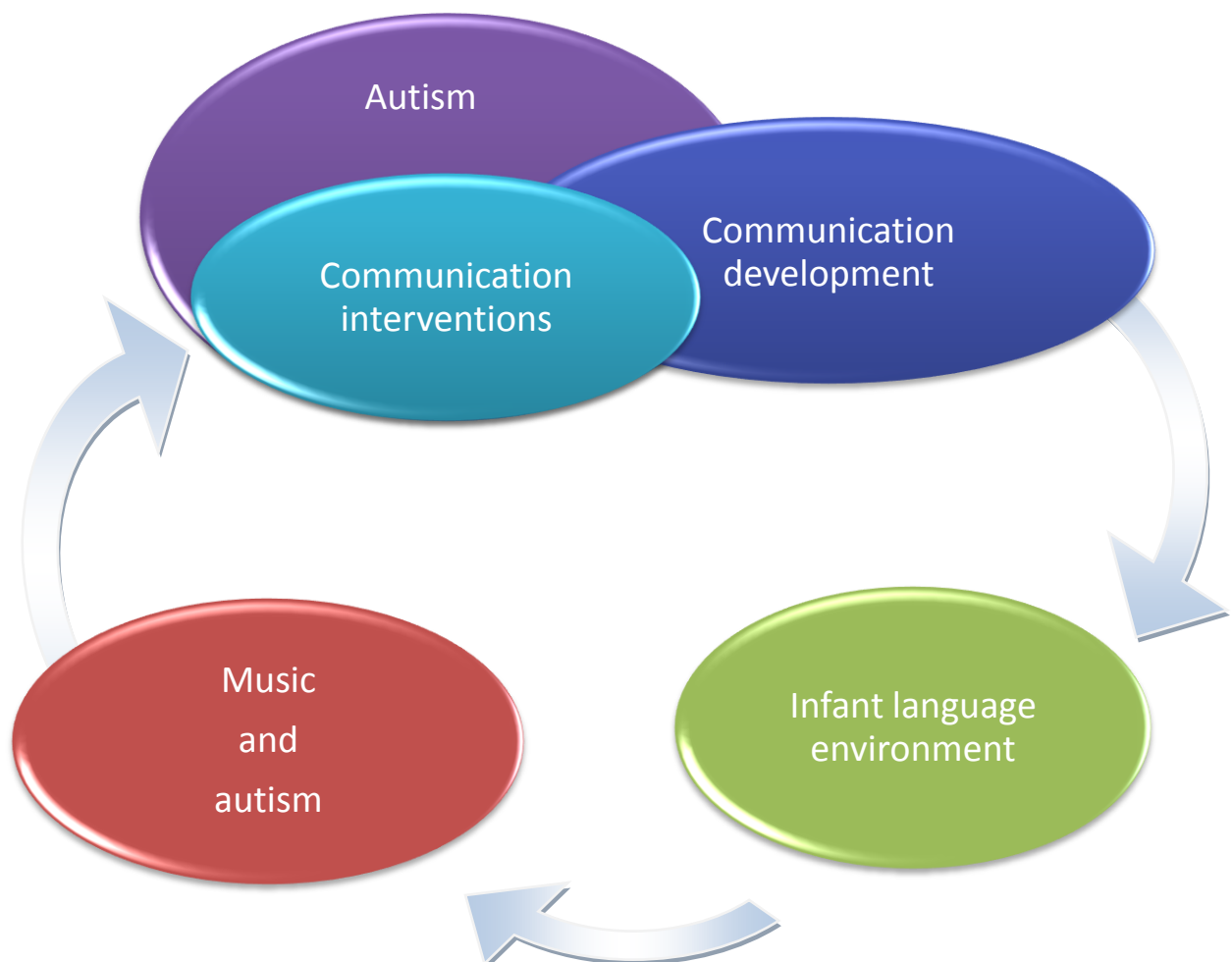


Figure 2.1. Research context

In this chapter, four of the key bodies of research literature shown in Figure 2.1 will be reviewed, with the fifth (music and autism) reviewed in Chapter 3. Through an analysis of the literature presented in Chapters 2 and 3, current knowledge and understanding of autism and the heterogeneity of the disorder will be conveyed. A more detailed examination of communicative development in typical children will provide the framework for understanding communicative impairments in children with autism. An important aspect of communicative development in infancy is the nature of the language learning environment. The research literature in this area may provide insights into how children with autism learn language and thus inform communication interventions. Current knowledge about and understanding of how music could possibly play a role in communication development is the final component shown in Figure 2.1. This will be examined both in relation to language learning in infancy and in music as a factor that may influence learning and engagement in children with autism.

Autism

Autism is a term commonly applied to a cluster of neurodevelopmental disorders currently referred to as Autism Spectrum Disorders (ASD; the term autism has been used as shorthand throughout) and includes Asperger's Disorder, Autistic Disorder and Pervasive Developmental Disorder Not Otherwise Specified (Wing, 1996). These disorders are defined in the Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.,; *DSM-IV-TR*; American Psychiatric Association, 2000) under the diagnostic umbrella of Pervasive Developmental Disorders. This group shares a commonality and overlap in areas of impairments, with core characteristics identified as impairments in social and communicative behaviour, and repetitive and stereotyped behaviour (American Psychiatric Association, 2000). In the DSM-IV, ASD is not a diagnostic category and the three subtypes are distinguished; however, the DSM-5 launched in May 2013, adopted the

term Autism Spectrum Disorder (American Psychiatric Association, 2013). This diagnostic term now replaces the previous separate categories that were used in the DSM-IV. The DSM 5 replaces the three core impairment areas with two symptom domains: social and communication impairments, and repetitive and restrictive behaviours and interests. Given the timing of the release of the DSM 5, the research in this thesis was undertaken using the DSM-IV which for consistency has been used throughout to define and describe the disorder and study participants.

In recent years there has been an increased rate of autism being reported, largely accounted for by the broadening of the diagnostic criteria, improved identification and public awareness (Fombonne, 2005; Wing & Potter, 2002). In addition, there appears to be some consensus that there is a true increase in the prevalence rate of autism (Fombonne, 2009a). The recent prevalence rates reported in the United States of children with autism were 1 in 88 (Centers for Disease Control and Prevention, 2012). The Australian estimated rate of 62.5 per 10 000 (MacDermott, Williams, Ridley, Glasson, & Wray, 2007) is more conservative and consistent with the current estimated prevalence rate of 60-70 per 10 000 in other parts of the world (Fombonne, 2009a). The prevalence of autism is higher in males to females 4.3:1 (Fombonne, 2005). This increased prevalence rate has placed further demands on intervention and educational resources. To address this issue the Australian Federal government has introduced a funding package “Helping Children with Autism”, to provide funding for children with autism to access early intervention treatment planning (Australia. Department of Health and Ageing, 2009). It is recommended that effective interventions address the core characteristics of autism (National Research Council, 2001). This requires an understanding of the characteristics of autism and how they impact on an individual’s functioning.

Characteristics of Autism

Autism is characterised by impairments in the areas of communication, socialisation and stereotyped behaviour, interests and activities (American Psychiatric Association, 2000). Individuals with autism demonstrate a marked variation in the extent and severity of these core impairments. In addition to the core impairments some individuals with autism display features common to other diagnostic groups. These features are not specific to autism, nor are they common to all individuals with autism and are therefore not included in the diagnostic criteria. As, however, some of these features may impact on interventions they are included in this discussion under associated descriptive features.

Communication. Autism is characterised by qualitative impairments in nonverbal and verbal communication (American Psychiatric Association, 2000). There is a wide heterogeneity in the presentation of communication abilities and these abilities are associated with nonverbal mental age (Charman, Drew, et al., 2003; Luyster, Lopez, et al., 2007; Thurm, Lord, Lee, & Newschaffer, 2007). Impairments in communication are apparent early and are frequently the initial area of concern for parents (Hess & Landa, 2012; Lord & Paul, 1997). Furthermore, early communicative abilities are predictors of later language skills (Mawhood, Howlin, & Rutter, 2000; Thurm et al., 2007). Characteristics of early communicative abilities are examined in more detail later in this chapter.

Language abilities in individuals with autism are variable and are one of the factors used to differentiate between Autistic Disorder and Asperger's Disorder (American Psychiatric Association, 2000). These abilities can range from within normal limits to little if any functional speech (Charman, Drew, et al., 2003; Lord & Paul, 1997; Luyster, Lopez, et al., 2007). Even individuals whose language is within the normal range demonstrate

persistent anomalies particularly in the area of language comprehension (Howlin, 2003; Seung, 2007). In children with autism, expressive language tends to be more advanced compared to receptive language in contrast to the reverse profile for typically developing children and children with language delay (Charman, Baron-Cohen, et al., 2003; Hudry et al., 2010; Luyster, Lopez, et al., 2007; Maljaars et al., 2012). There is incredible variability across individuals and the relative advantage of expressive language over receptive language abilities appears to be associated with lower nonverbal mental age and to a small effect more severe ASD symptoms (Volden et al., 2011).

Severe delays in language ability have been associated with challenging behaviour with delays in receptive language demonstrating a stronger association with challenging behaviour compared to delays in expressive language (Sigafoos, 2000). Challenging behaviours can contribute to increased caregiver stress (Lecavalier, Leone, & Wiltz, 2006). These factors highlight the importance of early interventions to address communicative behaviours to assist the individual and his/her family.

Social behaviour. Individuals with autism demonstrate impairments in the development of social behaviours including reduced responsivity to social stimuli (Dawson et al., 1998; Osterling, Dawson, & Munson, 2002), and deficits in responding and producing nonverbal joint attention skills, in particular gestures and eye contact (Charman et al., 1997; Landry & Loveland, 1988; Mundy, Sigman, & Kasari, 1994). Retrospective studies have identified that early social behaviours appear to be impaired in 1-year-olds with ASD (Osterling et al., 2002) and are early signs of concern identified by parents (Chawarska et al., 2007). These early social behaviours significantly impact on communicative development and are discussed in more detail in the review of communicative development that follows.

Restrictive and repetitive behaviour, interests and activities. Individuals with autism may demonstrate behaviour that is abnormal in terms of intensity, duration, or focus. This may be displayed in a preoccupation with restricted interests and activities, insistence of sameness, stereotyped repetitive motor behaviours, routines and rituals, and repetitive speech (American Psychiatric Association, 2000). There is some support to suggest a relationship between repetitive behaviours and sensory processing issues (Boyd, McBee, Holtzclaw, Baranek, & Bodfish, 2009) with individuals displaying hyper, hypo or fluctuating responsivity to sensory stimuli (Prior & Ozonoff, 1998). These behaviours can comprise major barriers to learning with increased severity and frequency of restricted and repetitive behaviours associated with more impaired social interaction and pragmatic language skills (Barret, Prior, & Manjiviona, 2004; Bruckner & Yoder, 2007).

Associated descriptive features not part of the diagnostic criteria. Features that have been documented in association with autism, but are not classified as part of the diagnostic criteria include intellectual disability and abnormalities of mood and behaviours. These are included in this review as they can impact on the individual's learning.

Intellectual disability. Intellectual disability is frequently documented in association with autism, with estimates that 70% of individuals with autism are affected (Fombonne, 2003). The reliability of these rates, however, has been queried in a review by Edelson (2006) who concluded that many of the reported sources of this data lacked empirical evidence. Furthermore, an individual's performance on standardised tests may be influenced by motivational and attentional variables which may result in an underestimate of intellectual functioning (L. K. Koegel, Koegel, & Smith, 1997). More conservative figures recently published indicate that 38% of individuals with autism have an associated intellectual disability (Centers for Disease Control and Prevention, 2012).

The generalised view of high rates of intellectual impairment may impact on the type of intervention being provided to individuals with autism. Interventions may be directed at cognitive levels below the individual's actual functioning and or the interventions may be presented in a context that does not capitalise on their cognitive skills. Intellectual ability is one of the main prognostic determining factors on adult outcomes (Howlin & Moss, 2012). Interventions that address the impact of the individual's cognitive functioning on learning have the potential to maximise intervention outcomes.

Behaviour. Children with autism experience high levels of emotional and behavioural problems beyond their core autism symptoms (Brereton, Tonge, & Einfeld, 2006; Georgiades et al., 2011). These behaviours occur with greater frequency in individuals with autism than for typically developing peers and individuals with other developmental disabilities (Georgiades et al., 2011; Matson, Cooper, Malone, & Moskow, 2008). In particular, the occurrence of attention problems, emotional reactivity and withdrawn behaviours were significantly higher in young children with autism compared to typically developing peers (Georgiades et al., 2011). These together with other repetitive behaviours can be viewed as challenging when they interfere with social interactions and learning contexts. Challenging behaviour has been associated with impaired communicative behaviour in particular receptive skills compared to expressive skills (Sigafos, 2000). The incidence of aggressive behaviour towards others has been associated with low expressive and receptive language scores; while self-injurious behaviour is significantly related to low expressive vocabulary scores (Dominick, Ornstein Davis, Lainhart, Tager-Flusberg, & Folstein, 2007). These behaviours can impact on the individual's quality of life and are associated with increased levels of parental stress (Georgiades et al., 2011). Early communication interventions may reduce levels of challenging behaviour.

There has been a rapid growth in interventions available for children with autism which has outstripped the speed at which research can determine the effectiveness of these practices. An eclectic array of interventions including biological, psychodynamic and educational practices are now available with individuals frequently accessing multiple interventions concurrently regardless of the presence or absence of empirical support (Carter et al., 2011; Goin-Kochel et al., 2007; V. Green et al., 2006).

In parental surveys, speech therapy has been reported as the most commonly used treatment (Goin-Kochel et al., 2007; V. Green et al., 2006) highlighting the importance parents place on addressing communication impairments in their children with autism. These surveys, however, do not describe the nature of the speech therapy undertaken. Early intervention to facilitate language development among young children with autism is recommended because of the strong associations between language skills and later functional outcomes (Luyster, Qiu, Lopez, & Lord, 2007). This study focuses on children with autism who display severe language delay. The communication impairments within this group of individuals are best understood by first examining communication development in typically developing children.

Communicative Development

From birth (if not before) humans appear to be attuned to the sound of the human voice and can detect and distinguish this sound from the bombardment of auditory sounds in their environment. This early ability to perceive human voice seems to facilitate a relationship with caregivers that builds and shapes their experience. The young infant progresses rapidly from a period of identifying voice to being able to identify meaning within that auditory sound and to develop competence with that sound to produce meaning. The developmental process within the first two years of life is one of rapid growth in physical, cognitive and social-communicative skills. Infants appear rapidly to

acquire a complex rule-based native language that proves to be a challenge for non-native adults to learn. The infant passes through a number of developmental stages with communicative competence increasing across each stage. In this thesis, the focus is on the first two stages of development, the perlocutionary and illocutionary stages, and the key milestones that signal the transition from prelinguistic to more intentional and symbolic forms of communication.

From birth to 9 months, infants are categorized as being in the perlocutionary stage of communicative development (Bates, Camaioni, & Volterra, 1975). This is characterised by infant behaviour that impacts on the listener, but it is primarily reflexive in nature. The behaviour is not viewed as intentionally communicative, but the listener interprets and responds to the infant's behaviour as if it was intentional. The infant's behaviour is not part of the purpose for that communicative act and it is generally interpreted by someone familiar with the infant (Bates, 1979). Even the familiar communicative partner may find the behaviour difficult to interpret as the infant may use the same behaviour for a number of communicative functions or may use a number of behaviours for the one communicative function (Neilsen & McEvoy, 2004). Around 9 months of age the typically developing infant transitions to the illocutionary phase.

Transition to the illocutionary phase

The illocutionary phase is characterised by the onset of communicative intentions, conventional signals and the emergence of symbolic communication (Bates et al., 1975). Intentional communication is viewed as predictive of language development (McCathren, Warren, & Yoder, 1996) and is characterised by the emergence of joint attention (Adamson & Bakeman, 1991; Bates, 1979). Impairments in joint attention and symbol understanding are correlated with language abilities, with symbol understanding a stronger predictor of receptive language skills than joint attention (Maljaars et al., 2012).

Joint Attention. Joint attention is viewed as coordinated attention between the child, partner and object/event and consists of initiating and responding behaviours (Bates, 1979). That is a child may initiate a joint attention bid behaviour using eye gaze or gestures to direct the attention of others to an object or event, or may respond to the joint attention bids of others (Bruinsma, Koegel, & Koegel, 2004; Mundy et al., 2007). Impairments in joint attention have been identified as a characteristic feature of children prospectively diagnosed at 14 months with autism (Landa, Homan, & Garrett-Mayer, 2007); and retrospectively as an indicator of emerging autism symptoms in toddlers (Charman, 2003).

Joint attention is intertwined with the development of social communication abilities and it is during periods of joint engagement that opportunities are provided for symbols to be introduced and developed (Adamson, Bakeman, & Deckner, 2005). In typical development, linguistic contingent responses to joint attentional focus is viewed as facilitating object name acquisition (Akhtar, Dunham, & Dunham, 1991; Tomasello & Farrar, 1986). It is during this period that caregiver's model, scaffold and expand the infant's communication abilities.

Individuals with autism are less responsive to joint attention bids and initiate less joint attention behaviours than typically developing or developmentally delayed children (Charman et al., 1997; Loveland & Landry, 1986; Mundy, Sigman, & Kasari, 1990; Mundy, Sigman, Ungerer, & Sherman, 1986). This is more evident in individuals with autism who have a mental age below 20 months (Leekam, Hunnisett, & Moore, 1998; Mundy et al., 1994). A number of studies have found a correlation between joint attention behaviours and language skills in children with autism with responding to joint attention bids identified as a significant predictor of receptive language development (Luyster, Kadlec, Carter, & Tager-Flusberg, 2008; Mundy et al., 1986; Murray et al., 2008).

In order to understand joint attention impairments in children with autism there has been recent research investigating precursor skills required for joint attention focusing particularly on eye gaze (Bedford et al., 2012; Gliga et al., 2012). Infants and young children at risk of autism appear to have intact ability to follow eye gaze (Bedford et al., 2012; Gliga et al., 2012), but children who later displayed socio-communicative difficulties seem to maintain their attention with the object for a reduced period (Bedford et al., 2012). Furthermore, although children with poor socio-communicative skills were able to follow the direction of the adult's gaze this did not aid their word learning outcomes (Gliga et al., 2012). This would suggest that the relationship between joint attention and language acquisition requires a level of engagement by the child to access the relevant cues to assist in learning.

Children with autism appear to be less responsive to social compared to non-social stimuli (Dawson et al., 1998; Lewy & Dawson, 1992). Contexts, however, can be created by caregivers synchronizing their behaviour to the child's focus of attention and contingently responding to their communicative acts irrespective of the regard the child shows to the partner (Adamson et al., 2005; Siller & Sigman, 2002). Creating these contexts has facilitated language development in some young children with autism (Adamson et al., 2005; McDuffie & Yoder, 2010; Siller & Sigman, 2002). Although a recent study by Kasari and associates suggests some interventions may be effective in increasing joint attention in children with autism (Kasari, Gulsrud, Wong, Kwon, & Locke, 2010), Adamson and associates propose an investigation into communication interventions that actively engage the child in contexts that may facilitate the development of symbolic communication but are not dependent on joint attention (Adamson, Bakeman, Deckner, & Ronski, 2009).

Symbolic Communication. In typical development, symbolic communication emerges with the use of conventional gestures for the purpose of communication (e.g. giving, showing, pointing and requesting) and extends to the use of linguistic symbols (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979). Gestures are viewed as actions with communicative intent, for the purpose of establishing a reference (deictic gestures) or establishing a reference with a fixed semantic content (representational gestures). Intent is evidenced by accompanying eye contact with the communicative partner or by vocalisation (Iverson & Thal, 1998). Symbolic communication requires the communicative partners to be able to comprehend and produce the shared symbols. To be termed symbolic communication, the use of a symbol must reach a level of decontextualisation. This occurs when the symbol can be separated from the context in which it was learned (Wetherby, Reichle, & Pierce, 1998). The use or understanding of the symbol typically occurs in a highly ritualised or specific context then progresses to a variety of contexts (Bates et al., 1979). Typically comprehension of symbols occurs prior to the production of symbols (Bates et al., 1979); however, this may not be typical for individuals with autism (Hudry et al., 2010).

Communication Interventions

The main focus of communication interventions for individuals with autism in the prelinguistic stage is to develop functional communication skills by increasing intentional and symbolic forms of communication behaviour by employing evidence-based treatments (National Research Council, 2001). Knowledge about what constitutes evidence-based practice is not always available to parents and interventionists. As a result a number of reports have been contracted by organisations to identify evidence-based treatments and provide this information for parents and interventionists, including the National Autism Center (National Autism Center, 2009) and the Australian Government Department of

Families, Housing, Community Services and Indigenous Affairs (Prior et al., 2011). The authors of the National Autism Centre report (2009) developed a Scientific Merit Rating Scale (SMRS) to determine the effectiveness of a treatment or intervention (established, emerging, unestablished, and ineffective/harmful). This scale was used by Prior et al. (2011) in their evaluation of the effectiveness of treatments for young children. In addition, Prior and associates evaluated treatments by considering the treatment in terms of the research knowledge in regard to autism. These two reports identified established and emerging practices that target communication skills including both comprehensive treatment models (CTMs) and focused intervention practice. Currently the majority of established interventions targeting communication skills are essentially based on or employ behavioural practices although there is emerging support for some interventions that adopt a more developmental approach (National Autism Center, 2009).

Much of the research to date investigating CTMs has compared early intensive behavioural interventions with eclectic approaches (Odom, Hume, Boyd, & Stabel, 2012). In recent years there has been a move to identify the essential characteristics of intervention practices required to promote communication outcomes. The multi-component nature of CTMs, however, complicates the identification of efficacious strategies to promote communication outcomes. This is further confounded by a lack of clarity in the strategies and combination of strategies used in comparative studies (Odom et al., 2012). In addition, comparative studies vary in the intensity and duration of the intervention and use different methods to assess outcomes (Howlin, Magiati, & Charman, 2009). Moreover, different theoretical approaches underpinning these treatments create challenges for researchers and educators who seek to identify key elements of effective interventions (Rogers & Vismara, 2008). These factors have hampered the identification of essential components required for effective interventions. Furthermore, it has been

proposed the intensive behavioural approaches and alternative comparative interventions may overlap in terms of intervention components obscuring essential elements (Odom et al., 2012).

Similarities between naturalistic behavioural approaches and developmental, social-pragmatic (DSP) interventions have been identified despite the different underlying philosophies (Ingersoll, 2010). Ingersoll (2010) proposed that commonalities may emerge from a common understanding of terminology across different approaches. In her work, she found similarities in the use of child initiated teaching episodes, meaningful activities, environmental arrangements to facilitate communicative opportunities, and the use of natural reinforcement (Ingersoll, 2010). Behavioural approaches use prompt strategies to facilitate learning (Mirenda & Iacono, 1988), whereas DSP approaches focus on adult responsivity to the child (Prizant, Wetherby, & Rydell, 2000). While differences between approaches to intervention persist, understanding components which are effective in promoting communication development will inform intervention practice.

The identification of efficacious focused intervention strategies in the National Standards Report (National Autism Center, 2009) has distinguished instructional strategies and practices which may be key components of interventions. This work has been developed by classifying these practices according to evidence support based on the age of the individual and the targeted learning outcomes (Odom, Collet-Klingenberg, Rogers, & Hatton, 2010; Odom et al., 2012). Despite these attempts, variability in children's responses to the interventions has been reported in the research literature spanning the last 25 years (Howlin et al., 2009; Reichow, 2012; Rogers & Vismara, 2008).

In a key study on behavioural interventions, major gains that were reported by Lovaas (1987) were demonstrated by less than 50% of the participating children. A follow-up study found that a group of children demonstrated little improvement after 7 years of

intensive intervention (McEachin, Smith, & Lovaas, 1993). Similar results were reported by Sallows and Graupner (2005) with more than half the children showing little significant change from pre-test to post-test following 4 years of intensive daily treatment. This subgroup was characterised by children who had lower IQ and limited language skills. The individual variability in outcomes across interventions has resulted in research focusing on the identification of individual characteristics which mediate responses to interventions (Howlin et al., 2009; Magiati et al., 2012; Reichow, 2012).

Individual Factors

Children's IQ, language abilities and adaptive behaviours have been identified as predictors of treatment outcome; although variability has been reported between these variables and responses to intervention (review Magiati et al., 2012). Age and IQ at the commencement of intervention have been associated with overall performance (Harris & Handleman, 2000; Zachor, Ben-Itzhak, Rabinovich, & Lahat, 2007). In contrast, Howlin et al. (2009) identified IQ but not age as a characteristic relating to progress, while a number of studies have reported that IQ does not significantly impact intervention outcomes (Eikeseth, Smith, Jahr, & Eldevik, 2007; Zachor et al., 2007). Child characteristics as predictors may vary depending on learning outcomes. Nonverbal IQ was reported as predictive of changes in expressive and receptive language skills (Bopp, Mirenda, & Zumbo, 2009; Luyster et al., 2008). Thurm and associates found this was a significant factor in 2- year-olds but communication scores at age 3 were a stronger predictor of language outcomes (Thurm et al., 2007). This may be dependent on the assessment measures used, as early social communicative behaviours have been identified as predictors of language outcomes. Gestures and response to joint attention have been identified as additional predictors of receptive language, while gestures and imitation have been identified as additional predictors of expressive language (Luyster et al., 2008). In

addition the severity of autism has been identified as a predictor of language production (Bopp et al., 2009). Higher adaptive behaviour skills have also been reported to impact positively on language skills (Makrygianni & Reed, 2010), while socially unresponsive behaviour negatively correlates with expressive and receptive language skills (Bopp et al., 2009). The discrepancies in identifying the impact of child characteristics on learning outcomes may depend on interventions used (Magiati et al., 2012). As a result identification of effective communication interventions requires an understanding of communication development in children with autism and the identification of intervention techniques associated with specific child characteristics. Additionally, other factors may impact on the effectiveness of an intervention and one that has received quite a deal of attention is the level of the child's engagement with the learning task.

Engagement

Communicative interventions can present challenges to individuals with autism and lead to disruptive behaviours. These behaviours may serve a communicative function: to escape or avoid a task for example (Carr & Durand, 1985). They are likely to result in lower levels of attention and on-task behaviour thereby impacting on the individual's performance (Bopp et al., 2009; M. Edelson, Schubert, & Edelson, 1998). Children with autism spend less time engaged in social and non-social activities than their typically developing peers or children with other developmental disabilities resulting in reduced learning opportunities for them (Kishida & Kemp, 2006; McWilliam & Bailey, 1995; Ruble & Robson, 2007). Promoting and supporting engagement for children with autism is viewed as a critical feature of effective learning interventions (Corsello, 2005; National Research Council, 2001).

It is acknowledged that 'engagement' is multidimensional and encompasses behavioural, cognitive and emotional elements (Fredricks, Blumenfeldm, & Paris, 2004;

Keen, 2009). Behavioural engagement relates to the individual's on-task behaviour, emotional engagement relates to the individual's interest, values and emotions, and cognitive engagement relates to effort or goal-directed behaviours (Keen, 2009). There is overlap between the types of engagement. Motivational components such as providing choices, using preferred items, embedding reinforcers in the task and alternating level of task difficulties (L. K. Koegel, Singh, & Koegel, 2010; R. L. Koegel, Koegel, & Surratt, 1992) may emotionally engage the individual but are assessed in terms of behavioural engagement outcomes e.g. level of outcome and behaviour (R. L. Koegel et al., 1992). The multidimensional construct of engagement may impact on how the relationship between engagement and learning in children with autism is evaluated.

Engaging individuals with autism in learning programs may require deliberate manipulation of materials, activities and the environment. Strategies that have demonstrated some success include the use of activity schedules (Bryan & Gast, 2000); using motivational variables including the child's interests and preferences (Hurth, Shaw, Izeman, Whaley, & Rogers, 1999; Rispoli et al., 2011) and providing choices (Ulke-Kurkcuoglu & Kircaali-Iftar, 2010), and treatment packages incorporating motivational variables (L. K. Koegel et al., 2010; Pelios, MacDuff, & Axelrod, 2003). In addition, children with autism may be more engaged during structured one-to-one activities (Kishida & Kemp, 2006). Despite these strategies, there is still a limited understanding of engagement and how this can be promoted in learning tasks for children with autism.

Although what is known is beneficial, there is still much research required in identifying the components of effective educational interventions to address the communication impairments in this heterogeneous group of individuals. Within this population a subtype has been characterised based on language profiles (Tager-Flusberg & Joseph, 2003). One group of individuals displays language profiles resembling typical

development, while the other group of individuals displays impaired language profiles similar to the language profile seen in individuals with specific language impairment (Tager-Flusberg, 2006; Tager-Flusberg & Joseph, 2003). The language impaired subgroup includes a group of individuals who do not develop functional language (Charman, Drew, et al., 2003; Lord & Paul, 1997). The differing developmental trajectories in language acquisition and individual profiles in children with autism may impact on intervention outcomes (Boucher, 2012; Tek, Mesite, Fein, & Naigles, 2013). Current communication interventions for young children with autism with severe language delay have focused on developing symbolic forms of communication, frequently using augmentative and alternative communication (AAC) systems.

Augmentative and Alternative Communication Interventions

Augmentative and alternative communication systems (AAC) provide an alternate mode of communicating that augments or substitutes spoken language and are used extensively with individuals who demonstrate impairments in communication. They provide the user with communication tools that can be used across a range of environments, contexts and communicative partners (Cafiero, 2005). Manual signs, picture-based interventions and speech generating devices are the AAC devices predominantly used with individuals with autism. The different AAC options vary in terms of the demands on symbolic representation and memory.

Manual signs. The use of manual signing in conjunction with speech was the preferred AAC mode used with individuals with autism in the 1980's (Wendt, 2009). Manual signs are categorized as unaided symbol systems and as such they do not rely on other devices. They are viewed as convenient; however, like speech the information is transitory and imposes memory requirements on the participants. An understanding or

familiarity with the signs is required for communication which can limit the potential communicative partners (Beukelman & Mirenda, 2005).

Manual signs have been used effectively to teach a range of expressive language skills (labelling, requesting, and commenting) and receptive skills to children with autism, predominantly employing behaviour based instructional approaches including prompts, modelling and reinforcement (Wendt, 2009). Children with autism acquired receptive and expressive vocabulary more rapidly when taught manual signs with speech compared to speech alone (Kurt, 2011; Mirenda, 2003). There are inconclusive results as to the effectiveness of the generalisation of manual signs across settings and communication partners (Wendt, 2009).

There are a number of mediating factors identified which impact on the use of manual signs. Execution of the manual signs is related to the individual's fine motor skills. This system may be less beneficial for individuals with autism who demonstrate poor fine motor development (Seal & Bonvillian, 1997; Tincani, 2004), and may not be suitable for individuals in the prelinguistic stage of communication development due to the high symbolic level. Responses to manual signs may be associated with verbal imitation scores (Carr & Dores, 1981). Carr and Dores (1981) identified two subgroups following speech and manual sign training. Irrespective of mental age, children with good verbal imitation skills receptively responded to both the sign and the spoken label, while children with poor verbal imitation skills responded to the sign alone but not the spoken label.

Picture-based interventions. The reported preference for visual-spatial materials by individuals with autism has led to the use of picture based materials in communication interventions (Quill, 1997; Schuler & Baldwin, 1981). It provides a static presentation that allows for repeated examination (Schuler, Prizant, & Wetherby, 1997). Picture-based

interventions rely on recognition rather than memory recall which can be advantageous for some individuals (Wilkinson & McIlvane, 2002).

As with any symbolic communication the communicative partners need to have an understanding of the symbol system. For picture-based systems to be used for symbolic communication it requires both parties involved to understand dual representation i.e. the picture is an object in its own right and at the same time refers to the object in the picture (DeLoache, 2005).

The Picture Exchange Communication System (PECS; Bondy & Frost, 1994) has been one area that has attracted much research interest. PECS is a manualised intervention protocol based on the principles of applied behaviour analysis, aimed at developing functional communication and spontaneous initiations. It uses a discrete-trial format and relies on the use of highly preferred items as a reinforcement to motivate the development of requesting skills; as well as the use of prompting and shaping techniques. PECS is a step-by-step, six phase program. The first three phases focus on teaching spontaneous initiation of a request using a symbol. This progresses in Phase IV to the use of a symbol sentence and “reading” the sentence request. The last two phases introduce responsive requesting and commenting (Frost & Bondy, 2002). PECS incorporates teaching communicative skills and generalising across communicative partners and environments at each phase (Bondy & Frost, 2001).

A perceived advantage of PECS is that it does not rely on the individual demonstrating any prerequisite skills (Beukelman & Mirenda, 2005). In Phases I and II no symbol awareness is required as the individual is taught to pick up and exchange a picture-based symbol for an item (Bondy & Frost, 2001). An additional advantage is that the generalisation of initiating and requesting skills to other communicative partners and contexts is embedded into the training protocol. PECS has demonstrated effectiveness as

an intervention to increase the communicative function of initiating requests for some, but not all children with autism (Flippin, Reszka, & Watson, 2010; Gordon et al., 2011; Howlin, Gordon, Pasco, Wade, & Charman, 2007; Preston & Carter, 2009). Although Gordon et al. (2011) reported a significance increase in initiating requests following PECS intervention for a group ($n = 56$) of children with severely impaired verbal and nonverbal skills, 16% of the children did not initiate any requests following intervention.

Research findings are currently inconclusive as to the maintenance of skills following intervention. A number of studies with small participant numbers reported maintenance at follow-up (Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet, 2002; Ganz, Heath, Rispoli, & Earles-Volrath, 2010); while results from a randomised controlled trial reported skills were not maintained following the cessation of intervention (Howlin et al., 2007). There has been little empirical research conducted into the impact PECS has on learning picture skills and verbal comprehension.

While PECS does not aim to facilitate verbal expression, the concomitant development of speech by PECS users has been reported in a number of studies (Beck, Stoner, Bock, & Parton, 2008; Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Schwartz, Garfinkle, & Bauer, 1998; Yoder & Stone, 2006a). These findings, however, are inconclusive as the findings are not universal (Flippin et al., 2010; Howlin et al., 2007). When speech developed it was more likely to occur during Phase IV coinciding with the introduction of verbal modelling and time delay suggesting that these strategies may facilitate speech production (Flippin et al., 2010; Preston & Carter, 2009). Child characteristics may also impact on speech development following PECS training with children displaying lower levels of autistic symptomatology pre-intervention showing the greatest improvement (Gordon et al., 2011).

PECS as a communication intervention has been compared with Responsive Education and Prelinguistic Milieu Teaching (RPMT). In RPMT parents are taught to respond to their child's communication using prompts for verbal imitation and questions to evoke spoken communication (Yoder & Stone, 2006a, 2006b). Both interventions facilitated communication but results were dependent on the child's pre-intervention object exploration skills. Individuals who had object exploration skills performed better in the PECS condition, while individuals who had poor object exploration skills performed better in the RPMT context. It is possible that the use of objects with children with low object exploration skills may not have been motivating for the individual, while RPMT may be more effective in developing an interest in the object (Yoder & Stone, 2006a). PECS was more effective than RPMT in developing requesting skills in children who were initially lower in initiating joint attention (Yoder & Stone, 2006b). This provides support for the use of PECS for children who have difficulty initiating communication behaviours.

PECS has been used in conjunction with the existing communicative forms of two females with autism to develop social-communicative behaviours (Cannella-Malone, Fant, & Tullis, 2010). Both participants used a combination of communicative forms for greetings, requesting, and responding, providing support for the use of PECS as part of a multi-component AAC system (Cannella-Malone et al., 2010).

The use of picture-based interventions has also been incorporated into natural settings to teach multiple communication functions – initiating, responding, questions and comments (Cafiero, 2001; Drager et al., 2006; Keen, Sigafos, & Woodyatt, 2001). Picture symbols were used by Keen et al. (2001) to replace existing prelinguistic behaviours in young children with autism during daily routines. This required identifying the function of the behaviour and replacing it with a functionally equivalent alternative. Picture symbols

were used for requesting an object, requesting a turn and choice making, highlighting that multiple communication functions could be taught using this form of AAC.

The use of an AAC system by the communicative partner to augment and model language has been effective in developing communicative behaviours in children with autism (Cafiero, 2001; Drager et al., 2006). Cafiero (2001) described a case study where natural aided language intervention was used with a teenage boy with autism. During this intervention picture based communication boards displaying context specific symbols were available for the student's communication. The student was not provided any formal training in the use of the board. The communication partners pointed to the symbols to ask questions, model, respond and expand the student's communicative attempts. The researchers reported an increase in the number and functional use of symbols for requesting and commenting and the ability to chain words to make a sentence. Ancillary outcomes included improvements in academic subjects and a reduction in challenging behaviour. This study incorporated AAC within naturally occurring communicative exchanges as occurs in typical language development.

The approach of augmenting and modelling language was also used by Drager and associates with two preschool-age children with autism. During interactive play sessions the communicative partner provided augmented input by pointing to a referent in the environment, pointing to the corresponding picture symbol on an AAC board and providing the verbal name. In this study, children's ability to respond to the picture symbol preceded their use of the picture symbols consistent with typical language development suggesting AAC devices can be used to develop receptive communication skills (Drager et al., 2006).

Speech generating devices. Speech generating devices (SGDs), also known as voice output communication aids, use words or pictorial representations to display

messages on a portable electronic device that when activated emit a recorded or synthesized speech message (Beukelman & Mirenda, 2005). The use of SGDs provides a verbal model in association with a visual-graphic representation of the message and these devices can be embedded within naturalistic teaching contexts (Olive et al., 2007; Ronski & Sevcik, 1996; Schepis, Reid, Behrmann, & Sutton, 1998) and taught by peers (Trembath, Balandin, Togher, & Stancliffe, 2009). Similar to picture exchange programs, SGDs have been effective in teaching requesting as a communicative behaviour (Lancioni et al., 2007; Schlosser et al., 2007; van der Meer & Rispoli, 2010). SGDs have also been used to increase comprehension skills (Brady, 2000; Light, Roberts, Dimarco, & Greiner, 1998; Ronski & Sevcik, 1996), as a communication repair strategy (Sigafoos, Drasgow, et al., 2004) and have been associated with a decrease in challenging behaviours (Durand, 1999; Olive, Lang, & Davis, 2008). As with manual signing and picture based interventions, behaviour based instructional approaches have been effective in teaching the use of SGDS to children with autism (van der Meer & Rispoli, 2010). There is some support for maintenance of skills following SGD training (Schepis et al., 1998; Schlosser et al., 2007) and the use of SGDs has been generalised across settings, people and tasks (van der Meer & Rispoli, 2010).

It has been proposed that the consistent modelling of language that occurs in association with activating the device facilitates speech improvement (Olive et al., 2007; Ronski & Sevcik, 1996). This, however, may be dependent on the type of speech used for modelling. Schlosser et al.(2007) compared the use of a SGD with synthesised speech on and speech off and reported inconsistent results for the use of speech to facilitate improvements in vocalisations. Furthermore, there has been little research investigating the impact of the type of speech output used on comprehension skills (Schlosser & Blischak,

2001). The use of SGDs appears to be unrelated to cognitive ability but better outcomes have been linked to its introduction at an earlier age (Mirenda, Wilk, & Carson, 2000).

Similar to picture based interventions, the SGD is not dependent on communicative partners requiring an understanding of symbols and this enhances the communicative partner's ability to understand the child's communication (Light et al., 1998). In contrast to picture based interventions and manual signing, SGDs are not dependent on the communicative partner being within the child's immediate proximity or looking at the child, thus reducing the chance of the communicative partner missing the communication attempt. A limitation of SGDs is accessibility and children may require specific training to locate their SGD in order to use the device as a communication mode (Sigafoos, O'Reilly, Seedy-York, & Edrisinha, 2004).

Consistent with previous findings for AAC interventions, SGDs have been effectively implemented with a number of participants; however, performance between participants was variable with the use of the SGD effecting little change in performance for a number of children (van der Meer & Rispoli, 2010). There is a wide range of SGDs available and children's individual preference for a device may impact on their performance (Sigafoos, O'Reilly, Ganz, Lancioni, & Schlosser, 2005).

In the last few years there has been rapid technological advancement in the use of AACs. The release of the Apple iPad™ in 2010 and similar Android™ tablets has seen the adoption of these devices as potential SGD modes of AAC. This has been exacerbated by the prolific development of affordable language apps. There is an emerging body of research investigating the effectiveness of these devices using single-subject designs (van der Meer & Rispoli, 2010). Studies comparing the use of SGDs with other AAC systems are discussed in the following section.

Comparisons of AAC systems. A review of the literature identified comparative studies investigating the efficacy of the three main AAC systems used by children with autism. These studies have focused on the efficacy of each AAC system, and which system may work best for particular individuals with autism. Table 2.1 presents a summary of the studies identifying the AAC systems that have been compared, the number and age of participants, the form of communication taught and the outcomes. As some studies included participants without autism, only those with an autism diagnosis were included in the table.

Table 2.1.

Studies Comparing Manual Signs, Picture-based Interventions and Speech Generating Devices

Studies	AAC system			Participants		Form	Outcomes
	MS	PBI	SGD	n(CA)			
Beck, Stoner, Bock, & Paton (2008)		X	X	4 (preschool age)	Request	Acquisition faster with PBI than SGD however this may have been affected by requirement to pick up SGD. Generalisation reported for one participant showing a preference for SGD. Mixed results for impact of AAC on verbalisations.	
Flores et al. (2012)		X	X	3 (8-9yrs)	Request	Two participants requested more frequently using SGD compared to PBI.	
Sigafoos, Green et al., (2009)		X	X	1 (15yrs)	Request	Acquisition with both systems. Selection on AAC system relative to access.	
Son et al. (2006)		X	X	3 (3-6yrs)	Request	Acquisition rates similar with using both AAC systems. Follow-up 2 participants displayed a preference for PBI, while 1 participant displayed a preference for SGD.	
Tincani 2004	X	X		2 (5-7yrs)	Request	One participant requested more frequently using MS. One participant requested more frequently using PBI. Verbalisations increased more with MS than PBI.	

Table 2.1. *continued*

Studies	AAC system			Participants		Form	Outcomes
	MS	PBI	SGD	<i>n</i> (CA)			
van der Meer, Didden et al., 2012	X	X	X	2 (12-13yrs)	Request		One participant reached acquisition criterion with all systems but did not maintain with MS. The other participant reached acquisition criterion with SGD and PBI but not MS. Preference for SGD – both participants
van der Meer, Kagohara et al., (2012)	X	X		2 (7-10yrs)	Request		P1 reached acquisition faster with MS than SGD, maintained at 6 months. Preference for MS. P2 reached acquisition with SGD but not MS. Preference for SGD.
van der Meer, Sutherland et al., (2012)	X	X	X	4 (4-11yrs)	Request		P1 acquisition criterion for SGD, high levels on PBI and MS. Maintained for SGD and PBI but not MS. Preference for SGD P2 acquisition criterion not reached for any mode. High levels for PBI. Preference assessment PBI P3 acquisition criterion for all systems, maintained for SGD and PBI, reduced MS. Preference for SGD P4 acquisition criterion for all systems, maintained for SGD and PBI, reduced MS. Preference for PBI

Note: MS, manual signs; PBI, picture based interventions; SGD, speech generating device; CA, chronological age

The studies shown in Table 2.1 provide evidence to support the use of the three AAC systems to teach requesting skills with children with autism who have limited functional communication skills: manual signs, picture-based interventions and SGD. The results were inconclusive in identifying the effectiveness of one device over another, with the research suggests that children were able to learn using a number of different systems. These studies support the use of behaviourally based instructional strategies with AAC systems.

Participants' preferences for an AAC was measured in a number of studies including pre-intervention, intervention and follow-up (Son, Sigafoos, O'Reilly, & Lancioni, 2006; van der Meer, Didden, et al., 2012; van der Meer, Kagohara, et al., 2012; van der Meer, Sutherland, O'Reilly, Lancioni, & Sigafoos, 2012). The studies showed participants demonstrated a preference for an AAC; however, there was no agreed preference for a particular system across the studies. In addition, preference may not necessarily be related to individual's performance and individuals can demonstrate change in preference over time (van der Meer, Kagohara, et al., 2012). There were no conclusive results favouring an AAC system for increasing vocalisations (Beck et al., 2008; Tincani, 2004).

AAC Research Summary

This review identified evidence for the use of the three major AAC systems (manual signs, picture based interventions and SGD) to teach early communicative behaviour to children with autism. There was strong support for the use of behaviourally based interventions to teach communication skills to children with autism although there was considerable variation in individual outcomes reflective of the heterogeneity in this population (Howlin et al., 2009). Although progress has been made in identifying child characteristics which may impact on the effectiveness of AAC interventions, there appears

to be a group of children with autism who fail to progress or respond to many of these interventions. What is still unknown is whether this group of individuals learns differently or they are unable to respond or access the salient features of the intervention.

The majority of studies reviewed have targeted teaching the early communicative function of imperatives (requesting or refusing). Although imperatives are an important early language function (Sigafoos & Mirenda, 2002), it is equally as important to extend these skills to ensure this is not the extent of communication skills being taught to individuals with autism (Mirenda, 2008). Two decades ago, Ronski and Sevcik (1993) highlighted the limited research in understanding the role of comprehension in the AAC process and encouraged researchers to examine this area. Despite this, the review of the literature found little research focusing on receptive communication skills using AAC. When receptive communication skills were mentioned they were often not the main or central focus of the intervention. This appears to be consistent across AAC research. Snell and associates found receptive communication was not measured or targeted in 83% of the studies investigating the use of AAC with individuals with developmental disabilities (including autism) spanning a 20-year period (Snell et al., 2010).

The body of research which has been conducted in the area of receptive communication interventions for children with autism with limited functional speech has predominantly focused on the use of instructional techniques to aid discriminative skills. This has included investigation into prompt strategies to help children learn to respond correctly (Carp, Peterson, Arkel, Petursdottir, & Ingvarsson, 2012; Eikeseth & Hayward, 2009; Ingvarsson & Hollobaugh, 2011); the use of reinforcement (Grindle, 2002); error-correction strategies (Turan, Moroz, & Paquet Croteau, 2012); and discrimination training methods (Grow, Carr, Kodak, Jostad, & Kisamore, 2011). There was variability within children's performance resulting in procedural modifications made to the instructional

strategies for some children following their low levels of response and their interfering behaviour (Carp et al., 2012; Grow et al., 2011). These studies demonstrated individual responsiveness to different types of strategies which may have impacted on outcomes (Turan et al., 2012). Although this research provides information about intervention strategies it does not identify methods of facilitating receptive communication.

Much of the current understanding in regard to how best to facilitate communicative development has been informed from an understanding of typical language development with particular emphasis on the period of intentional communicative development. Given that receptive communication may be more impaired than expressive communication in children with autism, research identifying effective interventions to facilitate comprehension skills is required. Receptive communicative development precedes expressive communicative development in typical development. Investigating the language environment of infants and understanding the development of receptive language in typical development may provide insights to aid in the communicative development of children with autism.

Infant Language Environment

During the first twelve months, the infant develops the ability to identify and understand a new language with a speed unparalleled in adulthood. The prelinguistic infant is exposed to a linguistic environment characterised by musical speech and song. This auditory stimulus demonstrates specific features that appear to heighten the infant's attention, facilitate language acquisition, communicate affect and enhance social engagement.

Both speech and song directed to an infant audience are characterised by infant preferred features of higher pitch levels, heightened emotionality and repetitive phrases compared to adult-directed contexts (Bergeson & Trehub, 1999; Fernald & Simon, 1984).

Typically developing infants demonstrate a preference for infant-directed song over infant-directed speech (Nakata & Trehub, 2004). Although there has been more research conducted in the area of infant-directed speech, parallels between features of infant-directed speech and infant-directed song and their potential impact on linguistic development can be demonstrated.

Infant-directed Speech

From an early age infants are exposed to a distinct type of speech commonly known as ‘motherese’, ‘baby talk’, or ‘infant-directed speech’. It is characterised by higher pitch, wider pitch range, longer pauses, shorter utterances and more repetitions; than speech directed to adults (Fernald & Simon, 1984). These characteristics appear to be innately adopted cross-culturally and used by adults, regardless of their gender or previous exposure to young infants (Fernald & Simon, 1984; Fernald et al., 1989; Papoušek et al., 1991). Infants demonstrate a preference for this type of speech compared to speech directed to adults (Fernald, 1985).

The prosodic contours of speech are identified as expressing different communicative intentions. These are viewed as more exaggerated and more easily identifiable in infant-directed speech compared to adult-directed speech (Fernald et al., 1989; Stern, Spieker, & MacKain, 1982), suggesting that the characteristics of infant-directed speech may provide a didactic support for preverbal communication (Papoušek et al., 1991). Investigating infants’ responses to this type of speech during infancy will extend the knowledge of influences on communicative development in typically developing children and identify influences that may benefit individuals with autism.

Developmental progression. From birth (if not before), infants are able to attune to sounds in the midst of a barrage of auditory information. The newborn is able to discriminate between his/her mother’s voice and an unfamiliar voice – a fact which has

been demonstrated using both behavioural and neurophysiological methods (Beauchemin et al., 2011; DeCasper & Fifer, 1980). This propensity to speech sounds evident in infants appears to be utilised to acquire language at rates not replicated in adult life.

At this early stage infants demonstrate a preference for infant-directed speech over adult-directed speech (Cooper & Aslin, 1989; Fernald, 1985; Fernald & Mazzie, 1991; McRoberts, McDonough, & Lakusta, 2009). This appears to be irrespective of whether it is spoken by a familiar or unfamiliar adult; presented in native or non-native language; or occurring in quiet or noisy background (Fernald, 1985; Hayashi, Tamekawa, & Kiritani, 2001; Newman & Hussain, 2006). At this age, expanded pitch contours are identified as the significant feature determining infant-directed speech preference (Fernald & Kuhl, 1987).

During the second six months infants transition from language-general to language-specific sensitivity and demonstrate a preference for infant-directed speech in their native language (Jusczyk, Cutler, & Redanz, 1993). At this stage the infant appears to use the prosodic characteristics of infant-directed speech to aid in identifying linguistic features of their native language (Thiessen et al., 2005; Trainor & Desjardins, 2002) and to enhance memory for these sounds (Singh, Nestor, Parikh, & Yull, 2009). The infant's ability to discriminate acoustic differences in language sounds at 6-7 months of age is predictive of later abilities at 2 years (Kuhl, Conboy, et al., 2005; Tsao, Liu, & Kuhl, 2004) and this ability is enhanced by social interaction (Kuhl, Tsao, & Liu, 2003). At this age an infant's preference for speech is influenced by the affective qualities of the speech (Singh, Morgan, & Best, 2002; Trainor, Austin, & Desjardins, 2000). This correlates with a reported peak in the use of utterances associated with positive affect directed at 6-month-olds (Kitamura & Burnham, 2003). There is also an increase in repetitive utterances produced by mothers (Fernald & Morikawa, 1993); and a correlated preference for repetition displayed by 6-

month-old infants (McRoberts et al., 2009). The structure of familiar repetitive utterances provides cues that may facilitate the infant to distinguish and recognize linguistic information in a stream of sound. By 7 months, infants are able to recognise familiar words presented in sentential contexts (Jusczyk & Aslin, 1995). At this stage infants are demonstrating an auditory recognition of the target word rather than simply responding to a familiar phonemic structure (Bortfeld, Morgan, Golinkoff, & Rathbun, 2005). It is not until 9 months that the infant associates the linguistic form with a specific referent and by the age of 12 months the infant is beginning to use this knowledge to expressively label the object (Oviatt, 1980).

Age-related changes in infant-directed speech corresponding with a mother's communicative intentionality complementing the infant's developmental stage have been reported (Kitamura & Burnham, 2003). This would suggest a reciprocal social communicative interaction between the caregiver and the infant which is responsive to the infant's developmental stage. It would appear that prosodic characteristics of infant-directed speech that aid in language acquisition are continued beyond infancy. These features continue to be utilized by toddlers to aid in word recognition (Song et al., 2010) and speech directed towards 5-year-olds (child-directed speech) demonstrates similar features to infant-directed speech and is distinct from speech directed to adults (Liu et al., 2009). This would suggest features of infant-directed speech continue to aid children with language development. For ease of reading infant-directed speech is the terminology used throughout this study to describe this speech type regardless of the age of the audience.

Infants seem to progress from global processing of sound, evidenced by their responsivity to affective and prosodic characteristics of auditory stimuli; to the local processing of individual speech segments, evidenced by their recognition of individual words. It appears the characteristics of infant-directed speech aid in facilitating

communicative development. During this period the infant's language environment consists of songs which differ in presentation to those used with older infants or adults (Bergeson & Trehub, 1999).

Infant-directed Song

Like infant-directed speech, infant-directed song demonstrates specific features. These include higher pitch, slower tempo and more emotive voice quality (Bergeson & Trehub, 1999; Trainor et al., 1997; Trehub, Unyk, et al., 1997) and appear to be inherently adopted by both mothers and fathers in western cultures (Trehub, Hill, & Kamenetsky, 1997). Infants are more responsive to songs performed to an infant, than to a simulated situation or when songs are directed to an adult, suggesting the distinguishing features are more predominant in the presence of the infant (Nakata & Trehub, 2004). The predominant research relating to infant-directed song has compared the two song genres, that is, lullabies and playsongs.

The two song genres demonstrate perceptually distinct characteristics, express different emotional messages and elicit different responses from the infant audience. Lullabies are characterised by smooth descending contours for the purpose of calming the infant, while playsongs are viewed as more rhythmic with clipped qualities for the purpose of arousing the infant (Rock, Trainor, & Addison, 1999; Trainor, 1996; Trehub & Schellenberg, 1995). Lullabies are identified cross culturally, suggesting soothing songs may express comfort to listeners in a number of cultures (Unyk, Trehub, Trainor, & Schellenberg, 1992). Behavioural responses to the song genres indicate that infants tend to focus their attention towards themselves during lullabies, while they are more focused on their external world when listening to playsongs (Rock et al., 1999). Infants' preference for contextual presentation may be dependent on the pitch levels. In infant-directed songs pitch is higher in playsongs compared to lullabies (Trainor et al., 1997) with infants

demonstrating a preference for high-pitched over low-pitched versions of playsongs and low-pitched over high-pitched versions of lullabies (Tsang & Conrad, 2010; Volkova, Trehub, & Schellenberg, 2006).

As with speech, newborns demonstrate a preference for infant-directed singing over non-infant-directed singing (Masataka, 1999). There has, however, been little research investigating developmental changes in infant-directed song. In a recent study, Delavenne and associates compared mothers' infant-directed singing at 3 and 6 months during musical play routines. Mothers used final lengthening cues to mark the end of the line at both ages, but when singing to the older infants they used a slower tempo and lengthened the final syllable of the verse (Delavenne, Gratier, & Devouche, 2013). This coincides with changes in the infants' development stage and may be used by mothers to emphasise phrasal structure. Changes in infant-directed singing like infant-directed speech continue to the preschool years. Bergeson and Trehub (1999) compared songs sung by mothers to their infants and preschoolers and identified that the pitch was higher and rated as more affectionate in the infant-directed version while the preschool version was more clearly enunciated.

Comparison of Speech and Song

Comparative studies suggest that song demonstrates a more facilitative effect on language acquisition than speech (Thiessen & Saffran, 2009). Research has found that learning of lyrics was enhanced when lyrics were paired with melody compared to a spoken format (Schön et al., 2008; Thiessen & Saffran, 2009). This was more effective if the melody was familiar or it was heard repeatedly creating familiarity (Wallace, 1994). Lyrics presented with melody provide a more complex auditory input than lyrics alone; however, there appears to be bidirectional influence between lyrics and associated melody that facilitates learning of both the lyrics and the melody (Peretz, Radeau, & Aguin, 2004).

Possible explanations for this include that the melody provides a more engaging context that infants attend to for longer than speech (Nakata & Trehub, 2004; Schön et al., 2008; Thiessen & Saffran, 2009) or the mapping of music on linguistic structure optimises learning (Schön et al., 2008). In addition, infant-directed singing displays more regularity in tempo, rhythm and dynamic range compared to infant-directed speech (Bergeson & Trehub, 2002). Infants' (6-8 months) attend to regular sound sequences longer than to irregular sound sequences, while older infants (9-11 months) don't exhibit a differential listening preference (Nakata & Mitani, 2005). The regularity preference in song displayed by young infants coincides with the preference 6 month olds display towards repetitive speech as previously mentioned, suggesting this preference may coincide with a developmental stage.

This review has indicated that infant-directed speech and infant-directed song are used for the purpose of gaining infants' attention, providing emotional engagement and facilitating communicative development. The unique characteristics of infant-directed speech and infant-directed song, in particular the use of pitch, appear to facilitate language acquisition in typically developing infants. In the last decade there has been an emergence of research investigating the influence of infant-directed speech on language development in children with autism, but to date there has been no research investigating the use of infant-directed song.

Infant-directed Stimuli and Autism

Individuals with autism are less attentive to auditory stimuli which are social compared to non-social (Dawson et al., 1998; Klin, 1991, 1992; Kuhl, Coffey-Corina, et al., 2005) and this seems to hold true for infant-directed speech. Children with autism attend to infant-directed speech less than typically developing peers (Kuhl, Coffey-Corina, et al., 2005; Paul et al., 2007; Watson, Roberts, Baranek, Mandulak, & Dalton, 2012).

Furthermore it appears children with autism may be less attentive to auditory stimuli compared to typically developing peers irrespective of the form suggesting that a general inattention to auditory input may impact on language learning (Watson et al., 2010).

Sustained attention to auditory stimuli, in the form of both infant-directed speech and non-social auditory stimuli, has been associated with concurrent measures of expressive and receptive language skills (Watson et al., 2010). There is, however, a stronger relationship between attention to infant-directed speech and language skills (Watson et al., 2010). A concurrent relationship between the time spent by individuals with autism attending to infant-directed speech and measures of language performance has been identified in a number of studies (Kuhl, Coffey-Corina, et al., 2005; Paul et al., 2007; Watson et al., 2010). In particular, the listening time of toddlers with autism to infant-directed speech has been correlated to their receptive language abilities one year later (Paul et al., 2007).

Attending to infant-directed speech may be related to child characteristics. Kuhl, Coffey et al. (2005) found children with autism who attended to non-speech sounds over infant-directed speech had more severe autistic symptoms as measured on the ADOS and scored lower on measures of initiating joint attentions and expressive language. Furthermore, this group of children did not display brain wave patterns to syllabic change which was evident in the typically developing children and the children with autism who attended to the infant-directed speech, indicating these children demonstrated less discriminative capacity for linguistic cues. It is possible the children with autism who were less attentive to infant-directed speech were functioning at an earlier developmental age. This is supported by Paul and associates who found typically developing toddlers showed a listening preference for auditory speech sounds consistent with their level of language functioning. This preference for linguistic cues was not evident in the toddlers with autism

suggesting they were functioning at a younger developmental age (Paul et al., 2007).

Further support for the association between attending to infant-directed speech and the developmental age of individuals with autism was reported by Santarcangelo and Dyer (1988). In their study, teenagers with autism and a developmental age less than three years increased responsivity to directives and increased eye gaze in response to the use of speech prosody typical of infant-directed speech compared to conversational speech. This was less effective with individuals functioning at a developmental level older than five years.

The research findings to date indicate a correlation between attending to infant-directed speech and language outcomes in children with autism indicating features of this auditory input may contribute to language acquisition. Children with autism, however, are generally less attentive to infant-directed speech than their typically developing peers and this may contribute to language acquisition difficulties. Increasing the salient features of infant-directed speech may assist children with autism to acquire language. During the prelinguistic period infants are also exposed to infant-directed song. Infant-directed song shares many features in common with infant-directed speech but to date, research has not investigated whether infant-directed song facilitates language acquisition in the same way as infant-directed speech. Children with autism are more attentive to speech sounds when they are presented in a sequence of tones compared to on their own (Whitehouse & Bishop, 2008) suggesting combining speech sounds with music may assist in focusing the individual's attention to language. Given the listening preference for music by children with autism (Blackstock, 1978), and the potential this may have for facilitating attention to speech a review of the literature investigating the use of music with children with autism was conducted.

In Chapter 3, a review of the literature regarding the use of music with children with autism is presented. This consists of a published paper reviewing the literature for the

period 1990- mid 2010. This is supplemented with a review of studies published since mid-2010 until the end of 2012.

Chapter 3: Literature Review of Music Interventions

Musical elements, as identified in Chapter 2, may provide an auditory stimulus to assist in communicative development in children with autism. This chapter presents a review of the current evidenced based research investigating the use of music as an intervention with children with autism. It includes the published paper: Simpson, K., & Keen, D. (2011). Music interventions for children with autism: Narrative review of the literature. *Journal of Autism and Developmental Disorders*, 41, 1507-1514. doi: 10.1007/s10803-010-1172-y. The focus of this paper was to review the research investigating the use of music as an intervention for children with autism published during the period 1990 to April 2010. The paper has been formatted to meet the submission requirements of *Journal of Autism and Developmental Disorder* including the use of American spelling. The page numbers have been re-numbered to be consistent throughout the thesis. The Tables have been presented in-text and re-numbered with the preface of 3. The list of excluded studies from the review are available in Appendix B. Following the paper, a review of the literature published since April 2010 has been presented to provide an update to the literature review. This chapter concludes with a summation of the key findings from the literature review presented in Chapter 2 and 3, and identifies the purpose of this research and the guiding research question.

Abstract

It is widely reported that music can be beneficial to individuals with autism. This review was undertaken to determine the evidence base for the use of music as an intervention for children with autism. After searching relevant databases, 128 articles were identified of which 20 articles met the study's inclusion criteria. Composed songs and improvisational music therapy were the predominant music techniques used. There was somewhat limited evidence to support the use of music interventions under certain conditions to facilitate social, communicative and behavioural skills in young children with autism. The implications of these findings in terms of use of music interventions, issues related to generalisation and maintenance, and future research are discussed.

Keywords Autism, music, intervention, review

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Music Interventions for Children with Autism: Narrative Review of the Literature

Music has been used by therapists to facilitate communicative behaviours and social engagement with individuals with autism (Alvin, 1978; Alvin & Warwick, 1992). The nonverbal aspect of music is viewed as a means of engaging the child and the therapist/ others in musical-emotional communication (Alvin, 1978; Alvin & Warwick, 1992; Malloch & Trevarthen, 2009). Much has been written about the purported benefits of music for individuals with autism based on the preference, responsivity and predisposition this group display to music stimuli.

A number of studies have reported that individuals with autism demonstrate a preference for auditory stimuli over other stimuli when the auditory stimuli is presented in the form of music (Blackstock, 1978; Kolko, Anderson, & Campbell, 1980); and these individuals will engage with the auditory stimuli for a longer duration than typically developing children matched on developmental age (Thaut, 1987). Thaut (1988) measured musical responsiveness in a group of children with autism using music improvisations and found no significant difference in rhythm, restriction and originality compared to chronologically age matched peers, supporting the in-tact nature of musical responsiveness in this group.

Findings from experimental studies suggest that musical perception may also be preserved or enhanced in individuals with autism. Superior identification and labelling of pitch (Applebaum, Egel, Koegel, & Imhoff, 1979; Bonnel et al., 2003; Heaton, Hermelin, & Pring, 1998); enhanced sensitivity for pitch direction (Heaton, 2005) and enhanced detection of changes in pitch contours (Heaton, Hudry, Ludlow, & Hill, 2008) have been demonstrated by individuals with autism when compared to matched controls. On auditory discrimination tasks using music stimuli, Jones et al. (2009) found that adolescents with autism performed as well as age and IQ matched controls; however, a subgroup of

individuals with autism demonstrated enhanced performance on the frequency discrimination task. Musical processing appears to be intact at both local and global levels (Heaton, Williams, Cummins, & Happé, 2007; Mottron, Peretz, & Menard, 2000) with a bias towards local processing when absolute pitch is used for discrimination (Mottron et al., 2000). Although some individuals with autism may display a preference and/or aptitude for elements of music, the implications of these abilities in terms of the impact on the efficacy of interventions need to be investigated.

A number of reviews investigating the use of music with individuals with autism have previously been conducted (Accordino, Comer, & Heller, 2007; Gold, Wigram, & Elefant, 2006; Whipple, 2004). Accordino and associates provided a narrative account of articles they identified as using music therapy from 1973 – 2000. The review encompassed the use of music therapy with children, adolescents and adults with autism to address social, behavioural and communicative outcomes. The parameters of the review limited the results to studies that only used music therapy and excluded studies that involved music in conjunction with intervention components. Of the 20 articles identified in the review, less than half were experimental design studies. With the exception of one study, the experimental studies identified used Auditory Integration Training.

In a Cochrane Report by Gold et al. (2006), three studies were selected which compared the use of music to non music conditions with children under the age of 10 years. Although significant results for gestural and verbal communicative skills during a music condition were reported, the studies were limited to receptive music therapy conducted within highly structured environments, with small numbers of young children. Gold et al. found there was little assessment by the researchers of generalization or maintenance following cessation of the intervention.

Whipple (2004) conducted a meta-analysis of nine studies comparing music and no music situations with children and adolescents with autism. Articles that described the use of music in any form were included. Whipple reported that music was effective as an intervention with individuals with autism irrespective of the age of participants, type of intervention, treatment, methodology and profession of the music provider. However, Whipple's review relied heavily on unpublished manuscripts, with only three articles published in peer reviewed journals being included.

The recent National Standards Project conducted by the National Autism Center (2009) classified music therapy as an emerging evidenced-based practice useful in teaching individual skills or goals by initially targeting the skill through song or rhythmic cuing. The project reported on six studies that used a range of music techniques. The project did not provide narratives of the studies or comparisons of treatment techniques.

Given the classification of music therapy as an emerging evidenced-based practice and the limitations of previous reviews, the aim of this paper was to review current research literature to determine the effectiveness of music interventions, the music technique used and the contexts of the intervention.

Method

Procedure

A comprehensive search of three selected computer databases, ERIC, Proquest and PsycINFO, using the search criteria 'autis*' and 'music' for the period 1990 – April 2010 was conducted. Articles were included for the current analysis if they met the following criteria:

1. Articles were published in a peer reviewed journal.

2. Participants were children (0-18 years) with a diagnosis of autism. Studies involving other special education populations were excluded regardless of inclusion of individuals with autism.
3. Participants demonstrated no savant behaviour in the area of music. The current review has focused on experimental studies that used music as an intervention or as a means to facilitate intervention. The studies associated with musical savants have generally focused on understanding their musical talents rather than considering music as an intervention.
4. Included studies demonstrated experimental control by using a music intervention to address an identified behaviour (Kennedy, 2005). Case studies and AB designs that did not demonstrate experimental control were excluded.

Articles that met the selection criteria were also identified through the National Standards Project (National Autism Center, 2009), and the three review articles, Accordini et al. (2007), Gold et al. (2006), and Whipple (2004). A further analysis excluded studies using treatments classified by the National Research Council (2001) as lacking theoretical support to substantiate or dispute the technique i.e. Auditory Integration Therapy and Facilitated Communication.

Results

Of the 128 studies located, 20 met the inclusion criteria. A list of excluded studies is available from the authors on request. The included studies were then categorized according to the focus of intervention, based on the skills and behaviours addressed (see Table 3.1). The focus areas were communication, socialization, and behaviour.

Table 3.1.

Music studies

Author	Study		Participants		Focus of Intervention
	Year	Design	<i>n</i>	Age	
Brownell	2002	ABAC/ACAB	4	6-9y	Behaviour
Buday	1995	Within subject design	10	4 – 9y	Communication
Camahan, Basham & Musti-Rao	2009	ABCAC reversal	6	6-11y	Behaviour
Camahan, Musti-Rao & Bailey	2009	ABCAC reversal	6	6-11y	Behaviour
Corbett, Shickman, & Ferrer	2008	Double blind, placebo-controlled, crossover	11	3-7y	Communication
Devlin	2008	Changing criterion design	1	6.1y'	Behaviour
Edgerton	1994	Within subjects, BAB design	11	6 – 9y	Communication
Gunter & Fox	1993	Multiple baseline design combined with a withdrawal of treatment	1	14y	Behaviour
Katagini	2009	Counterbalance treatment design	12	9-15y	Socialization
Kern & Aldridge	2006	Multiple baseline design across participants.	4	3-5y	Socialization
Kern, Wolery & Aldridge	2007	1. A-B-C-A-C	2	3y	Socialization
		2. A-B-A-B			

Table 3.1. (*continued*)

Author	Study		Participants		Focus of Intervention
	Year	Design	<i>n</i>	Age	
Kim, Wigram & Gold	2008	Random control, single subject comparison in two different conditions.	10	3-5y	Socialization
Kim, Wigram & Gold	2009	Random control, single subject comparison in two different conditions.	10	3-5y	Socialization
Lanovaz, Fletcher, & Rapp	2009	Three-component multiple-schedule reversal design	3	5-7y	Behaviour
Orr et al.	1998	ABAB	1	11y	Behaviour
Pasiali	2004	ABAB reversal	3	7-9y	Behaviour
Rapp	2007	Reverse design	1	9y	Behaviour
Simpson & Keen	2010	Multi-baseline design across participants	3	3-4y	Communication
Stephens	2008	Multiprobe design across behaviour tiers (3 participants)	4	5-9y	Socialization
Wimpory, Chadwick & Nash	1995	ABAB reversal (1 participant) ABC design	1	3.3y	Socialization

⌈

Music Used as an Intervention for Communication

In the area of communication, two studies used music in conjunction with alternative and augmentative communication systems to facilitate communication with young children, during individual sessions (Buday, 1995; Simpson & Keen, 2010). Buday (1995) compared music to rhythm conditions to determine if one condition was more effective in facilitating memory for signed words. In the music condition the text was sung, while in the rhythm condition the words were spoken rhythmically and at the same speed as the song. The number of signs and spoken words correctly imitated was significantly higher, and participants were observed to be more attentive during the music condition. However, the study did not report on generalization of the signs and words to other contexts and maintenance of the symbols and signs over time. Simpson and Keen (2010) used a song embedded into a Powerpoint presentation to teach 3 young children displaying low level verbal comprehension skills to receptively label visual graphic symbols. A multiple-baseline design was used across participants that measured the children's correct number of responses. The music condition facilitated the receptive skills for each of the participants and performance was maintained when assessed three weeks following the cessation of intervention. Results showed little generalization of these skills to other contexts. In both studies the music consisted of generic songs that were pre-recorded and used during intervention.

Corbett, Shickman, and Ferrer (2008) compared the use of the Tomatis method of music intervention with a placebo condition to determine what effect, if any the individual music intervention had on improving receptive and expressive communication in a group of eleven children, aged 3-7 years. The Tomatis method can be described as a sound therapy that provides auditory stimulation by attenuating low frequency and amplifying higher frequency sounds in order to focus listening on language frequencies (Corbett,

Shickman, & Ferrer, 2008). There was no significant difference in language measures across the participants attributed to the treatment condition.

Using improvisational music therapy, Edgerton (1994) reported that music therapy increased the musical and non musical communicative behaviours, for a group of 11 children aged 6-9 years, during individual sessions. The communicative behaviours were measured using The Checklist of Communicative Responses/Acts Score Sheet (CRASS) designed specifically for the study to measure subject's musical and non musical communicative responses and acts. The CRASS predominantly assessed musical categories (91 of the 107 items) and communicative responses (69 of the 107 items). The reversal condition, consisting of one session using composed music, reported a substantial decrease in communicative acts and responses for all participants. Generalization of communicative behaviours assessed by parents, teachers and speech therapists using The Behaviour Change Survey reported minimal changes in behaviours in other contexts. Maintenance following the conclusion of the 10 week period was not assessed. A limitation of the B-A-B design is the absence of the initial baseline pattern of behaviour (Kennedy, 2005). Although experimental control was demonstrated by a decline in all behaviours during the reverse condition and an increase during intervention, the findings would demonstrate more confidence if the reverse condition consisted of more than one session.

Music Used as an Intervention for Socialization

A number of the studies reviewed used music as an intervention to develop socialization skills in children with autism. With the exception of Katagiri (2009), these studies included engagement as a focus of the research. Katagiri conducted individual sessions to teach decoding and encoding of four emotions – happiness, sadness, anger and fear. A counterbalance treatment-order of four different instructional conditions: no

contact control; contact control where verbal instructions accompanied visuals; background music utilizing pre-recorded improvised music designed to reflect the emotion and verbal instructions; and song texts using specifically composed songs about the emotion; was used. Participants demonstrated an increase in decoding skills in all conditions, with the background music condition being most effective. Improvements in decoding skills were higher than changes in encoding abilities. The nature of the counterbalanced situation resulted in participants improving decoding skills during the no contact control by a process of elimination. The researchers did not assess whether the skills achieved during intervention generalized to life situations and whether the individuals maintained the skills.

Two studies focusing on social engagement, compared music contexts to play contexts (Kern & Aldridge, 2006; Kim, Wigram, & Gold, 2008). Kern and Aldridge (2006) embedded music into an outdoor play context and compared the baseline conditions of no directed music activities to teacher and peer mediated music intervention. Individually composed songs, sung by teachers and peers resulted in an increase in positive peer interactions that was more apparent in the teacher initiated sessions. The authors acknowledged the lack of generalization and maintenance strategies in the study. This study provides some support for individualized interventions based on music therapy embedded into outdoor play routines and the involvement of peers to participate and model target behaviour. Classroom teachers and peers demonstrated the ability to learn and implement the program, with the teachers' accuracy of implementing the intervention being reported as high.

In the program research conducted by Kim et al. (2008), improvisational music therapy was compared to play sessions to determine the more effective condition for developing joint attention and positive emotional communication during individual

sessions. The music condition was significantly more effective than the play sessions in increasing responses to joint attention and initiating low level joint attention acts i.e. eye contact while little change was observed in initiating high level joint attention behaviours, like pointing and showing. Children engaged in longer periods of turn-taking during music situation. Comparing the same conditions, Kim, Wigram, and Gold (2009) rated the frequency of 'joy', 'emotional synchronicity', and 'initiation of engagement' more higher and longer durations of 'joy' and 'emotional synchronicity' during the music compared to play sessions. The frequency and duration of these behaviours was higher during the undirected session versus the directed session of music. Compliance response was more frequent during the music session, while no response was more frequent during the play session. These studies provide some evidence that music may facilitate a number of joint attention and affective behaviours; however generalization to other settings was not investigated.

The use of music has also been incorporated into a playful context. Wimpory, Chadwick, and Nash (1995) used musical interaction therapy with a 3-year-old and her mother. The intervention led to improvements in the area of social engagement evidenced by increased use of eye contact and initiations of interactive involvement. These skills were maintained when assessed at follow-up 20 months later.

Stephens (2008) conducted a study using a music context during individual sessions to create a social routine for the purpose of engaging the participants in reciprocal imitation behaviours. The sessions used music to establish a repetitive imitating routine prior to children being provided the opportunity to imitate adults modelled action and word pairs. The music was used to define the play routines and to distinguish between the researcher's behaviour. The focus was on the participants' willingness to engage spontaneously with the adult. Spontaneous action and word imitation was demonstrated by

3 of the 4 participants during the social interaction, but was only maintained during the probe situation for 2 of the 4 participants.

Kern, Wolery, and Aldridge (2007) embedded music into morning routines to increase independent functioning of two children aged 3 years. Individualised lyrics were composed to a common melody for each participant. Teaching staff were trained and provided with the song and song transcripts. Kern and associates reported the use of the song facilitated independent functioning and peer initiated interaction. The teachers reported the interventions were effective but they were challenged by structural elements of the song. Maintenance and generalization data were not reported.

Music Used as an Intervention for Behaviour

The predominant number of studies in this review focused on the use of music intervention to regulate behaviour. Two studies implemented music interventions in conjunction with social stories (Brownell, 2002; Pasiali, 2004). Social stories are short stories designed to aid in the social understandings of individuals with autism (Gray, 2000). In both studies, the music therapist used the social story format to create prescriptive songs addressing the individual's target behaviour. Brownell (2002) compared reading and singing versions of the social story using a counterbalanced treatment order and reported a significant reduction of the target challenging behaviour for all four participants in both conditions. Although the targeted behaviour was recorded less frequently in the singing condition, it only reached statistical significance for one participant. Pasiali (2004) introduced the prescriptive song protocol as an individual intervention conducted in the home environment. Two of the three children demonstrated a significant reduction in behaviour between the baseline and intervention. Although the third child did not display a significant reduction in behaviour, the child did demonstrate an increase in the more appropriate alternate behaviour described in the song. Pasiali

observed the use of the naturalistic environment contributed to a number of unpredictable factors that were difficult to control and may have influenced performance including a possible bias by parents in scoring. The decrease in behaviour was maintained at follow-up for all participants however there was a lack of generalization which Pasiali attributed partially due to the specificity of the behaviours to the home environment.

Carnahan, Basham, and Musti-Rao (2009) and Carnahan, Musti-Rao, and Bailey (2009), explored the use of music within a group setting to determine the effect music had on levels of active engagement during an interactive book session. This was assessed by measuring attending behaviour. Carnahan and associates compared three conditions: read only; interactive story using two and three dimensional materials; and music added with text sung. A system of observations occurred where each child was observed during a 6 second interval. Results indicate levels of engagement increased for all children when interactive books were used with music. The intervention was implemented by the class teacher who was positive about the intervention and the ease of implementing it within the daily classroom schedule.

The remaining studies used music as auditory stimuli to regulate behaviour. Orr, Smith Myles, and Carlson (1998) reported that the use of specifically metered music reduced aberrant behaviour in an 11 year-old girl during situations she found moderately stressful. Gunter and Fox (1993) compared the use of music which was either non-contingent or contingent on task performance, for a 14 year-old boy during vocational training. For this student, the use of non-contingent music was more effective in reducing aberrant behaviour. Similar effects were reported by Rapp (2007). Rapp compared the contingent use of music played on a CD with music and toys; no music and toys; and no music, no toys. Levels of vocal stereotypy displayed by the participant, a 9 year-old boy with autism, were lowest in the contingent music condition, suggesting that auditory

stimuli may be functionally matched to the product of vocal stereotypy. In another study assessing impacts of auditory stimuli on vocal stereotypy Lanovaz, Fletcher, and Rapp (2009) compared four conditions, two that matched the sensory product of stereotypy (music and musical toys), and two that provide no matched sensory product (toys that provided no auditory feedback and no toy situations). Their results indicated that for 2 of the three participants, vocal stereotypy was not specific to the matched sensory product.

Not all individuals with autism find listening to music a positive experience. Devlin, Healy, Leader and Reed (2008) observed an increase in challenging behaviour displayed by a six year-old when he was exposed to certain types of music. In their study they were able to increase the boy's tolerance for the music by using it as a differential negative reinforcement of other behaviour.

Discussion

The current study identified 20 experimental studies for review to evaluate the effectiveness of music as an intervention with individuals with autism. The included studies used music interventions to target communication, socialization and behavioural skills. This is consistent with Kaplan and Steele's (2005) findings that identified 80% of primary music therapy goals were recorded in the area of language/communication and behaviour/psychosocial. In the review, a number of study characteristics emerged that may potentially impact on the effectiveness of music interventions. These include the music techniques used, the context of the interventions, training, participants, generalization and maintenance.

Music Technique

Improvisational music therapy and the use of composed songs were the predominant forms of music interventions reported in the reviewed studies. In the improvisational music therapy interventions the music context evolved during the sessions,

while in the composed song intervention the music and or lyrics were composed prior to the intervention and implemented using a recording or a sung presentation. Both techniques demonstrated some support for the use of music to facilitate target skills in the areas of communication and socialization, while two studies found composed songs to be effective in targeting particular behaviours. In a number of studies, composed songs were used in conjunction with other interventions which may have contributed to the effectiveness of this type of music intervention and highlights the need for improved research designs that isolate different components of the intervention to determine their relative contributions.

One study found that improvisational music therapy was more effective than set songs in facilitating change in targeted skills (Edgerton, 1994). However in this study, the individuals were exposed to proportionally more improvisational sessions than composed song sessions, making it unclear how the type rather than the length of intervention influenced the outcome. The improvisational technique allows the therapist to be responsive to the child and to facilitate active and receptive musical elements, while the structured set songs rely on receptive music techniques and allow for little flexibility in the mode of presentation. From the results of the studies reviewed here, it is unclear whether these elements can impact on the effectiveness of the intervention. Two music techniques identified in the review, auditory stimuli and Tomatis method, demonstrated no link between the music intervention and changes in the individual's learning outcomes.

Context for Intervention

Although a number of studies were embedded into the natural classroom environment or home situation the majority of the studies were conducted in experimental environments. The nature of a number of the interventions, particularly when music was used in conjunction with other strategies, displayed the potential for these strategies to be

embedded within a naturalistic environment. However, Pasiali (2004) observed implementing the intervention in the naturalistic environment generated a number of external variables that were difficult to control and may have impacted on the experimental research. Although music interventions may demonstrate efficacy within the experimental environment to support inclusive and naturalistic education it will be important to demonstrate effectiveness in more naturalistic settings.

Training

There is little research on the core skills training required for interventionists to implement music interventions with children with autism. Improvisational music therapy, a technique used in a number of the reviewed studies, is an insight oriented therapy that was implemented by certified music therapists; while the composed song interventions were implemented by music therapists, class teachers, family members and peers. Music stimuli used in the composed song interventions ranged from songs specifically composed by the music therapist (Brownell, 2002; Kern and Aldridge, 2006; Kern et al., 2007; Pasiali, 2004), original lyrics composed by a music therapist using familiar melodies (Pasiali, 2004) and the use of conventional songs (Buday, 1995; Carnahan, Basham et al., 2009; Carnahan, Musti-Rao et al., 2009; Simpson & Keen, 2010). One class teacher viewed using the conventional song as easy to implement in the group situation (Carnahan, Basham et al., 2009; Carnahan, Musti-Rao et al., 2009), while other teachers and parents experienced difficulties with the complexity of the composed songs (Kern & Aldridge, 2006; Pasiali, 2004). Embedding a traditional song into a PowerPoint presentation (Simpson & Keen, 2010) eliminated the need to provide musical training to the teacher and may be a useful area to pursue in future research.

Participants

One selection criteria for included studies in this review was children aged 0-18 years. The use of music interventions with individuals with autism predominantly focused on young children (3-11 yrs), with only 2 of the 106 participants in the adolescent age range (12-18 yrs). There is little published research involving participants aged 11-18 years making it difficult to determine whether music interventions may be efficacious for this age group.

Generalization and Maintenance

Questions of generalization and maintenance of target behaviours acquired through music interventions remain, as few of the studies included these measures in their design. When studies did include generalization measures, there was little generalization of skills to other contexts (Edgerton, 1994; Pasiali, 2004; Simpson & Keen, 2010), raising questions about the social validity of these interventions in the lives of children with autism. Maintenance of the skills following the cessation of intervention was only reported in two studies (Pasiali, 2004; Simpson & Keen, 2010). As individuals with autism experience particular difficulty in generalizing skills to contexts other than the training context and comprehension is often only in highly familiar contexts (Lovaas, Koegel, Simmons, & Long, 1973), this creates questions as to the individual's level of comprehension during intervention or whether they are responding to the contexts and cues provided during the intervention.

Future Directions

Over the last 20 years there has been an increase in the number of experimental studies investigating the use of music as an intervention with children with autism. This has been prompted by a lack of evidence in this area and the demand for investigating and identifying effective interventions to be used with children with autism. In a review of

educational and behavioural treatments that target the core characteristics of autism the use of music has been identified as an emerging practice, however additional studies are required before treatment effectiveness can be determined (National Autism Centre, 2009).

The studies reviewed provide some initial although limited evidence about the efficacy of music interventions with children with autism. These studies were generally conducted with small numbers using a range of techniques and applications. A number of them incorporated the use of music as one component of a multi-component intervention. There is a need for comparative studies to identify the effectiveness of the music component of these interventions.

It appears that some individuals with autism may respond to elements of music and more research is required into the efficacy of specific applications of music stimuli. Given the support for music to facilitate engagement it would be informative to observe if this intervention context then facilitates learning. There is preliminary evidence that children with autism may benefit from music interventions within naturalistic settings and further investigation into these types of interventions and the training required to implement them is required. Although music intervention has been used to facilitate social, behaviour and communication skills, further research is required to establish the contribution of these interventions to the maintenance and generalization of these skills.

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Music interventions for children with autism 2010-2012

The narrative review conducted by Simpson and Keen (2011) covered articles published for the period 1990 - April 2010. Since then, a number of articles have been published that reported on the use of music as an intervention for children with autism. As a result, a review was conducted for the period May 2010 – December 2012, using the same procedure, inclusion criteria and exclusion parameters outlined by Simpson and Keen. This updates the information presented in the published paper and provides a current review of the literature on music interventions for children with autism.

Results

Of the 35 studies identified seven studies met the inclusion criteria. The included studies are described in Table 3.2 identifying study design, number and age of participants, and the focus of the intervention (see Appendix C for excluded studies). Since the Simpson and Keen (2011) review, three large group studies have been conducted targeting communication outcomes (Gattino, Riesgo, Longo, Leite, & Faccini, 2011; Lim, 2010; Lim & Draper, 2011). Two studies compared the use of music, spoken and no treatment conditions on expressive communication skills with young children and found both the music and spoken conditions were effective in increasing speech production (Lim, 2010) and forms of expressive communication (Lim & Draper, 2011). Lim and Draper (2011) reported a correlation between intervention conditions and communication forms, with increased verbal imitation skills associated with the music condition while increased expressive labelling skills were associated with the speech condition. In contrast, Gattino et al. (2011) found weekly relational music therapy sessions over a six month period had no significant difference on verbal, nonverbal and social communication scores in children compared to children receiving no music therapy. Children who were assessed as

functioning moderately to severely below their developmental language age however produced greater changes in the music training compared to the speech training.

Table 3.2

Music studies 2010-2012

Author	Study		Participants		Focus of Intervention
	Year	Design	<i>n</i>	Age	
Finnigan & Starr	2010	Single subject alternating treatment design	1	3y8m	Socialization
Gattino, Riesgo, Longo, Leite, Faccini	2011	Randomised controlled trial	24	7-12y	Communication
Lanovaz & Sladeczek	2011	Reversal design	3	6-9y	Behaviour
Lanovaz, Sladeczek & Rapp	2011	Reversal design	2	5-6y	Behaviour
Lim	2010	Randomised controlled trial	50	3-5y	Communication
Lim & Draper	2011	Alternating treatment design	22	3-5y	Communication
Saylor, Sidener, Reeve, Fetherston, & Progar	2011	Reversal design	2	5-7y	Behaviour

There has been only one recent study focusing on social behaviours. Finnigan and Starr (2010) reported increased social engagement and responsive behaviours for a young child with autism during music sessions compared to non-music sessions, when a series of prompting procedures were utilised. The social responsive behaviours were not maintained during follow-up with the removal of music, while the socially avoidant behaviours remained unchanged (Finnigan & Starr, 2010).

There has been a recent interest in the use of music to reduce vocal stereotypy in children with autism (Lanovaz & Sladeczek, 2011; Lanovaz, Sladeczek, & Rapp, 2011; Saylor, Sidener, Reeve, Fetherston, & Progar, 2012). This focus contributes nearly half the studies identified in Table 3.2. The findings from these studies suggest the use of noncontingent music may be effective for reducing the frequency of vocal stereotypy in some participants. These seven studies are discussed in light of the additional contribution they have made to the published review.

Discussion

The studies in the supplementary review contributed some additional information to the published narrative review. Since the published review, three large scale studies ($n > 20$) have been conducted investigating the use of music with children with autism providing comparative studies investigating the use of music and non-music interventions. This was a limitation in the previous research.

In the last two years there has been a move to include standardised tests in research studies to provide descriptive information about participants (Finnigan & Starr, 2010; Gattino et al., 2011; Lim, 2010). This has enabled investigation of music interventions in regard to child characteristics with some evidence suggesting music interventions may be more effective for children with language skills that are assessed as moderately to severely delayed (Gattino et al., 2011; Lim, 2010). This is a promising addition to the body of

research to assist in identifying children who may benefit from the use of music interventions. Conversely defining the characteristics of music interventions that are essential for effective practices still requires further examination.

The recent studies provided additional support for the use of music to be used as a component of a multi-component intervention. There continues to be a lack of research investigating the music techniques employed and the elements of music used in the interventions. Until this is undertaken, identifying the effectiveness of the use of music in interventions with autism will continue to be limited. Music therapy approaches such as improvisational music therapy and music relational therapy are techniques specifically implemented by a trained music therapist and require the therapist to be musically responsive to the child's lead. As this varies between sessions and is individualised it creates difficulty in replicating this technique across participants and determining what features of the intervention are contributing to the effectiveness of the therapy. There continues to be limited investigation into the maintenance and generalisation of skills following the use of music interventions with children with autism.

The supplementary review has identified some positive contributions to research in this field including the use of comparative studies and the addition of child characteristics. Further research is required to substantiate the effectiveness of music techniques and music stimuli. Although these studies provide some support for the use of music as an intervention with children with autism to target communication, social and behaviour skills, there continues to be a dearth of research investigating the use of music to facilitate receptive language skills.

Summary: Previous Research Findings

The review of the literature presented in the previous chapter (Chapter 2) highlighted the limited research conducted in the area of receptive communication

development in children with autism. Research indicates receptive communication skills may be more impaired compared to expressive communication skills in children with autism. Despite this, there has been little research investigating interventions to target these skills. The current research on communicative development in children with autism and severe language delay has focused primarily on expressive communication skills in particular identifying effective interventions addressing requesting skills. The review reported in this chapter identified wide variability in children's responsiveness to the different interventions and furthermore some children continue to show little development in communication skills following the intervention. This highlights that further investigation is required to extend the existing knowledge of communication development in children with autism and in particular the under researched area of receptive communication. To investigate factors which may impact on the development of receptive language skills a review of the literature focusing on the prelinguistic language environment was conducted. This review identified that infant-directed speech is used by caregivers to attract the infant's attention, communicate meaning and is associated with language acquisition. There has been little research investigating whether this applies to children with autism.

The limited research in this area has identified an associative relationship between attending to infant-directed speech recordings and language development. Furthermore, there is some indication that the associative relationship between infant-directed speech prosody and language acquisition may be more beneficial for children functioning at a developmental language age under 5 years, suggesting this auditory input may be beneficial for children with autism and severe language delay.

The review of the literature poses the question: if the prosodic features of infant-directed speech are associated with language acquisition can these features be emphasised

to make them more salient for children with autism? Chapter 2 highlighted that infant-directed song demonstrates the prosodic features of infant-directed speech while providing additional musical elements. There has been little research investigating the association between the use of infant-directed song and language acquisition in typically developing children or children with autism. The review of the literature in Chapter 2 comparing the facilitative effect of speech and song on language acquisition, identified that the addition of musical elements may be more effective in facilitating learning. This suggests the use of infant-directed song may provide a more effective auditory input for children with autism and it is worth investigating if this will assist these children in receptive language learning.

The literature reviewed in this chapter suggests children with autism may find music an engaging context. Promoting and supporting engagement for children with autism is viewed as a critical feature of effective learning interventions. The addition of musical elements may increase the child's engagement with this form of auditory input. There has been no research to date investigating whether the use of music in a language learning task increases engagement in the task and furthermore if this then promotes learning or merely provides an engaging experience.

Rationale and Aims of the Current Research

The purpose of this research is to determine if the addition of musical elements influences receptive language development in children with autism and severe language delay. It is acknowledged language learning is a complex process that is dependent on a number of interacting features. The review of the literature identified the auditory input evident in the prelinguistic language environment and the child's ability to engage with these materials as potential factors which may impact on language learning in children with autism. This is an exploratory study due to the limited research with inconclusive

findings in this area to base a firm hypothesis. As a result a research question has been formulated guided by the identification of the research purpose:

What effect does the use of musical elements compared to non-musical elements in a receptive labelling task have on learning outcomes and engagement levels of children with autism and severe language delay?

This question identifies two fields of research. The research question was broken down into two specific areas of enquiry visually displayed in Figure 3.1 and identified in the subquestions.

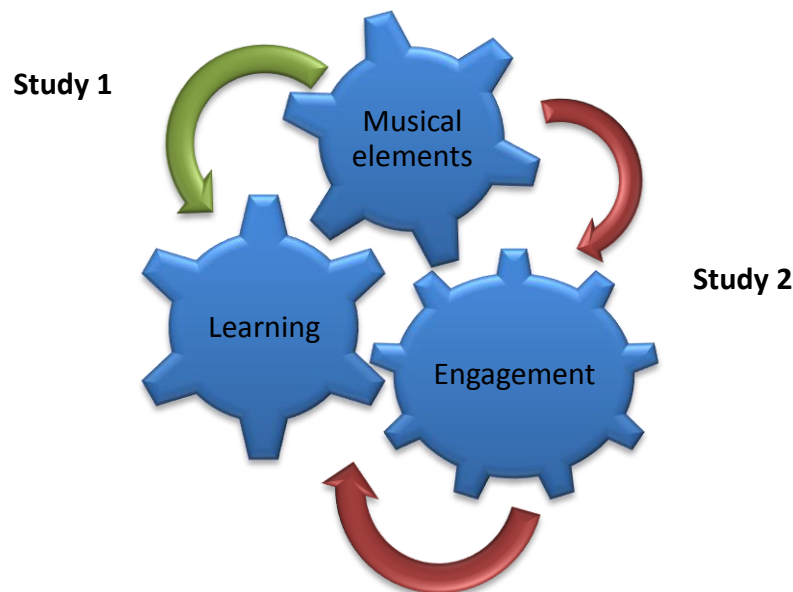


Figure 3.1. Representation of the research question.

Sub-question 1. What effect does the use of musical compared to non-musical elements in a receptive labelling task have on the learning outcomes of children with autism and severe language delay? Investigation of this line of enquiry will inform whether increasing the elements of infant-directed stimuli compared to the absence of these elements increase in language labelling skills. This will provide new knowledge of the effects of infant-directed stimuli, language learning and children with autism. Furthermore,

this sub-question will inform whether the additional use of music associated with lyrics assists in the maintenance and generalisation of language learning in children with autism.

Sub-question 2. How does the use of musical elements compared to non-musical elements relate to engagement and learning outcomes for children with autism and severe language delay in a receptive labelling task? This will build on the limited research investigating the use of musical elements to engage children with autism. In doing so, this will be the first study to investigate the influence of musical elements on the relationship between engagement and language learning in children with autism.

The identification of the two subquestions will address the two lines of enquiry in the research question which are evident in Figure 3.1. The specific theoretical framework underpinning this research and the detailed methodological considerations applicable to these two studies are presented in Chapters 4 to 6.

Chapter 4: Theoretical Framework

The major purpose of this research was to investigate the effect of the use of musical elements compared to non-musical elements in a receptive labelling task on learning outcomes and engagement levels of children with autism who have severe language delay. This chapter provides a discussion of the theoretical framework identifying the ontological, epistemological and methodological rationale underpinning this research. This is followed by a rationale for the selection of the experimental research design utilising a cross-over design.

Theoretical Framework

The theoretical framework for this research is positioned within a positivist paradigm. This position was taken with an awareness of the related assumptions that framed and guided the enquiry process. These assumptions address three fundamental interconnected questions: the ontological question defining the researcher's view on the nature of reality; the epistemological question identifying the relationship between the researcher and the knowledge; and the methodological question addressing the best way to gain information (Guba & Lincoln, 1994).

This research is positioned in the belief that reality exists independently of the individual's perceptions of it and knowledge of reality can be discovered through observation and experience (Sarantakos, 2005). This provides the researcher with knowledge that explains the laws of human behaviour (Sarantakos, 2005), achieved through changing and understanding the natural correlations that occur in nature (Punch, 2009). Underpinning this research is the belief that there is an objective reality that can be discovered and measured using empirical or sensory evidence (Preissle & Grant, 2004). To obtain knowledge through observation and experience involves the identification, and control or manipulation of factors that may influence the outcomes (Guba & Lincoln,

1994). In this study, the researcher assumes the research question can be verified or refuted by manipulating musical elements to determine the relationship between music and constructs of learning and behaviour. This relates to the researcher's epistemological position that assumes the researcher is separate from the independent entities being investigated. Underlying this position is the belief the researcher can obtain knowledge objectively without influencing or being influenced by the knowledge being obtained (Guba & Lincoln, 1994). In doing so, the results are viewed as "objective in that they are open to anyone's observation and do not depend on the subjective belief of the individual scientist" (Zuriff, 1985, p. 9).

To investigate the identified research question and subquestions within a research paradigm of positivism required systematic, evidence-based, empirical research. This framework dictates an experimental methodology which provides a strict research design (Zuriff, 1985) that allows the researcher to determine what is meaningful (Sarantakos, 2005). This framework is consistent with empirical educational research.

Empirical educational research is grounded in observation. It takes phenomena (things that exist or happen), or at least our perceptions of phenomena, as its starting point, and attempts to represent them as data which can then be analysed. In this way, empirical research aims to represent, describe and understand particular views of the educational world (Coe, 2012, p. 10).

Furthermore, this is supported by recent government initiatives including the Australian Education Act (2013) and the Education Queensland: Pedagogical Framework (Department of Education Training and Employment, 2013) promoting best teaching practice using evidence-based teaching methods.

There has been a strong move to identify evidence-based practices for individuals with autism (Horner et al., 2005; Reichow, Volkmar, & Cicchetti, 2008; Schlosser & Sigafoos, 2009). In the past decade a number of countries have commissioned task forces to report on the effectiveness of interventions used with individuals with autism. Included within these reviews are the findings from the National Standards Project (National Autism Center, 2009) investigating practices conducted with individuals aged from birth to 22 years; and the Australian reviews evaluating the effective models of practice with children with autism aged between birth and 7 years (Roberts & Prior, 2006; Prior et al., 2011). These reviews used a Scientific Merit Rating Scale (SMRS) to evaluate the effectiveness of the practices by establishing the experimental rigor demonstrated within the research. The SMRS evaluated the research design, measurement of the dependent variable, measurement of the independent variable or procedural fidelity, participant ascertainment and generalisation (National Autism Center, 2009). The last twenty years have also seen the rise of collaborations established to conduct systematic reviews to evaluate the scientific evidence of research in this field. These include the Cochrane Collaboration (<http://www.cochrance.org>) focusing specifically on health care treatments and practices, the Campbell Collaboration (<http://www.campbellcollaboration.org>) focusing on social intervention, and What Works Clearinghouse (<http://ies.ed.gov/ncee/wwc>) providing a summary of educational practices or interventions that have evidence of efficacy. These reviews base their findings on high quality empirical research in order to establish the efficacy of intervention and treatment practices. The use of music with children with autism has been classified as an emerging evidenced-based practice useful in teaching individual skills or goals; however, it is recommended further efficacy studies be conducted in this area (Gold, Wigram, & Elephant, 2006; National Autism Center, 2009; Prior et al., 2011).

This study proposed the use of an experimental design to investigate, measure, and analyse the relationship between variables within an objective framework. The focus of the design is on the relationship between music and outcomes within the constructs of learning and behaviour. In order to obtain this knowledge the constructs need to be described in terms of measureable behaviours that could be observed and compared under musical and non-musical conditions, independent of the researcher's personal opinions and prejudices. In this research the learning construct is measured by receptive language outcomes, while the behaviour construct is measured by levels of engagement and challenging behaviour. The identification of measurable outcomes allows for rigorous research to be conducted that reduces variables and limits conjecture (Clark-Carter, 2010). Furthermore, this approach is supported by the methodological procedure for high quality research and in accordance with the standards applied to determining evidence-based practice for children with autism (National Autism Center, 2009; Prior et al., 2011; Roberts & Prior, 2006)

An overview of the theoretical framework and direction of this study is provided in Figure 4.1. This identifies the study within a positivist paradigm by summarising the researcher's underlying assumptions framed around the three guiding questions: addressing the nature of reality with the ontological approach of realism, the objective relationship between the researcher and the knowledge (epistemology), and the use of an experimental methodology as the best way to gain the knowledge to address the research question (methodology). Having determined the use of an experimental methodology, identification of a research design consistent with this methodology was required. The selection of the experimental research design required careful consideration to ensure the data collected would support the validity of the inferences drawn from the research to answer the question (Hedges, 2012). This approach required the identification of a

research design prior to the commencement of the research. The rationale for the selection of a cross-over design is discussed in the next section.

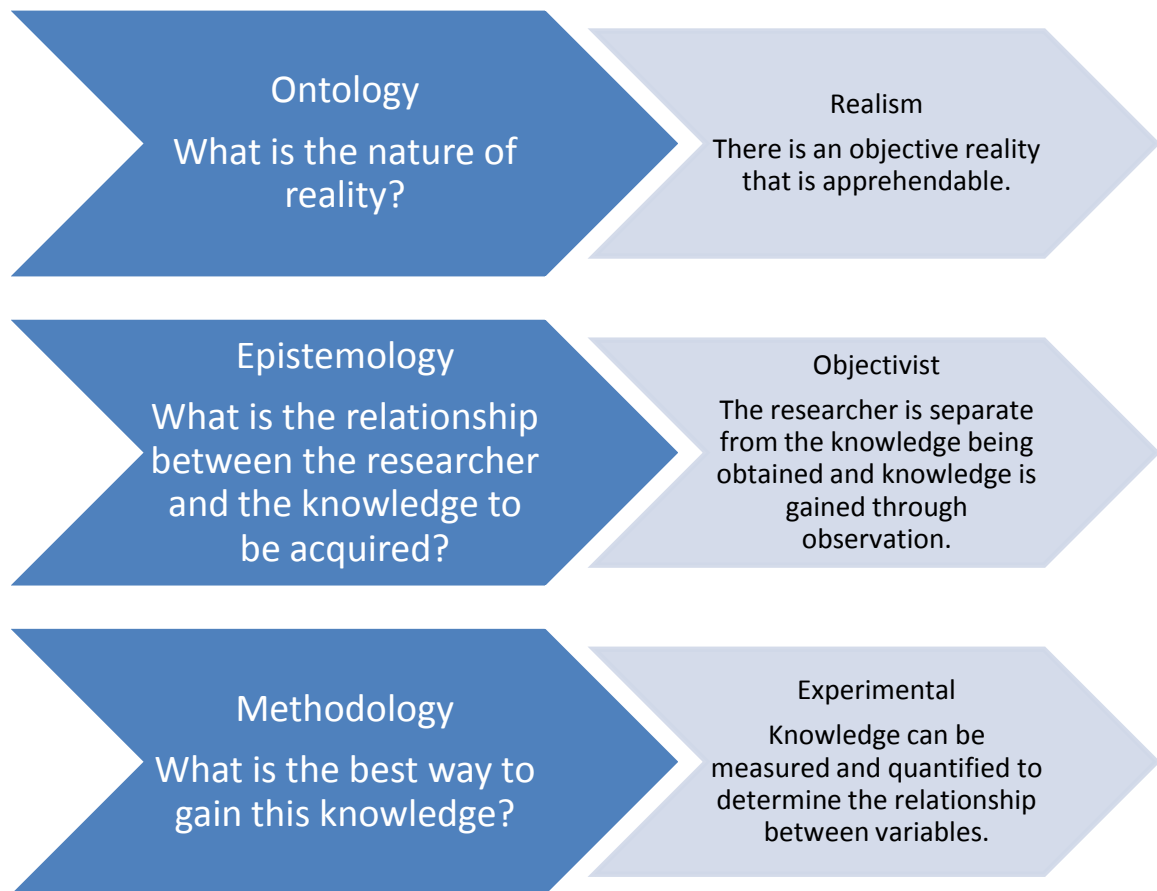


Figure 4.1. Overview of the theoretical framework

Experimental Design

The most common types of experimental designs include between-group designs and within-group designs (Creswell, 2008) and both have been used to evaluate interventions for children with autism. Between-group designs allow for the comparison between two or more groups of individuals. Common designs include pretest-posttest control group design, posttest-only control group design and Solomon four-group design (Heppner, Wampold, & Kivlighan, 2008). The random assignment of participants to groups minimises threats to internal validity by equating the groups and reducing major differences between participants prior to the commencement of treatment/intervention, and ensures each participant has an equal chance of being in each group (Creswell, 2008). In contrast, within-group designs provide the treatment/intervention to all participants allowing for the effects of the different treatments/interventions on participants to be compared. This reduces the threats to internal validity which can result from characteristics of one group predisposing the participants to the intervention being tested (Clark-Carter, 2010). Common within-group designs include cross-over, the Latin-square and single-subject designs (Creswell, 2008; Heppner et al., 2008).

The use of randomised controlled trials (RCTs) is a highly desirable between-group design and has been used recently to conduct research into the use music interventions with children with autism (Gattino et al., 2011; Lim, 2010). There are, however, a number of limitations in conducting RCTs. To mediate for moderating variables including child characteristics requires large numbers of participants. Additionally, in view of the research supporting the implementation of early intervention practices, withholding an intervention for participants in the control group creates ethical issues (Lord et al., 2005). Gattino et al. (2011) compensated for this issue by offering music therapy sessions to participants in the control group at the conclusion of the study. Withholding an intervention was less of an

issue in Lim's research as the study was conducted over a 3-day period. The use of RCT to compare minimal differences in an intervention, in the case of this research study, may not be sufficiently informative to warrant the large scale support (Lord et al., 2005).

Alternatively, single-subject designs have been effectively employed to investigate interventions with individuals with autism.

Single-subject design was the predominant research method used in the music intervention studies reviewed in Chapter 3. While this design is appropriate for studies with small participant numbers, there is an inherent challenge in generalising the research findings from these studies. Synthesising knowledge from individual studies is challenging due to the differences in design, participants, procedures and problem identification (Kavale, 2001). Following a review of methodological issues related to conducting research investigating interventions with individuals with autism, it was recommended innovative research designs be explored (Lord et al., 2005).

In response to this recommendation, the researcher investigated research designs that may be applicable for this research. The criteria for this research design was to provide data that would allow a comparison of music and non-music interventions while controlling for individual variation, to feasibly conduct the research with the resources available; and to provide data that could be generalised to the broader population of children with autism. As a result the cross-over design was identified as a research design that met the criteria for this study and has previously been used in investigating music interventions with children with autism (Buday, 1995; Corbett, Shickman, & Ferrer, 2008; Kim, Wigram, & Gold, 2008, 2009).

The cross-over design is used in experimental studies for the purpose of comparing treatment or intervention effects (Hills & Armitage, 1979; Senn, 2007). It permits the study of participants on all treatments allowing for individual reactions to the treatments to

be observed (Senn, 2007). Participants serve as their own control reducing the influence of confounding covariates and allows for statistical power to be obtained using smaller numbers than required for between-group designs (Heppner et al., 2008). In view of this potential a cross-over design was identified as providing the strongest design method to address the research questions. A more detailed description of cross-over design is provided in the next section.

Cross-over design

In the cross-over design, participants are randomly assigned to receive a prespecified sequence of treatments or interventions (Heppner et al., 2008). The most common form of cross-over design is the AB/BA design, displayed in Figure 4.2. This design allows for comparison of two treatments in two periods (Senn, 2007). Participants that are randomly assigned to the AB design component undertake intervention A first, followed by intervention B. Participants who are randomly assigned to the BA design component undertake intervention B first, followed by intervention A.

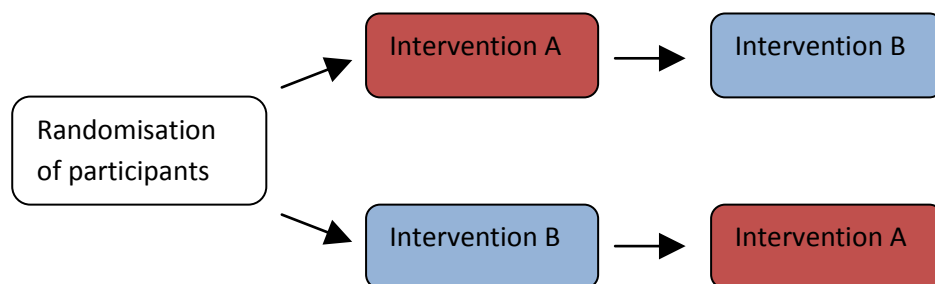


Figure 4.2. Model of AB/BA cross-over design.

This design, however, presents a number of unique threats to validity, resulting from order effects and carry-over effects (Clark-Carter, 2010). Order effects can result in practice effect or fatigue effect. Practice effect is when the participant performs better as they become more practised with the technique used, while fatigue effect is when the participant's performance decreases as the study progresses. Carry-over effect occurs when

the first condition leaves a residue of that participation which influences the following intervention (Clark-Carter, 2010). As a consequence the results may reflect not only the effect of the current intervention, but also the previous intervention (Senn, 1993). These effects can be controlled by counterbalancing the order of the intervention and delaying the period between the intervention conditions (Clark-Carter, 2010).

The use of a cross-over design allows for the investigation of individual responses to different interventions. In this study, the use of this method is viewed as providing more accurate information about the specific effects of music on individuals with autism in the constructs of learning and behaviours.

Chapter Summary

In this chapter the theoretical framework underpinning this research study and the rationale for the selection of a cross-over design, was presented. To empirically answer the research question it was essential that a carefully controlled instructional condition be used. This would enable the music variable to be manipulated to determine the relational effect of musical elements on receptive language learning and engagement in children with autism. In Chapter 5, the development and construction of the intervention that was used in the two experimental research studies addressing the two subquestions is discussed.

Chapter 5: The Research Intervention

The previous chapter provided an overview of the theoretical framework of a positivist paradigm underpinning this research study. A rationale was provided for the selection of a cross-over design as the experimental methodology to address the research question. An instructional intervention involving a receptive labelling task was selected to determine the effect of musical and non-musical elements on learning outcomes and engagement levels of children with autism and severe language delay. In this chapter an account of the development and construction of the intervention to be used in the study is presented. The rationale underpinning the selection of the materials and the instructional procedures used in this intervention are discussed. The implementation of this intervention using a cross-over design to address the research question is outlined in Chapter 6.

In accordance with the Australian Code for the Responsible Conduct of Research Use (Australian Government, National Health and Medical Research & Australian Research Council, 2007), the development and construction of the intervention involved creating teaching materials that embodied original research and extended current knowledge. In developing this intervention, decisions had to be made regarding the presentation of the treatment condition, manipulation of the treatment condition, control over extraneous variables and control for identified threats to validity. To create a positive learning experience for the participants, the intervention incorporated instructional strategies appropriate for use with children with autism. Central to the selection of these strategies was the use of available scientific evidence addressing good practice in autism and communication impairment, taking into consideration the underlying characteristics of children with autism and their unique strengths and needs.

The review of the literature on evidence-based communication interventions used with children with autism (Chapter 2) revealed a strong evidence base for instructional

techniques based on applied behaviour analysis principles. As a result, these techniques were incorporated in the construction and presentation of teaching material and in the instructional procedures used. To develop an effective intervention required careful consideration of the focus of the research.

Intervention Development

This research was designed to investigate the relationship between musical elements (the independent variable) and the dependent variables of receptive labelling responses, and engagement. This required the development of an intervention with two conditions in which the independent variable (musical elements) could be manipulated. The use of a cross-over design meant participants were exposed to both the intervention conditions, which required the development of two sets of matched materials.

Furthermore, the purpose of the research was to determine if the use of musical elements impacted on receptive labelling skills. Demonstration of receptive labelling skills required the participant to associate the spoken name of an object with a symbolic representation of that object (e.g., a picture of the object). To measure this involved the inclusion of a task requiring the participant to use auditory discrimination skills to correctly associate the label with the appropriate response. In this study the decision to associate the label with a picture was taken based on the strengths individuals with autism demonstrate toward visual stimuli (Quill, 1997) and the frequent use of picture symbols as an alternative or augmentative communication tool.

Materials

The review of the literature in Chapter 2 identified an associative relationship between attending to infant-directed speech and receptive language development in children with autism. The review highlighted that children with autism were less attentive to infant-directed speech compared to typically developing peers and it was proposed the

use of infant-directed song may emphasise features of infant-directed stimuli and provide a more engaging alternative. The similarities between infant-directed song and infant-directed speech allowed for the control of potentially salient elements of infant-directed voice while allowing for the manipulation of the musical elements of melody and rhythm.

The materials were developed using a thematic approach. The theme chosen for the materials was ‘In the Garden’ as this typifies themes used in early education settings, and can be extended to older children. Names of creatures found in the garden were chosen for the receptive labelling task as they provided variety and scope in the selection materials taking into consideration the age of the children and the potential learning outcomes. Two sets of lyrics were generated which could be sung or spoken and incorporated the creature labels. The lyric sets are displayed in Table 5.1 and identify the contextual sentence, instruction “Touch the”, and the creature labels. The verbal prompt preceding the naming of the label, is common in teaching receptive labelling tasks and was used to increase the children’s focus to the receptive label (Sulzer-Azaroff & Mayer, 1991). The labels were matched on syllabic count to reduce any confounding influence that may result from the simplicity or complexity of the words. The selection of labels was also influenced by the availability and variability of the associated pictorial representations of the labels which is discussed under the section on visual representation of the labels. The rationale for using four labels in each set is explained in the procedural section below.

Table 5.1.

Lyric Sets

Set	Contextual sentence	Instruction	Creatures
1	In my garden come and find the little creature that I say.	Touch the ...	Daddy Longlegs, Dragonfly, Stinkbug, Slug
2	Little creatures everywhere can you find the one I say?	Touch the ...	Praying Mantis, Cockatoo, Gecko, Wasp

The melody selected for the sung condition was “Ah! vous dirai-je, Maman”, by Mozart. This melody was selected because it has been used for a number of children’s songs: “Twinkle, Twinkle Little Star”; “Baa, Baa, Black Sheep”; and “The ABC Song”. In addition it has cross cultural appeal by its use in the German Christmas carol “Morgen kommt der Weihnachtsmann”; the Hungarian Christmas carol “Hull a pelyhes fehér hó”, and the Dutch song “Altijd is Kortjakje ziek”. The beginning bars of the melody were selected. The musical structure of the tune allowed for the use of simple language. Both sets of lyrics were developed so they could be sung to this melody. This reduced the impact the musical structure of an alternate melody could have on the outcome.

To investigate the influence of musical elements, the research study required the development of two intervention conditions that were identical except for these musical elements. One way researchers have attempted to minimise variability in the way instructions are given and tasks presented is to pre-record the instructions (Lim, 2010). This can eliminate issues that may arise with live presentation associated with inconsistencies across sessions. Furthermore, live presentation may encourage a social-communicative interaction between researcher and child which could introduce a confounding variable in relation to task performance and engagement in the task. In view of these considerations, the intervention for this study used pre-recorded auditory stimuli. The use of pre-recorded auditory stimuli also allowed the stimuli to be compared and analysed, eliminating a previously identified limitation regarding specific musical elements under investigation (discussed in Chapter 3).

The two sets of lyrics were sung and spoken by a professional female musician. They were recorded using Garage Band on an Apple Macintosh computer in the presence of 4-month-old infants to provide authenticity in creating the prosodic characteristics facilitated by the infant’s presence (Trainor, 1996). The selection of 4-month-olds was

based on the research indicating infant-directed stimuli directed to 4-month-olds is more appealing across age groups, including the participants in this study (McRoberts et al., 2009). The lyrics were sung unaccompanied because this was more typical of the natural language learning dyad of mother and child. Furthermore the use of voice only, controlled the musical elements for comparison which may have been confounded with the addition of an instrument. Analysis was conducted to determine the difference in the musical elements used in the sung and spoken conditions.

Analysis of sung and spoken material. A comparison of the recordings was conducted using the four musical dimensions described by Owen (2000) as temporal, pitch, structure and colour. Results are displayed in Table 5.2. The temporal dimension included the use of tempo, metre and rhythmic quality. The lyrics followed the same duration pattern during the sung recordings, but were delivered slightly faster during the spoken recordings, using a more natural pace. The duration of the sung recordings was 10 seconds, while the duration of the spoken recordings was 7 seconds. Both sung and spoken sound recordings used a moderate tempo that slowed at the end of the phrase producing a sense of conclusion. The sung recordings displayed a simple quadruple metre achieved by using the rhythmic quality of quarter notes reinforcing the metre. In contrast the spoken recordings displayed no sense of metre although a sense of rhythmic quality was evident in the speech pattern. This was not tied to a metre, but was produced by equally stressed syllables, creating the song like quality evident in infant-directed speech (Trainor, 1996).

Table 5.2.

Musical Dimensions in Sung and Spoken Sound Recordings

Dimension	Sung	Spoken
Temporal		
Tempo	Moderate	Moderate
	Duration – 10 seconds	Duration – 7 seconds
Metre	4/4 simple quadruple	Not evident
Rhythm	Rhythmic quality tied to metre	Rhythmic quality not tied to metre
Pitch		
Frequency	220 Hz – 370 Hz	220 Hz – 493.88 Hz (Set 1)
		174.61 Hz – 493.88 Hz (Set 2)
Melodic contour	Intervallic rise and fall using definite pitch	Mellifluous using indefinite pitch
Tonality	Major diatonic scale	No scale
Structural	Dictated by set lyrics	Dictated by set lyrics
Colour		
Timbre	Warm	Warm
Dynamics	Moderately soft maintained at an even level	Moderately soft maintained at an even level
Articulation	Clearly articulated by a trained voice with an Australian accent	Clearly articulated by a trained voice with an Australian accent

The sung recordings were constrained by the musical structure of the original melody, with the first and last notes using the lowest pitch and every syllable defined by a set pitch performed within a major diatonic scale. The spoken recordings displayed

indefinite pitch as there was variation within each syllable spoken and no sense of a governing frequency defined by a scale. The structural dimension for both sung and spoken recordings was dictated by the set lyrics. Owen (2000) describes the musical dimension colour, as timbre, dynamics and articulation. Both sung and spoken recordings were viewed as displaying moderately soft dynamics that were maintained at an even level, and warm timbre. This is consistent with research identifying the emotional expression of warmth observed in infant-directed speech (Trainor et al., 2000). The comparisons between the sung and spoken recordings identified differences in temporal and pitch musical dimensions.

Having identified and developed the material to be used with musical elements and without musical elements, consideration of the visual materials to be used within the intervention was required. As previously mentioned, the participants were required to associate the sung/spoken label with a corresponding visual representation.

Visual Representation. The visual representation of the creature names were line drawings created using Boardmaker V. 6 (Mayer-Johnson, 2007) and presented on a computer screen. Boardmaker is a commercial software program that combines a graphic database and a drawing program. Boardmaker contains over 4,500 Picture Communication Symbols (PCS), available in black and white or colour; with or without labels. This program was chosen because of the ease of production and the flexibility in being able to present the pictures in different formats during the intervention. Boardmaker has been identified as speciality software popularly used by individuals with autism (Shane & Albert, 2008). Furthermore, Boardmaker symbols are commonly used in the Brisbane region with children with autism, and this suggests children participating in this research may be familiar with this mode of picture representation.

A search of the Boardmaker program identified 32 potential garden creatures. The associated creature names were categorised according to the number of syllables in each word and are displayed in Table 5.3. To reduce the likelihood of the children's prior knowledge of the words, names that were viewed by the researcher as commonly used in early childhood stories and songs were eliminated. Four creature names were required for each set of lyrics and needed words containing one, two, three and four syllables. The selected words are highlighted in Table 5.3.

Table 5.3.

Creature names

One-syllable words	Two-syllable words	Three-syllable words	Four-syllable words
Ant	Aphid	Butterfly	Caterpillar
Bat	Beetle	Centipede	Daddy Longlegs
Bee	Galah	Cockatoo	Kookaburra
Bird	Gecko	Dragonfly	Lady Beetle
Bug	Magpie	Grasshopper	Praying Mantis
Fly	Lizard	Mealybug	Red Back spider
Slug	Spider	Mosquito	
Snake	Stink Bug		
Snail			
Wasp			
Worm			

Note. Creature names highlighted in red font were selected for the intervention condition.

As previously mentioned, the selection of labels was influenced by the associated visual representation. Consideration was taken to match the pictures in each set on as many variables as possible, including picture, colour and creature features such as number of legs and wings. The visual representations of the creatures are displayed in Figure 5.1. No

titles or numbers were included in the presentation as these may be a potential distracter for some children (review Brown & Bebko, 2012; Lovaas, Koegel, & Schreibman, 1979). Both sets included a context picture (PCS of a garden) which was displayed on the upper half of the screen. This was used to attract the children's attention to the screen prior to the presentation of the lyrics and PCS creatures.

Following the selection of the materials, careful consideration was given to the mode of presentation of the teaching materials to minimise threats to internal validity. The rationale for the selection of recorded music has previously been discussed. To further standardise the presentation of the tasks comprising the intervention, a computer interface was selected.

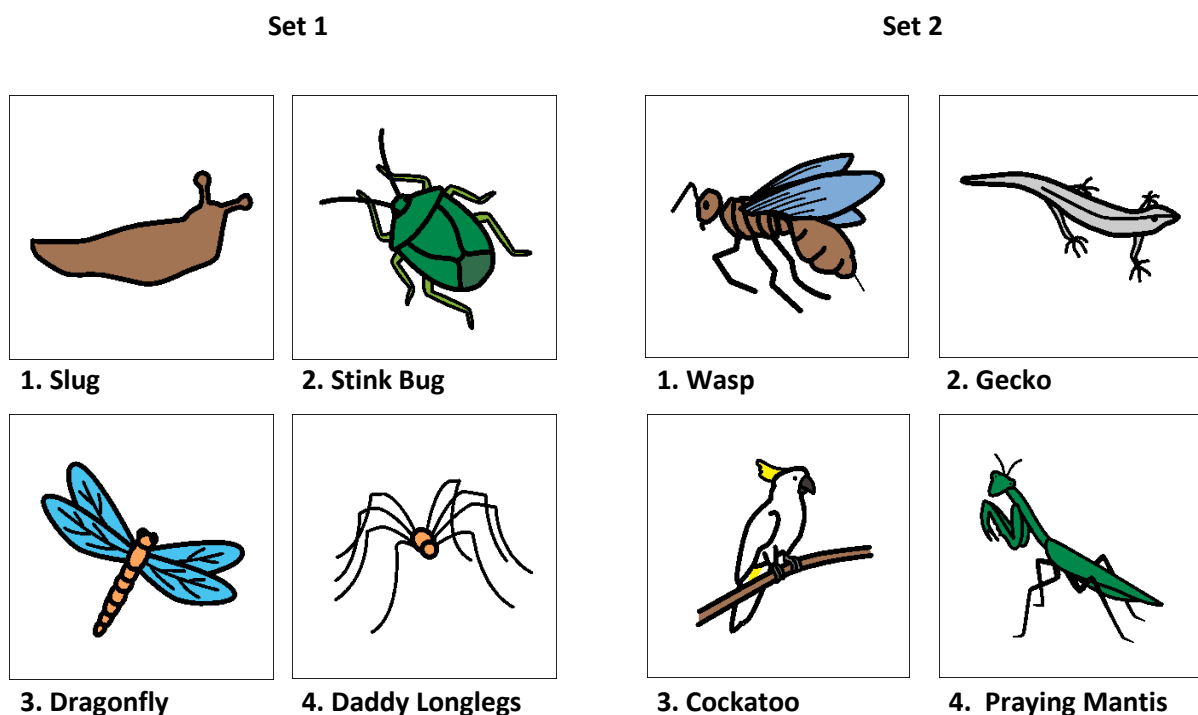


Figure 5.1. Visual representation of creatures

Equipment

The use of a computer interface allowed for the repetitive presentation of the materials in a consistent format, avoiding inconsistency of presentation that could have impacted on the reliability of the results (Goldsmith & LeBlanc, 2004; Mineo, Ziegler,

Gill, & Salkin, 2009; Panyan, 1984). In addition, this provided a predictable format across repeated presentation and this repetitive routine may have aligned well with a preference for routine that appears common in children with autism (Roberts & Prior, 2006). The use of the computer interface provided the researcher with the ability to embed auditory and visual materials using Microsoft PowerPoint as the format for the intervention. PowerPoint was chosen because of the multimedia capabilities of adding sound files and picture communication symbols (PCS), and the relative ease of use. Further support for the use of the computer interface was found in reports that suggest individuals with autism are more engaged in computer instruction over typical teaching instruction (Moore & Calvert, 2000), and the effective use of a computer interface using an interactive whiteboard to teach picture names to children with autism (Simpson & Keen, 2010).

In developing a computer-based presentation there were several practical considerations. The researcher required a piece of equipment that was portable and easily accessible for the children. A touch screen monitor with an inbuilt stand allowed for the presentation of the materials to be consistently presented on the same interface across settings. An advantage of the touch screen monitor was that it did not rely on the eye-hand skills required when using a mouse which could have been problematic for some children with autism (Huguenin, 2004; Light & Drager, 2007).

In summary, the identification of the materials to be used in the intervention required careful consideration of children's strengths and the identification of potential impacts on the validity of the study. As a result, this intervention provided auditory input in the form of two sets of lyrics that were presented in a format containing the elements of infant-directed song and infant-speech. The song and speech auditory input differed in the musical elements of melody and rhythm. Embedded into each set of lyrics were four picture labels. These labels were visually represented using coloured PCS available from

Boardmaker. The sung and spoken recordings and PCS were embedded into a PowerPoint presentation to be displayed using a touch screen monitor. The next step in the development of the intervention required the identification of the instructional procedure to facilitate a correct response, without impeding on the experimental control of the study.

Instructional procedure

The instructional procedure was informed by the research literature identifying the most efficient and effective procedures to teach receptive labelling skills and promote generalisation of these skills in children with autism. This required an understanding of the receptive labelling task and the procedures more likely to increase the occurrence of a correct response without contaminating the data gathering of correct/incorrect responses required to inform this study.

As previously discussed, receptive labelling requires an individual to associate a heard label with a representation of that label. To determine if the individual has provided a correct response above chance, it is necessary for the individual to discriminate between correct and incorrect (or distractor) materials. To teach this requires discrimination training. There are two common procedures used with children with autism to teach the discrimination skills required for receptive labelling: the simple/conditional and the conditional discrimination task procedure (Love, Carr, Almason, & Petursdottir, 2009). The simple/conditional task is a progressive teaching procedure with the complexity of the presentation increasing as the participant reaches a predetermined mastery criterion (Lovaas, 2003). It commences with the target stimulus presented in isolation and moves to a conditional discrimination task where the target stimulus is presented with a non-target distractor stimulus. The conditional discrimination task commences with the target stimulus presented and at least one distractor (non-target) stimulus (G. Green, 2001; Leaf & McEachin, 1999). It is recommended that at least three stimulus comparisons be used

when implementing a conditional procedural approach, with each stimulus targeted an equal number of times (G. Green, 2001). Both the simple/conditional and the conditional discrimination approach have been employed in Early Intensive Behavioural Interventions, but there has been little investigation into the comparative effectiveness of these approaches. The research previously conducted has reported mixed results; with some children benefiting from the inclusion of the training session without a distractor, while this provided little benefit for other children (Gutierrez Jr et al., 2009). In this current study, a modified simple/conditional procedural approach that has previously been used to teach receptive labelling skills by Simpson and Keen (2010) was selected. This consisted of four training sessions using the simple procedural approach and fifteen sessions using the conditional procedural approach. This set number of intervention sessions was delivered to fit in with time restrictions related to the length of the school term. A detailed description is provided below of the training and teaching sessions.

The training sessions. The four training sessions were conducted using a simple procedural approach where the lyrics (sung/spoken) were presented with a single creature PCS (see visual display in Appendix D). In each session the four creature labels were used three times resulting in twelve trials. The order in which the labels were named and the positional display of the PCS (left, centre, right) were randomly generated across the four training sessions using Microsoft C#. The Microsoft program randomisation was based on each label being presented three times per session with the corresponding PCS displayed equally in each of the three positions across the four sessions. The order of the labels and the positional layout were consistent for the sung and spoken conditions.

The teaching sessions. The teaching phase was based on a conditional discrimination format using an array of three PCS (see visual display in Appendix E) chosen from the four PCS used in each set. This allowed for the generation of 24 possible

arrays with each array providing the possibility of three labels to be selected resulting in 72 possible PowerPoint slide presentations. The probability an individual would choose a correct response from an array of three comparisons was 33%. As each label was named three times per session, the probability of a participant randomly selecting the correct response was further reduced to 3.7%. This allowed for some variability in the presentation of the distractor PCS and reduced the probability of chance correct responding.

A program was developed using Microsoft (.net 2008) C# program language to generate pseudo random displays for each session. The parameters used to calculate the random displays were as follows: each of the four labels was to be presented as the target stimuli three times per session, the position of the target stimuli was to be presented equally in the three positions (left, centre, right) across the fifteen teaching sessions, no PCS could be presented more than once in an array, and the PCS were to be presented an equal number of times across the sessions. The random selection of arrays reduced the possibility of rote learning positional responses and avoided selection according to positional bias (Duker, Didden, & Sigafos, 2004). The array selection, order of presentation and creature named was the same in the sung and spoken intervention conditions. The order of the target labels and the positional layout of the PCS were consistent for the sung and spoken conditions.

Inherent within this study was the aim of increasing the children's receptive labelling skills. One instructional procedure employed in communication interventions using AAC devices reviewed in Chapter 2 was the use of a time delay procedure. This is when a period of time occurs between the discriminative stimulus and a prompt, allowing the individual sufficient time to independently respond to the stimulus prior to a prompt (Halle, Marshall, & Spradlin, 1979). Two commonly used time delay approaches are constant delay where the duration of delay remains the same and progressive delay where

the duration of the delay increases with an individual's increasing competence (Snell & Gast, 1981; Wolery et al., 1992). Both methods have been used effectively for teaching children with autism picture and word recognition skills (Browder, Ahlgrim-Dezell, Spooner, Mims, & Baker, 2009; Ledford, Gast, Luscre, & Ayres, 2008; Spector, 2011).

Time delay and prompting. The use of time delay has been identified as an evidence-based instructional strategy to promote communication outcomes in young and school aged individuals with autism (Odom, Collet-Klingenberg, et al., 2010; Odom et al., 2012). A constant time delay period of 10 seconds was selected as the most suitable approach for the purpose of this research and this approach has been used effectively with individuals with autism (Sigafoos et al., 2009; van der Meer, Didden, et al., 2012). The use of a constant time delay procedure allowed for a controlled format to be implemented across the group of participants. In contrast, the progressive delay raised a number of potential difficulties which could impact on the validity of the study. A consideration of the progressive delay is determining when to increase the time delay period (Duker et al., 2004). As this is usually dependent on the participant's correct responses it would require deliberation of the individual participant's performance on a sessional basis. Additionally, as four labels were taught across the sessions, increasing the time delay period as a result of a correct response for one label would not necessarily correspond with the time delay period required when an alternate label was presented as the target stimulus. This had the potential of creating a complicated procedure that would be difficult to implement.

Formulating the instructional procedures required consideration of the response to the participant's correct/incorrect responses. Five possible participant responses can be considered when time delay procedures are employed: correct unprompted response, correct prompted response, incorrect unprompted response, incorrect response following prompt, and no response (Wolery et al., 1992). The instructional procedures needed to

encompass consequences for each of these responses, without impacting on the data collection process required to inform the research. The focus of research was to investigate the effect of musical elements on the child's ability to produce a correct response. To provide this data it was necessary to provide children the opportunity to make a correct/incorrect unprompted response. As learning was a desired outcome for this study it was equally important to provide instructional procedures to increase the likelihood of a correct response following an incorrect response or a lack of response. Prompts are an instructional technique used within the applied behavioural analysis framework to facilitate correct responses and have demonstrated efficacy to promote communication outcomes when used with young and school-aged children with autism (Odom et al., 2012). There are two main types of prompt assistance hierarchies: least-to-most, and most-to-least. Least-to-most prompts provide increasing assistance and are arranged from least intrusive to most intrusive, while most-to-least prompts provide decreasing assistance and are arranged from the most intrusive to the least intrusive (Duker et al., 2004). In this study, the least-to-most prompt hierarchy was selected as it provided a clear criteria for the progression from one level to the next (Duker et al., 2004), decreased the likelihood of overprompting for some participants (Reichle, Cooley Hidecker, Brady, & Terry, 2003) and reduced the level of assistance provided by the researcher which could impact on the experimental control of the study.

The least-to-most prompt hierarchy progressed successively through levels following an incorrect response or lack of response. To ensure there was a progressive increase in prompt assistance the type and level of prompt was identified. Prompt type refers to the category which distinguishes the prompt and includes physical, gestural, or verbal; while the level or intensity of the prompt usually refers to an increase by increments across a continuum ranging from minimal to full. In this study, verbal prompts

were not used as there was a risk that the verbal input could interfere with the auditory stimulus which was the independent variable under investigation. Thus a mixture of gestural and physical prompts was selected for this study based on support for the use of mixed prompt types in communication interventions (Cannella-Malone et al., 2010; Son et al., 2006). The least-to-most prompt hierarchy used in this study is displayed in Figure 5.2. Challenges can occur in determining the level of prompts when different prompt types are used within the same hierarchy (Duker et al., 2004). In Figure 5.2, the least intrusive prompt, gesture, applied in Level 1 was simultaneously presented with the introduction of the physical prompt type in Level 2 to ensure there was a progressive increase in prompt assistance when different prompt types were employed. In Level 3, the physical prompt was increased in intensity to provide the most prompt support.

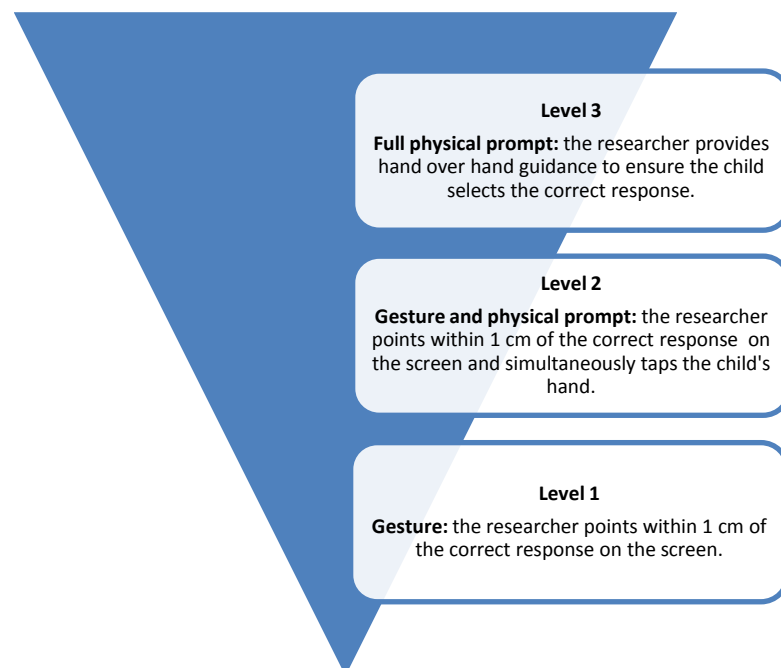


Figure 5.2. Prompt hierarchy

Following a correct response, whether unprompted or prompted, feedback was provided to participants by presenting the auditory label with the correct PCS. This is a common practice in teaching new words to children (Horst & Samuelson, 2008). In this study, a

correct response triggered the next PowerPoint slide which displayed the correct creature PCS using the 'spin' animation and simultaneously presented the pre-recorded name of the creature in a way consistent with the intervention condition (sung or spoken).

Overview of the Intervention

The materials were embedded into a PowerPoint presentation. The PowerPoint slides were developed following a set of sequential steps which are displayed in Figure 5.3. The same format was followed for the sung and spoken conditions. The slide presentation commenced with the context picture displayed in the upper half of the slide, highlighting the commencement of the presentation. The audio file (sung/spoken lyrics) was simultaneously commenced with the display of the PCS array, finishing with the audio prompt and the naming of the creature label. A block was inserted into the PowerPoint presentation to prevent the activation of the next slide prior to the creature label being provided. This was to avoid impulsive responding which can occur when the participant correctly responds prior to the presentation of the auditory instruction (Duker et al., 2004). Touching the correct PCS activated a hyperlink to the feedback slide consisting of the correct response displayed and named using the format consistent with the intervention condition (sung/spoken). This was followed by the activation of a new slide which began the process again. An incorrect response or a lack of response resulted in the PowerPoint slide remaining static. As seen in Figure 5.3, an incorrect response or lack of response within 10 seconds resulted in the implementation of the prompt hierarchy until a correct response occurred, triggering the feedback slide.

This intervention was developed and constructed in line with evidence-based practice and in view of the aims of the research study. The result was an intervention which could be implemented with individual participants, across settings, and over time, while informing the research question. In view of the recommended instructional

procedures (National Research Council, 2001) a generalisation training procedure was developed to be used in conjunction with the intervention as the ability to generalise learning is viewed as an essential element of evidenced-based interventions and treatments (National Autism Center, 2009).

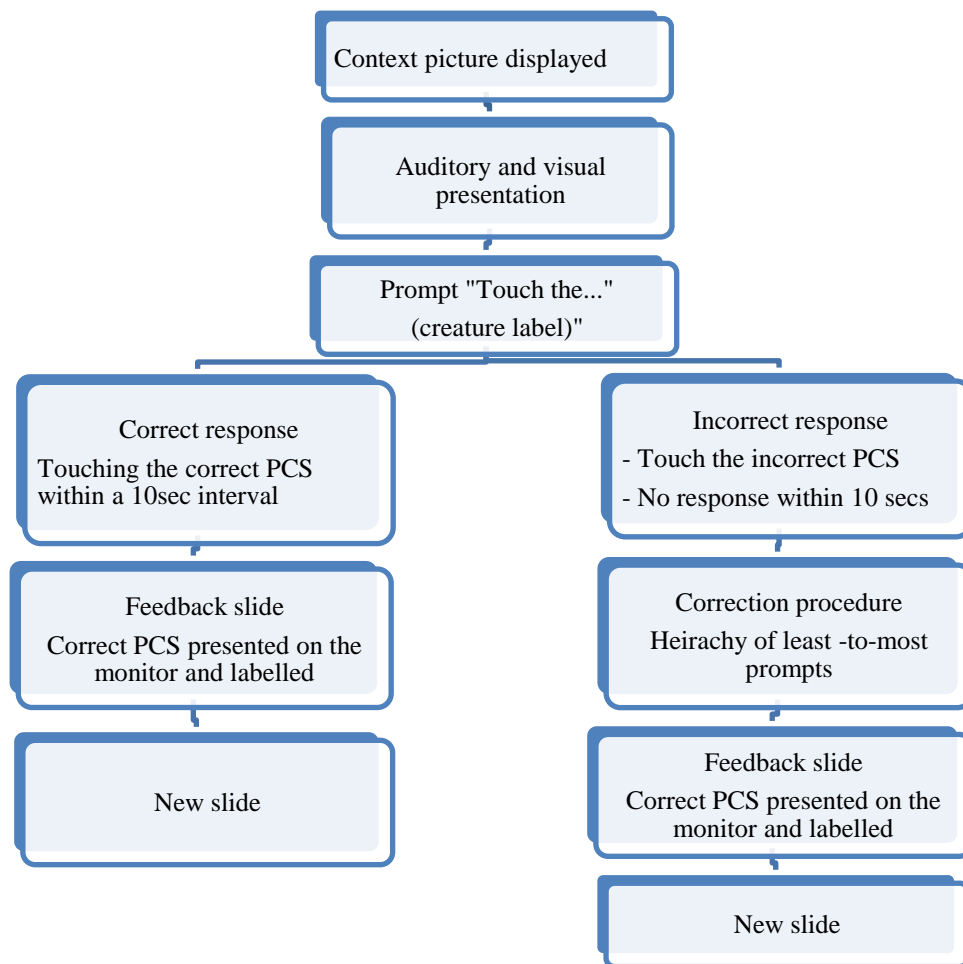


Figure 5.3. Intervention overview

Generalisation

Generalisation refers to children's ability to perform the behaviour learned in one context to different conditions or contexts (Stokes & Baer, 1977). Generalisation of skills learned as a result of treatment is often not achieved unless specifically included as a focus of treatment (Schreibman, Whalen, & Stahmer, 2000). One method of achieving

generalisation across environments and communicative partners is to embed generalisation training into the learning context (Bondy & Frost, 1994). Using this technique, Bosseler and Massaro (2003) used a computer-animated talking tutor to teach new vocabulary to individuals with autism. Participants in this study were able to generalise the newly learned vocabulary to novel images within the computer program and transfer knowledge to non-computer based contexts.

To promote generalisation, the instructional strategies implemented can be directed at settings, consequences, antecedents or other factors including reinforcing generalised responses and unprompted generalisations, and teaching functionally equivalent responses (Schlosser & Lee, 2000). Identifying the generalisation strategies for this study took into consideration the practicalities of implementing this training within a limited timeframe, across participant settings in a controlled manner without inconveniencing the participant's teacher or disrupting the class program. This required deliberation of the generalised conditions and responses from the onset (Horner & McDonald, 1982; Schlosser & Lee, 2000). To identify ways to enhance generalisation of receptive labelling skills learned during the intervention, the labelling task was analysed and broken down into components. This allowed for the development of materials for generalisation training and assessment. The components which were addressed are displayed in Table 5.4 and include the type of auditory material and PCS, the prompts, mode of presentation and the environment. Table 5.5 outlines the teaching condition (intervention), the generalisation training and the generalisation assessment with respect to each of these components.

The generalisation training consisted of the PCS labels being presented by an adult using his/her regular speaking voice. The PCS were displayed in a booklet with one black and white PCS per page. This provided the materials in a different format and enabled the PCS to be presented in a natural story-telling context or as a picture flick book. The

teachers were asked to show the participating child the booklet on a daily basis, providing a model by labelling the PCS. The generalisation training was designed to be conducted in the classroom by the teacher or teacher aide.

Assessing generalisation skills was an essential element in the evaluation of learning outcomes in this study. It was therefore necessary to identify an assessment task which could be implemented in a controlled manner across participants and environments. As the focus of the research was investigating the effect of auditory input on receptive labelling skills, it was therefore viewed as important to assess whether the participants could generalise learning using a different mode of auditory input and presenting the materials in a different format. Based on the review of the literature (Chapter 2) to create a difference in auditory input a monotonous adult voice was used to assess generalisation. This differed from the auditory material provided in the teaching sessions and the generalisation training (Table 5.5). The auditory material was provided by the researcher, who used a monotonous tone to provide the instruction “Touch the ...(PCS labelled)”. During the intervention the labels were taught using a computer interface. To further assess the generalisation of learning the assessment task used the coloured PCS displayed on an A4 laminated page. The format of the page was consistent with the PowerPoint teaching slide excluding the context picture. The pages were positioned on a slope board to reduce reflective glare. Consistent with the teaching sessions, the four PCS were assessed three times resulting in a total of twelve display pages. The assessment task did not include prompts or correct response feedback. The order the labels were named, and the position of the PCS in the array were generated following the same procedure used for the teaching condition (see page 110). The assessment was designed to be administered one-on-one in a separate room. The generalisation assessment task differed from the teaching task on the type of auditory material, the presentation of the PCS and the use of prompts.

Table 5.4.

Components used in Teaching, Generalisation Training and Assessment

Components	Teaching	Generalisation training	Generalisation assessment
Auditory material	Sung/spoken lyrics with instructional prompt, and PCS labelled.	PCS labelled using regular speaking voice.	Instructional prompt and PCS labelled using a regular speaking voice.
PCS presentation	Three coloured PCS displayed as a horizontal array on a touch screen monitor.	Black and white PCS displayed in a 10cm ² laminated booklet. One PCS per page.	Three coloured PCS displayed as a horizontal array on an A4 laminated page.
Prompts	Least-to-most hierarchy	Model	Nil
Mode of presentation	Computer	Teacher	Teacher (Researcher)
Environment	Separate room	Classroom	Separate room

Conclusion

The research study required the development and construction of an intervention to enable the collection of data for the purpose of informing the research question. This required a theoretically based intervention that could be implemented with fidelity, with different children, across a range of school settings, and over a period of time. A detailed description of this process was provided in this chapter. In Chapter 6, the research method associated with the implementation of this intervention, is described and substantiated

Chapter 6: Research Method

The theoretical framework underpinning this study supported the use of an experimental methodology to investigate the research question generated from the review of the literature (Chapter 2 and 3). In line with this methodological choice, a cross-over design was selected as the most appropriate method to obtain the data required to answer the research question. This required the development and construction of an empirically-based intervention to be used within the experimental design, described in Chapter 5.

In this chapter details are provided on the research method used to investigate the use of musical compared to non-musical elements in a receptive labelling task on the learning outcomes of children with autism and severe language delay (Study 1); and compare the use of musical and non-musical elements on engagement and learning outcomes for children with autism and severe language delay in a receptive labelling task (Study 2). Participant details including eligibility criteria, demographic and descriptive information for participants are provided. This is followed by a description of the procedure and data collection, data analysis and reliability. This chapter concludes with a discussion on validity, ethical considerations and the potential limitations of conducting this research. The materials and setting, and research design are not included in the method description in this chapter due to the extensive coverage of these sections in the previous chapters and the summary description provided in the two published studies, Study 1 (Chapter 7) and Study 2 (Chapter 8).

Method

Participants

Twenty two children met the research selection criteria and completed both intervention conditions providing comparative data for analysis. The selection criteria for child participation in the research was a paediatric diagnosis of ASD (confirmed by the

Social Communication Questionnaire), aged between 3 years 6 months and 8 years, and with limited communication skills requiring the use of Alternative and Augmentative Communication systems.

Participant profile. A summary of the participants' profile is provided in Table 6.1. The participants' ages ranged from 3 years 9 months to 8 years 9 months (mean age 5 years 9 months). The ratio of male to female was 3.4:1, the male female ratio found in epidemiological studies (Fombonne, 2009b). Assessment using standardised tests was conducted to provide descriptive comparative measures of the participants addressing the areas of diagnosis, adaptive behaviour skills, and language development.

The Social Communication Questionnaire (SCQ; Rutter, Bailey, Berument, Lord, & Pickles, 2003) confirmed the participants' diagnosis with all participants scoring above the ASD cut off score of 15. Adaptive behaviour skills measured on the Scales of Independent Behaviour Revised (SIB-R; Bruininks, Woodcock, Weatherman, & Hill, 1996), revealed participants' demonstrated a wide range in their levels of ability; however, age equivalent scores indicated all participants scored below 4 years of age. There was variability in the maladaptive scores with participants' behaviour described as marginally serious to very serious. Based on the SIB-R scores, participants were viewed as requiring frequent to pervasive support.

Description of the participants' expressive and receptive vocabulary abilities were obtained using the Expressive Vocabulary Test (EVT-2; Williams, 2007), and the Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 2007). All the participants commenced the EVT and PPVT tests at set one (age equivalent 2years 6months); however, the basal set rule for set one was only obtained by four participants on the EVT and by one participant on the PPVT. The standard scores on the EVT and PPVT were used to determine participants' abilities compared to age norms (displayed in Table 6.1). Consistent with the

selection criteria of limited communication, the majority of the participants scored below the 0.1 percentile on the EVT and PPVT, with two participants scoring above 0.1percentile on the EVT (0.5 and 6); and one participant scored on the 0.1 percentile using the PPVT.

Table 6.1.

Participant Profile

Measure	<i>M (SD)</i>
Age	70.50mths (19.70)
SCQ total score	23.41 (4.16)
SIB-R standard score	22.23 (19.22)
SIB-R age equivalent	23mths (9.21)
EVT standard score	28.18 (16.17)
PPVT standard score	26.55 (11.31)

Note. *M* = mean; *SD* = standard deviation

Initial screening was conducted to determine if the participants demonstrated prior knowledge of the picture names used in the intervention (Picture knowledge), and to determine if they were able to follow the intervention procedure (Task competence). Children who demonstrated prior picture knowledge of the pictures were excluded from the study (see Figure 6.1). All the participants demonstrated task competency and therefore no training was required to teach the children to use the materials following a verbal prompt.

Assessment materials. A description is provided of the standardised tests used to provide the participant profile, and the initial screening tests.

The Social Communication Questionnaire (SCQ). This test demonstrates high sensitivity as a screening tool for autism (Eaves, Wingert, Ho, & Mickelson, 2006) and can

be used on individuals from 4 years of age. The scores obtained on the SCQ provide an indication of the approximate level of severity of ASD symptomatology and allow comparisons of ASD symptomatology across individuals (Rutter et al., 2003). It is completed by parents/carers and consists of 40 statements requiring yes-or-no responses. The items on the Social Communication Questionnaire (SCQ) focus on reciprocal social interaction, communication and restrictive, repetitive and stereotyped patterns of behaviour. The recommended cut off score of 15 was used to confirm the participant's paediatric diagnosis.

Scales of Independent Behaviour Early Development Form (SIB-R).

Participants' adaptive behaviour skills and problem behaviour were assessed using the SIB-R. The early development form is used with individuals with developmental functioning levels below years and it provides normative scales ranging from 3 months to 8 years (Bruininks et al., 1996). The SIB-R is composed of two parts, the first part consists 40 items addressing motor, social interaction and communication, personal living, and community living. Each item is scored on a rating scale of 0-3. The second part addresses eight problem behaviour areas providing a maladaptive behaviour score. Behaviour is rated according to frequency of occurrence and severity (Bruininks et al., 1996).

The SCQ Lifetime form and SIB-R were administered by the principal researcher to the parent/guardian of 89% of the participants and to the teachers of 11% of participants. Teacher participation was due to parent/guardian unavailability. Sixty four percent of interviewees elected to complete the questionnaires by phone and thirty six percent of interviewees completed the questionnaires in person.

Expressive Vocabulary Test 2nd edition (EVT). This assessment tool is designed to assess single word expressive vocabulary and word retrieval (Dunn & Dunn, 2007). The stimulus pictures illustrate high frequency, commonly used words including nouns,

verbs, adjectives, and adverbs from American English vocabulary. One stimulus picture is displayed on each page of a self-standing easel. Participants are asked to name the picture. This assessment was conducted following the PPVT and adhered to the administration rules. All participants commenced at the start age 2:6 – 3:11.

Peabody Picture Test 4th edition (PPVT). This test is designed to measure receptive vocabulary of individuals from 2 years 6 months through 90 years using American English vocabulary (Dunn & Dunn, 2007; Williams, 2007). Four full coloured pictures are arranged on a page using a self standing easel. Following a stimulus word the participants are asked to select the picture that best illustrates the word. The PPVT was individually administered in a separate room. Administration rules were adhered to during the test. All participants commenced at the start age 2:6 – 3:11.

Both the EVT and the PPVT are norm-referenced instruments that demonstrate robust psychometric properties (Dunn & Dunn, 2007; Williams, 2007). These two tests assessed expressive and receptive vocabulary attainment of participants and allowed for comparison of attainment levels of individual participants with their peers and other participants.

Picture knowledge. Individual participants were screened to determine if they demonstrated prior knowledge of the picture names to be taught. Assessment took place in a separate area away from the participant's classroom. The participant was seated at a student table with the researcher positioned on his/her left hand side. Laminated colour Boardmaker pictures (6cm x 6cm) were used. The participant's knowledge of four picture names was assessed prior to the commencement of the intervention condition. The order the pictures were named and the display position of the pictures was randomly calculated using Microsoft (.net 2008) C# program language. Three pictures were displayed horizontally on a black felt board (35cm x 9cm) in front of the participant. The researcher

instructed the participant to “Touch the ... (naming a picture)”. Pictures were removed following a picture selection or if no response occurred within 10 seconds. Participant’s correct or incorrect response was recorded. Each picture was named three times.

Participants were identified as displaying prior knowledge of the picture if they scored two or more correct responses for a picture.

Task competence. Participants were individually tested using a touch screen monitor to determine their competency in following the verbal prompt “Touch the...”. This was to ensure that any incorrect responses during the intervention were not due to lack of competence in executing the task. The task used pictures illustrating farm animals commonly viewed in early childhood i.e. pig, cow, horse, bird. The screen was positioned on a student desk. The participant was seated in front of the screen with the researcher on the participant’s left hand side. Competency was determined if the participant was able to touch the picture on the monitor, following the instruction “Touch the ...” with sufficient pressure to activate the screen, on three consecutive occasions.

Recruitment and retention of participants. Following Ethical clearance from the researcher’s university ethics committee and approval from the Queensland Government Department of Education and Training (Appendix F), principals were approached and informed consent was obtained. Participants were recruited from South East Queensland state funded Special Schools within a 50 kilometre radius of the researcher’s base. Invitations to participate with information packs detailing the research (Appendix G) were sent to twenty Queensland State Special Schools. Principals forwarded information packs and consent forms to the class teachers (Appendix H) and parent/guardians of potential participants (Appendix I). Details of the recruitment and retention of participants is illustrated in Figure 6.1 and described below.

Seven principals provided consent for the research study to be conducted at their setting. These principals identified 74 potential participants meeting the research criteria. Parental/guardian permission was obtained for 47 potential participants. Details of the recruitment of participants is summarised in Figure 6.1. Following the initial screening 18 of the 47 children were excluded: one did not have an ASD diagnosis, one was outside the age limits, ten demonstrated prior knowledge of the picture names, and six were part-time and unavailable to attend all the intervention sessions.

Twenty nine participants were randomly assigned to either the sung or the spoken condition during the first intervention period. Incomplete data were obtained for three participants. These children demonstrated harmful behaviour to themselves, the researcher or the test materials and intervention was stopped for ethical and safety reasons. They did, however, commence the second intervention period to determine if their behaviour had been influenced by the intervention condition. As the children demonstrated the same behaviour in the second intervention condition that was evident in the first intervention condition, the intervention was discontinued and the data from these participants were not included in the analysis. Of the remaining 26 participants assigned to the second intervention condition, one participant demonstrated prior knowledge of the picture names, two participants left the school, and one participant did not consent to participate in the intervention. This resulted in 22 participants who completed both intervention conditions.

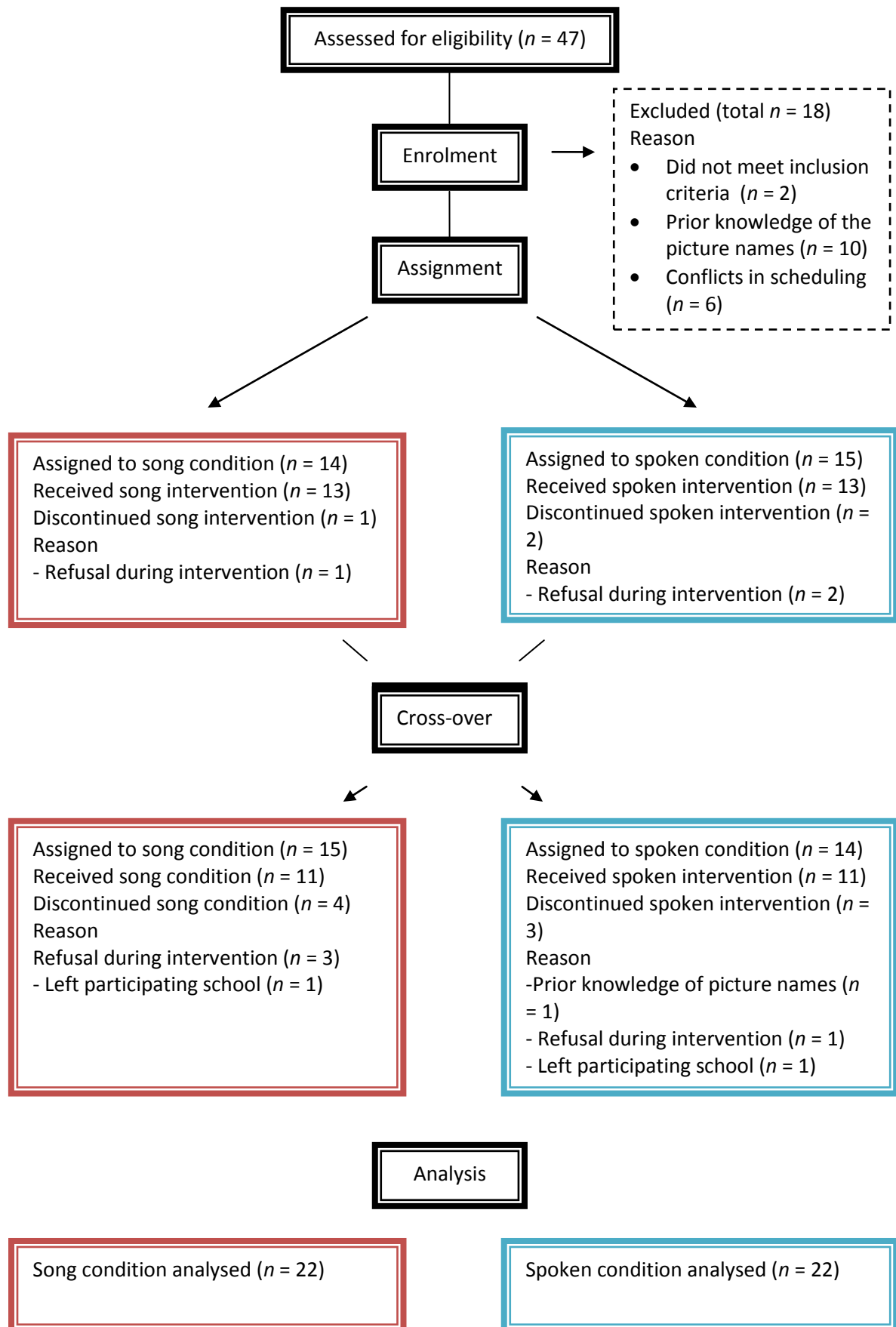


Figure 6.1. Participant recruitment and retention throughout the research

Procedure and data collection

The twenty two participants were randomly assigned to a sequence of conditions (Figure 6.2). Randomization was achieved by assigning each child in turn to one of two groups in the order in which they were recruited. Group 1 received the sung condition first followed by spoken condition, while Group 2 received the spoken condition first followed by the sung condition. The material sets were counterbalanced across conditions as displayed in Figure 6.2. The variation in the distribution of participants to each set evident in Figure 6.2 was a result of participant attrition during the intervention period.

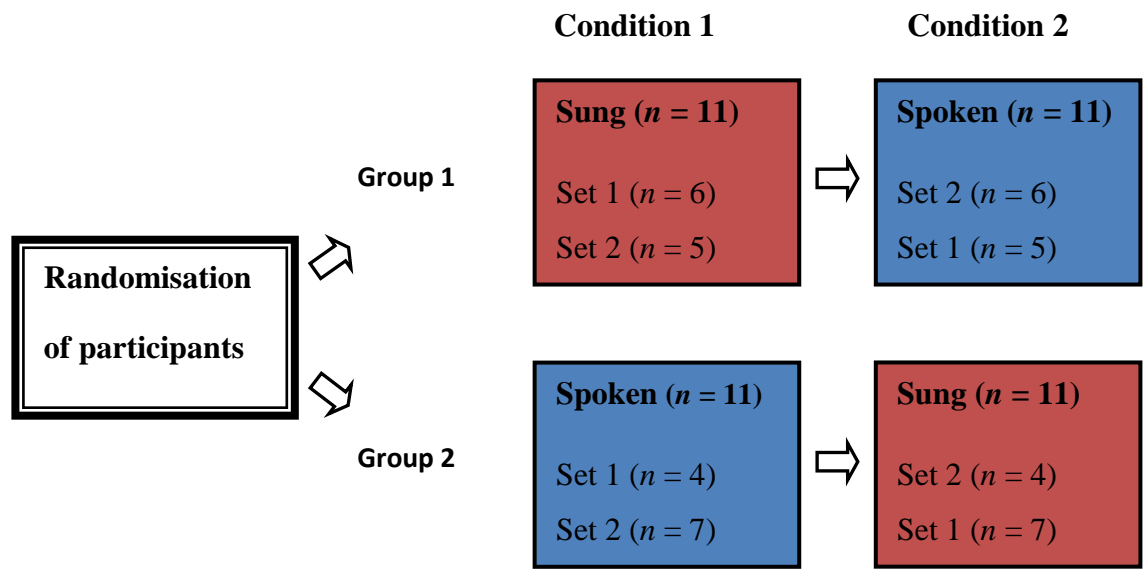


Figure 6.2. Random allocation format

The intervention was implemented within a cross-over design study for the purpose of investigating the influence of musical elements on receptive language learning (Study 1); and investigating the relationship between music, engagement and learning (Study 2). The procedure is discussed in detail in the published papers presented in Chapter 7 (Study 1), and Chapter 8 (Study 2) and therefore is not replicated here. An overview of the research summarising the procedural steps of the intervention, the method of data collection and the application to the studies is provided in Table 6.2.

Table 6.2.

Research Overview

Step	Procedure	Data Collection	Study
1	Baseline	Record of correct and incorrect labelling response	1
2	Training sessions		
3	Teaching sessions	Data collected during teaching sessions one to fifteen	1, 2
		- Record of correct and incorrect labelling response	2
		- Video recording to be used for coding levels of engagement and problem behaviour	
	Generalisation training		
4	Generalisation assessment	Record of correct and incorrect labelling response	1
5	Maintenance	Record of correct and incorrect labelling response	1

A baseline assessment of the individual's performance was conducted at the commencement of each intervention condition. The materials were presented using the computer interface as described in Chapter 5. The auditory material consisted of a pre-recorded voice (regular adult speaking voice) providing the instruction "Touch the (creature name)". The creature names were represented using PCS. Three PCS from the set were presented using a horizontal array format. Each creature label was used three times during a 12 slide presentation. Correct/incorrect responses were recorded providing the participants' baseline performance measure prior to the intervention and was used in the data analysis for Study 1.

The procedural Steps 2 to 4 outlined in Table 6.2 were explained in detail in Chapter 5, and are therefore not repeated here. Maintenance data were collected 3-5 weeks following the cessation of each intervention condition. Variation in the time period of maintenance data collection was due to school holidays and participant availability. During this period participants were not exposed to any intervention. The maintenance assessment task replicated an intervention session. All participants were exposed to the same maintenance session for their respective set of creature names. There was a one month time period between the cessation of the first intervention condition and the commencement of the second intervention condition.

The data collection procedure for Study 1 consisted of recording participants' correct/incorrect response at baseline, Session 15, generalisation assessment and maintenance. Correct response was defined as an unprompted correct response. The data collection procedure for Study 2 involved video coding of selected sessions. Due to the time required to undertake the detailed analysis and coding of the observational data, data from sessions 1, 5, 10, 15 were selected for analysis. These sessions provided a spread of intervals throughout the period of intervention. The video coding system used to assess child engagement was based on the protocol used by Keen and Pennell (2010) and involved continuous coding reported at 5 second intervals to determine the amount of time each child spent engaged in the learning task. In addition to coding for occurrences of engagement, the video sessions were also coded for occurrences of challenging behaviour. Challenging behaviour was included as this was identified in the literature review as occurring at high rates in individuals with autism and can negatively impact learning. Mutually exclusive coding descriptors were developed for engagement and challenging behaviour (see Chapter 9 for definitions). Correct responses were also recorded for the video sessions following the same protocol as Study 1.

Data Analysis and Reliability

Preliminary analysis was conducted on the data collected in Study 1 and Study 2 to test for normality using the Sharpiro-Wilk test. This was carried out to determine if the data met the assumption of normality required for parametric statistical tests (Tabachnick & Fidell, 2007). Data that violates normality would impact on the interpretation of the results as this reduces the generalisability of results to the population. The data analyses used to inform Study 1 and Study 2 are described in Chapters 7 and 8 respectively. The Kappa Measure of Agreement was used to estimate interobserver agreement in both studies. This measure was selected as Kappa statistically controls for the chance occurrence of the two observers randomly agreeing (Kennedy, 2005). The test of reliability in Studies 1 and 2 was conducted by a second observer, experienced in research with children with autism and trained in the data recording, but blind to the purpose of the study. Details of interobserver reliability calculated on the occurrence/non-occurrence of correct responses and behaviour are reported in Chapters 7 and 8.

Validity

The use of an experimental design allowed the researcher to address potential threats to validity by identifying the independent variable to be manipulated and controlling influences on the research by identifying dependent variables that may otherwise confound the results. The cross-over design was selected as the most appropriate research design to address potential threats to validity that could affect inferences being drawn from the research findings. The use of this design allowed for within-subject comparison where the participant acted as his/her own control reducing the threat to validity that arises from pre-existing differences in participants in the experimental and control group (Creswell, 2008). The influence of individual differences on the outcomes was further reduced by the random assignment of participants to the counterbalanced

conditions. Threats to validity that are identified in the use of a cross-over design include changes that can occur from period one to period two, and the carry over effect that can occur from exposure to the first intervention impacting on the performance in the second intervention (B. Jones & Kenward, 2003; Senn, 2002). These potential threats were identified and statistical testing was conducted to avoid confusion in interpreting the relationship between the independent and dependent variables. Furthermore, to counteract any potential carry over effect a delay period was used between intervention conditions where the children did not participate in any intervention.

The sample size (22 participants) for this research, could limit to some degree the ability to generalise the findings from Study 1 and 2 to the broader population of individuals with autism. The steps taken to ensure appropriate data analysis, reliability and validity led to this research being able to provide meaningful and justifiable inferences about the use of musical elements to facilitate receptive labelling skills in children with autism and severe language delay and the impact of music on levels of engagement within this population.

This study implemented an intervention that is applicable to typical educational contexts and could be applied with relative ease by teachers. The intervention employed the use of music and computer technology, both of which have been separately identified as engaging for children with autism. Learning receptive labelling skills has important ramifications for the individual's comprehension skills and future learnings. In addition, the identification of engaging environments informs future education practice to increase the learning opportunities for individuals.

Ethical considerations

This research was conducted in accordance with the ethical guidelines of the Australian Catholic University Research Project Ethics Committee, and the requirements

of the Queensland Department of Education and Training. The research was conducted in Education Queensland Schools across regional districts which required permission to conduct the research be obtained from Education Queensland Central Office. In accordance with ethics approval given, the anonymity of the individual participants and the schools were preserved.

Principals provided informed consent for the study to be conducted at their school and they identified children who could be considered for the study. Parent/guardians provided informed consent for their child to participate in this research prior to the commencement of the intervention with the full understanding they could withdraw consent at any point during the research project. Informed consent was obtained from the participants' class teachers. The teachers were consulted on the most appropriate time to conduct the intervention that would have the least impact on the participant and class schedule. Due to the nature of the children participating in this study, it was viewed as more appropriate to obtain voluntary consent from the participants on a session by session basis. Individual participant consent was obtained prior to each session. This process is explained in Chapter 7. Refusal to participate was viewed as the child's withdrawal of consent for that session at that period of time.

Limitations

The selection of the research methodology and methods of data analysis endeavoured to reduce the extent of limitations of this study; however, there are a number of limitations associated with these choices. Random controlled studies are traditionally conducted on large numbers of participants. The use of a small sample, although typical of studies of this type published in the literature, limit to some degree the generalizability of the results to the larger target population. In addition, the primary observer implementing the intervention and analysing the data was not blind to the research focus. Further

limitations are discussed in Chapter 7 and Chapter 8 specifically relating to Study 1 and Study 2, respectively.

Conclusion

This chapter provides an overview of the research method used to investigate the effect musical elements compared to non-musical elements in a receptive labelling task have on learning outcomes and engagement levels of children with autism and severe language delay. This chapter provided details on the eligibility and exclusion criteria and a profile of the participants who completed the study. The method of data collection and analysis, and measures used to ensure reliability was outlined. The validity and ethical considerations of this study were presented and the limitations of this research were examined. The implementation and findings from the two research studies are discussed in Chapter 7 (Study 1) and Chapter 8 (Study 2).

Chapter 7: Study 1 - Receptive Labelling

This chapter presents the findings from Study 1, investigating the effect the use of musical compared to non-musical elements in a receptive labelling task has on the learning outcomes of children with autism and severe language delay. This paper is currently under review in the *Journal of Speech, Language and Hearing Research*. The paper has been formatted to meet the submission requirements of the *Journal of Speech, Language and Hearing Research*. In this chapter, the page numbers have been re-numbered to be consistent throughout the thesis. The Tables have been presented in-text and re-numbered with the preface of 7.

Abstract

Purpose: There is a growing body of literature investigating the efficacy of music interventions for children with autism however little empirical research has been conducted into the use of musical elements to facilitate language learning. This study examined whether musical elements increased the number of correct responses made by children with autism during a receptive labelling task.

Methods: The experimental procedure consisted of a cross-over design comparing the responses of 22 children with autism (mean age 5.9yrs) exposed to two intervention conditions (sung and spoken) embedded into a computer based communication intervention designed to teach receptive labelling.

Results: There was a significant increase in receptive labelling skills in both conditions but no significant difference between the sung and spoken conditions. Skills were generalised and were maintained at follow up in both conditions. A difference in group performance was found.

Conclusions: Results from this study add to the limited body of evidence on the use of musical elements embedded into a multi-component intervention to teach receptive labelling skills to children with autism. Further research is required to investigate child characteristics which may impact on children's performance using this approach.

Keywords: autism, music, communication, intervention, children

Teaching receptive labeling to children with autism: A comparative study using infant-directed song and infant-directed speech

Children with Autism Spectrum Disorder (ASD) have impairments in expressive and receptive language which generally manifest early in their development. Receptive language abilities in particular appears to be more impaired in comparison to expressive language abilities in some children with ASD (Hudry et al., 2010; Maljaars et al., 2012). Early intervention to facilitate language learning among young children with ASD is recommended because of the strong associations between language abilities and later functional outcomes (Luyster, Lopez, et al., 2007). Identifying factors that may facilitate language abilities and ways to prevent or treat language delays is therefore an important focus for researchers. One factor that appears to facilitate language acquisition in typically developing children is infant-directed speech and this study was conducted to determine if music, which draws on elements of infant-directed speech and song, may assist receptive language learning for children with ASD.

Infant-directed speech

From an early age typically developing infants demonstrate reciprocity of communicative behaviours with their caregivers characterised by attunement and responsivity between the communicative partners (Stern et al., 1982; Trevarthen, 1999). During these exchanges the caregivers use a particular type of speech, referred to as infant-directed speech. This speech has been described as containing a musical quality (Malloch, 1999).

Infant-directed speech is the ubiquitous speech caregivers use with infants characterized by higher pitch, wider pitch range, longer pauses, shorter utterances and more repetitions, than speech directed to adults (Fernald & Simon, 1984; Fernald et al., 1989). This speech is used by caregivers to attract infant's attention and communicate

meaning, and is preferred by infants over other spoken stimuli (Fernald, 1985; Papoušek et al., 1991; Stern et al., 1982). To date, there is limited empirical evidence identifying the salient acoustic features of infant-directed speech that may contribute to language acquisition/learning; however, infants appear to use the prosodic characteristics of infant-directed speech to process linguistic information. By seven months typically developing infants are demonstrating a listening preference for words over non words when presented using the prosodic characteristics of infant-directed speech (Thiessen et al., 2005). Not only does the use of infant-directed speech appear to facilitate the infant's recognition of words it also impacts on the infant's long term memory of these words and the infant's ability to generalise the recognition of these words (Singh et al., 2009). At this age, infants' listening preference shifts from infant-directed speech to native infant-directed speech (Hayashi et al., 2001); suggesting they are attuning to the linguistic content in the speech rather than just the acoustics. Kuhl, Conboy, Padden, Nelson and Pruitt (2005) identified a predictive correlation between 7 month old infants' preference for native language speech and language scores tested at 18 and 24 months. Features of infant-directed speech prosody continue to be utilised to aid in word recognition by toddlers (Song et al., 2010). While acknowledging further research is required, there is evidence to indicate an associative relationship between infant-directed speech and typical language acquisition. This may also be the case for children with ASD.

A number of studies have identified a concurrent relationship between the time spent by individuals with ASD attending to infant-directed speech and measures of language performance (Kuhl, Coffey-Corina, et al., 2005; Paul et al., 2007; Watson et al., 2010). Paul et al. (2007) identified that the listening time of toddlers with ASD to infant-directed speech was correlated to their receptive language abilities one year later.

Consistent with typical developmental pathways, the associative relationship between the

prosodic characteristics of infant-directed speech and language acquisition appears to extend beyond the prelinguistic stage of development for individuals with ASD.

Santarcangelo and Dyer (1988) found teenagers with ASD and a developmental age less than three years were more responsive to directives and increased eye gaze when the adult used speech prosody typical of infant-directed speech compared to conversational speech. The infant-directed speech prosody was less effective with individuals functioning at a developmental level older than five years. These findings would suggest a potential association between listening to infant-directed speech prosody and language learning in children with ASD which may be dependent on the individual's developmental age.

While the research reviewed here suggests a relationship between infant-directed speech and language learning for children with ASD, these children are generally less responsive to infant-directed speech than their typically developing peers and this may contribute to language acquisition difficulties (Kuhl, Coffey-Corina, et al., 2005; Paul et al., 2007; Watson et al., 2012).

Infant-directed song

Infant-directed speech shares many features in common with infant-directed song (Trainor et al., 1997) but to date, research has not investigated whether infant-directed song facilitates language acquisition in the same way as infant-directed speech. Given the listening preference for music by children with ASD (Blackstock, 1978), the use of infant-directed songs may hold some promise as a means of facilitating language learning.

Although there has been little research investigating infant-directed song and language acquisition there is a broader body of research investigating the relationship between music and language acquisition. There is some indication that the use of melody may heighten the infant's awareness of the lyrics. Many playsongs used with infants have the same tune but different linguistic content, suggesting the linguistic content is important

(Trehub & Schellenberg, 1995). Also as seen with infant-directed speech, mothers modify their singing to the linguistic developmental stage of their audience (Bergeson & Trehub, 1999). The addition of melody to lyrics assists in detecting changes in lyrics (Lebedeva & Kuhl, 2010) and enhances the learning of both lyrics and melody in typically developing infants (Thiessen & Saffran, 2009). These findings support the theory of a bi-directional relationship between music and language (Peretz et al., 2004). Further, this learning appears to be more effective when the melody is familiar or heard repeatedly creating familiarity, and this association improves long term memory of words (Rainey & Larsen, 2002; Wallace, 1994). It is yet to be investigated whether combining lyrics and melody may be beneficial for individuals with ASD.

Communication interventions using music

To date, there has been no research investigating the use of infant-directed singing with children with ASD but there has been limited research incorporating musical elements into communication interventions. In a recent paper, Simpson and Keen (2011) reviewed experimental studies incorporating musical elements in interventions with children with ASD and identified only two studies specifically targeting language learning (Buday, 1995; Simpson & Keen, 2010). Buday (1995) targeted expressive language by comparing song and spoken conditions to teach spoken and signed words to children (4-9 yrs) with ASD. Learning was more effective and the children were viewed as more attentive in the song compared to spoken condition. In Simpson and Keen's (2010) study, receptive skills were effectively targeted by teaching picture names to young children (3-4yrs) with ASD, incorporating a familiar melody "Old Mac Donald" into a computer-aided intervention. After publication of the Simpson and Keen review, Lim (2010) compared the use of an accompanied song, spoken and no instruction, on verbal production in young

children with ASD. Children's verbal production improved following both instruction conditions compared to the no instruction condition.

These studies provide some support for the use of music in communication interventions for children with ASD. However, they have involved small numbers with only one study directly comparing sung and spoken conditions, and maintenance and generalisation data have not been reported. Given the challenge children with ASD experience in generalising learning from intervention conditions to other materials and environments (L. K. Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998) this is an important consideration in determining the effectiveness of intervention strategies. No studies have been identified that directly compare the effects of infant-directed song and infant-directed speech on aspects of language learning in children with ASD. In view of the associative relationship between infant-directed speech and language acquisition, the reduced responsivity individuals with ASD demonstrate to infant-directed speech and their listening preference for music stimuli, infant-directed song may provide a means of enhancing language learning.

The aim of this study was to determine if musical elements facilitate receptive labelling in young children with ASD. Learning outcomes for participants were compared following two intervention conditions: infant-directed song and infant-directed speech. It was hypothesized that performance in the infant-directed song condition would be superior as the musical elements would facilitate receptive labelling. Generalisation and maintenance conditions were also included to address limitations of previous studies in this area.

The following research question guided the study: Do children with ASD and severe language delay demonstrate an increased ability to learn picture labels using infant-

directed song compared to infant-directed speech? In this event, we may conclude that musical elements facilitated language learning with this group of children.

Methods

Participants

Twenty two children with a Paediatrician's diagnosis of ASD participated in this study. Participants were part of a larger study, being conducted by the authors, investigating the use of musical elements to support learning in children with ASD. The diagnosis of ASD was confirmed for each child using the Social Communication Questionnaire (SCQ; Rutter et al., 2003). The SCQ is a parent-completed questionnaire that is used as a screening tool for ASD (Eaves et al., 2006). All participants in the study exceeded the ASD cut-off score on this tool (≥ 15). The mean chronological age of participants was 5.88 ($SD = 1.60$; range 3yrs 9mths - 8yrs 9mths). The ratio of males to females was 3.4:1. Participants displayed severe delays in expressive and receptive language skills based on assessment using the Expressive Vocabulary Test 2nd edition (EVT; Williams, 2007) and the Peabody Picture Vocabulary Test 4th edition (PPVT; Dunn & Dunn, 2007). All participants scored at or below the 0.1 percentile on the EVT and PPVT with the exception of two participants who scored 0.5 and 6 on the EVT. Both the EVT and PPVT are norm-referenced instruments that demonstrate robust psychometric properties (Dunn & Dunn, 2007; Williams, 2007). These two tests assessed expressive and receptive vocabulary attainment of participants and allowed for comparison of attainment levels of individual participants to their peers and to other participants. The Scales of Independent Behavior Early Development Form (SIBR; Bruininks et al., 1996) is a test used to assess adaptive behaviour skills and problem behaviour in children functioning below eight years. All participants scored below the chronological age equivalent of 4 years. There was a wide range in scores for maladaptive behaviors with participants'

behavior described as marginally serious to very serious, requiring frequent to pervasive support. Ethics approval for the study was obtained from the Human Research Ethics Committee of the authors' University (Q2010 66) and research approval was obtained from the local State Education board. Potential participants were identified through state-funded special schools across Queensland, within a maximum distance of 50kms from the researchers' base. School principals identified children for the study based on the inclusion criteria: (1) a confirmed diagnosis of ASD from a Paediatrician, (2) aged between 3.5 and 8 years old, and (3) identified by the class teacher as individuals with limited communication skills, requiring augmentative and alternative communication support.

Parent/guardian permission was obtained for 47 participants. Two participants did not match the eligibility criteria, six children were unable to participate due to conflicts in scheduling and eleven children demonstrated existing knowledge of the picture symbols determined during a pre-intervention testing session. Data from a further six children were excluded from analyses: two of these children left the school part way through the intervention, four were distressed during early sessions, engaged in serious challenging behaviour, and were therefore excluded for ethical and safety reasons.

Design

A cross-over design (Hills & Armitage, 1979) was used to compare the learning outcomes for participants in two intervention conditions: infant-directed song and infant-directed speech. The participants were randomly assigned to one of two groups. Group 1 received the sung followed by the spoken condition while Group 2 received the spoken followed by the sung intervention condition. This design was used to compare the effect of the two intervention conditions, infant-directed song (sung) and infant-directed speech (spoken) on receptive labelling skills in young children with ASD.

Materials

Participants were required to label garden creatures. Two comparable sets of materials were required so that performance could be compared across the two different intervention conditions. Each set of materials consisted of a contextual sentence (sung or spoken depending on the intervention condition), a request to touch a picture, and four creatures (see Table 7.1). The two sets of garden creatures were counterbalanced across intervention conditions.

Table 7.1.

Material Sets

Set	Contextual sentence	Instruction	Creature
1	In my garden come and find the little creature that I say.	Touch the ...	Daddy Longlegs, Dragonfly, Stinkbug, Slug
2	Little creatures everywhere can you find the one I say?	Touch the ...	Praying Mantis, Cockatoo, Gecko, Wasp

The lyrics and instructions were delivered via a computer interface and vocal recordings for each set were made by a professional female musician. They were recorded in the presence of a four month-old infant during a play session to provide naturalness in creating the prosodic characteristics facilitated by the infant’s presence (Trainor, 1996). The sung lyrics were set to the melody “Twinkle, Twinkle Little Star”.

Both sung and spoken recordings displayed moderately soft dynamics that were maintained at an even level, and warm timbre. This is consistent with research identifying the emotional expression of warmth observed in infant-directed speech (Trainor et al., 2000). The lyrics were delivered slightly faster during the spoken sound files (7 seconds) compared to the sung sound files (10 seconds). There was no sense of meter in the spoken conditions; in contrast the sung files displayed a simple quadruple meter. Analysis of the

sound recordings indicated the pitch range was in accordance with the previous research using speech and playsongs directed to four month olds (McRoberts et al., 2009; Trainor et al., 1997). Frequency recorded during the sung bites was 220 – 370Hz compared to the spoken sound bites 174.61 Hz (220 Hz set one) to 493.88 Hz with the majority of the speech occurring between 277-311 Hz. The melodic contour in the sung recordings displayed a specific intervallic rise and fall compared to the mellifluous contour evident in the spoken recordings. Thus the sung and spoken recordings differed only in the musical elements of melody and rhythm.

The creatures were presented visually via the computer interface using coloured Picture Communication Symbols (PCS) selected from Boardmaker version 6 (Mayer-Johnson, 2007). Consideration was given to equating the two sets of creature PCS on visual characteristics of colour and type of creature.

Settings

A touch screen monitor was used to reduce the dependency on eye-hand skills required when using a mouse (Huguenin, 2004; Light & Drager, 2007). The monitor was a 40cm touch screen with an adjustable stand that could be situated on a table and adjusted for the child. Creature PCS were presented on the screen using Microsoft Office PowerPoint 2007. The use of a computer program to deliver the instructions and PCS allowed for a standardised presentation of the intervention in a consistent format, removing the potentially confounding effect of inconsistency of presentation (Goldsmith & LeBlanc, 2004; Panyan, 1984). The intervention sessions were conducted at the participants' schools. They occurred in a separate room to avoid disruptions to the class and data collection. The participant was positioned on a chair, facing the monitor placed at eye level. The researcher was positioned adjacent to the participant. A video recorder was positioned on a tripod to the side of the participant to capture the participant's eye gaze.

Procedure

Prior to the commencement of each session, participant consent was obtained. Participants were shown a visual symbol of the computer and invited to attend the session. Expression of consent was assumed if the participant willingly accompanied the researcher, while refusal was viewed as a withdrawal of consent for that session. The duration of each session was 3-6 minutes.

Participants in Group 1 received the sung condition first, followed by the spoken condition while Group 2 received the conditions in the reverse order. All other procedures were identical for both conditions. The intervention consisted of baseline, training, teaching sessions, generalisation and maintenance (at one-month follow-up). Each intervention condition was conducted within a five-week time period with a break of one month between the two intervention conditions.

Baseline. During baseline, horizontal arrays of three creatures were displayed on the monitor. Data were collected on the number of times a participant touched the correct creature following the instruction to do so. Touching any creature activated the presentation of the next slide. Each creature was requested three times during the baseline session. The order of presentation of the creatures, the position of the creature PCS in the array and the selection of the distractor PCS was randomly generated using the computer program described below (see intervention sessions). No error correction or reinforcement procedures were used. Correct and incorrect responses were recorded and sessions were video recorded.

Training Sessions. Each participant received four training sessions. In every session, the creature PCS were individually presented three times. A correct response involved touching the correct PCS on the screen within 10 seconds. If the participant did not make a correct response within a 10-second period the researcher prompted a correct

response following a least-to-most prompt hierarchy (Duker et al., 2004). A correct response (unprompted and prompted) triggered the next slide which displayed the correct creature PCS using the “spin” animation and simultaneously the pre-recorded name of the creature was presented in a way consistent with the intervention condition (sung or spoken). The order of presentation of creatures, and the position of the PCS on the screen (left, centre, right) were randomized across the training sessions.

Teaching Sessions. A block of fifteen teaching sessions was conducted. Creature PCS were presented in arrays of three: one target and two distracter PCS from the set. During each session a creature was presented three times. The time delay and prompt hierarchy were identical to the training session. The order of presentation of creatures, the position of the correct PCS in the array and the selection of the two distracter PCS was generated by means of a program developed using Microsoft (.net 2008) C# program language. The random selection of arrays reduced the possibility of rote learning positional responses and avoided positional bias selection (Duker et al., 2004). A correct response was recorded by the researcher on unprompted correct responses.

Maintenance. Maintenance data were collected 3-5 weeks following the cessation of the last teaching session in each intervention condition. The maintenance session procedures replicated the intervention sessions. Data were collected on the participants’ (correct/incorrect) responses.

Generalisation and assessment. Generalisation training took place during the five-week period of the intervention. This involved the labels being presented in a different setting (the classroom) by different people (teacher, teacher aide, volunteer, researcher) using a regular speaking voice. Black and white PCS of each creature were presented in a laminated 10 cm x 10 cm booklet. The booklets were shared with the participants on the days they attended school. Frequency of generalisation sessions did not vary for individual

participants across the two conditions, but did vary between participants depending on their school program.

Generalisation was assessed following the last teaching session. Participants were presented with a laminated A4 booklet containing 12 pages, positioned on a vertical slope board. Each page displayed a horizontal array of three colour creature PCS consistent with the teaching condition. The researcher, using her regular speaking voice, provided the prompt “Touch the (creature name)”. Each of the creatures was presented three times. No error correction or reinforcers were employed. The assessment was conducted in the same room as the intervention. Data were collected on the participants’ (correct/incorrect) responses and the session was videotaped to enable inter-rater reliability.

Data Analysis

Data analysis was designed to compare the effect of the two intervention conditions, infant-directed song (sung) and infant-directed speech (spoken) across time, baseline (pre-intervention, session 15 (post-intervention), and maintenance and generalisation on receptive labelling skills in young children with ASD in Group 1 (sung, spoken) and Group 2 (spoken, sung). The analyses, using IBM SPSS Version 19, were as follows:

1. A 2x2x3 (Group [1, 2] x Condition [sung, spoken] x Time [baseline, session 15, maintenance]) ANOVA was undertaken to determine whether either of the groups’ correct response scores were significantly different for the two intervention conditions and at each of the time periods, and to determine if there was an interaction between order of presentation and condition across time.
2. A two-way repeated measures ANOVA was undertaken on correct response scores in both Group 1 and Group 2 to determine if there was a

significant difference for the two intervention conditions, between sessions 15 and generalisation. These analyses were conducted to determine whether learning demonstrated as a result of the intervention was generalised for either of the groups.

Interobserver Reliability

The use of a computer interface for the intervention task allowed for infinite presentations without degradation of fidelity (Mineo et al., 2009). This also provided an inbuilt fidelity for recording correct responses for the intervention phase. Activation of the slide was dependent upon the participant's selection of the correct picture. Reliability was assessed on sessions where there was no inbuilt fidelity (baseline and generalisation). A test of reliability was conducted on a random sampling of 30% of the video recordings by a second observer trained in the data recording but blind to the purpose of the study. Sampling was representative of participants in both baseline and generalisation phases. The Kappa Measurement of Agreement value on the baseline data was .93 (occurrence 87.5%, nonoccurrence 100.0%); and on the generalisation data was .93 (occurrence 94.1%, nonoccurrence 98.7% incorrect).

Results

The mean correct response scores for Group 1 and Group 2 in both intervention conditions (sung and spoken) for baseline, session 15 and maintenance, and generalisation are presented in Table 2.

Table 7.2.

Group 1 and 2 Correct Response Scores

	Group 1 (<i>n</i> = 11)		Group 2 (<i>n</i> = 11)	
	Sung <i>M</i> (<i>SD</i>)	Spoken <i>M</i> (<i>SD</i>)	Spoken <i>M</i> (<i>SD</i>)	Sung <i>M</i> (<i>SD</i>)
Baseline	1.91 (0.83)	1.55 (0.82)	2.55 (1.04)	1.91 (1.30)
Session 15	3.36 (3.50)	2.55 (2.77)	6.45 (4.03)	5.91 (5.28)
Generalisation	3.36 (3.50)	1.91 (2.34)	5.00 (4.47)	6.09 (5.45)
Maintenance	3.55 (3.21)	2.45 (2.58)	6.45 (3.83)	6.55 (5.13)

Comparison of group, condition and time

A 2x2x3 mixed between-within subject ANOVA was applied to the results in Table 2 to compare groups' correct response scores in the sung and spoken intervention conditions across three time periods. A significant main effect for group was obtained $F(1,20) = 5.96, p = .02, \eta^2 = .23$, identifying 23% of the variance in scores was due to the group. No significant main effect for condition was found $F(1,20) = 0.14, p = .71$. A significant main effect for time was obtained, however, as sphericity was violated for time, adjustment was made using the Greenhouse-Geisser F resulting in $(1.39,20) = 12.94, p < .001, \eta^2 = .39$. There was no significant interaction for group and condition, group and time, condition and time, and group, condition, and time. This indicates there were no differences as a result of any unique interactions between group, condition and time. Furthermore the results suggest there was no effect for condition (sung or spoken) however there were differences due to the group regardless of condition and there were differences due to time regardless of condition. Further analysis was conducted to determine where the difference lay across the 3 time periods. Post hoc tests using the Bonferonni adjustment

revealed a significant increase from baseline ($M = 1.93$, $SD = 1.05$) to session 15 ($M = 4.57$, $SD = 4.21$), $p = .005$ and large effect, $d = 0.86$ and baseline ($M = 1.93$, $SD = 1.05$) and maintenance ($M = 4.75$, $SD = 4.09$) $p = .002$, and large effect, $d = 0.94$. There was no significant difference between maintenance and session 15, $p > .05$. These results indicate that the level of correct responses significantly increased with intervention and this level was maintained at follow-up.

Generalisation

A two-way repeated measure ANOVA was applied to the results for Group 1 and Group 2 (Table 2) to compare correct response scores for the condition (sung/spoken) in Session 15 and the generalisation session. There was no statistically significant main effect for Group 1 on condition $F(1,10) = 0.95$, $p = .35$ or session $F(1,10) = 0.10$, $p = .75$. There was no statistically significant main effect for Group 2 on condition $F(1,10) = 0.86$, $p = .77$ or session $F(1,10) = 0.54$, $p = .48$. There was no significant interaction between condition and session for Group 1 or Group 2. These results indicate participants' learning was generalised and generalisation was not better following one intervention condition over the other.

Discussion

This study found that there was no significant difference in the use of a sung over a spoken presentation to facilitate the learning of picture labelling for children with autism. Participants maintained and generalised the receptive labelling responses gained during intervention following both conditions. There was however a significant difference between the level of correct responses between Group 1 and Group 2. These findings are discussed in terms of potential differences between the groups, similarities between the conditions with reference to implications for practice, future research and study limitations.

Group comparison

Participants were randomly assigned to the groups to reduce the effect of any participant variability. In addition the two groups demonstrated no differences on the screening measures in terms of chronological age, receptive and expressive language and adaptive functioning and behaviour. Despite this, there was a significant difference in the levels of correct responses between groups in both conditions suggesting that there may have been between group differences that were not detected. This may have been due to a lack of sensitivity in the screening measures used or differences among participants in a characteristic not assessed in this study.

Participants expressive and receptive language skills were assessed used the EVT and PPVT for descriptive purposes. These norm referenced tests commence at the developmental age of 2 years 6 months. There were only two participants who scored above the .1 percentile on the EVT. These participants were both in Group 2 which may have resulted in noted differences between these groups. While there was not a significant difference between groups on this measure, learning outcomes may have been particularly sensitive to very small difference in the level of pre-intervention expressive language skills. These two participants scored below 0.1 percentile on the PPVT indicating their receptive language ability may be more impaired than expressive language ability, consistent with the finding of research by Hudry et al. (2010) and highlighting the importance of addressing receptive language learning. In any case, expanding the range of measures used to identify and describe participants and employing more sensitive measures, particularly of expressive language skills, would be important for any future studies in this area.

Sung and spoken conditions

Both the sung and spoken interventions increased the participants' receptive labelling responses, consistent with previous findings that identified language production increased in young children with autism following both music and speech interventions (Lim, 2010). Unlike earlier research (e.g. Buday, 1995), song did not lead to superior learning when compared to speech. The infant-directed song used in this study involved a solo voice without instrumental accompaniment, as is typically observed in caregiver singing to infants. Song can also include additional musical elements not included in this study, such as harmony and texture. The potential for these elements to facilitate learning in children with autism has yet to be investigated. It is possible that the learning in this study was influenced by commonalities between the two intervention conditions, identified as, similarities in the auditory stimuli, teaching strategies, and the use of a computer interface.

Common to both the sung and spoken conditions was elevated pitch. That pitch may be a salient feature for language learning is supported by previous research that has found individuals with autism have preserved or enhanced processing ability of linguistic pitch (Heaton et al., 2008; Järvinen-Pasley, Pasley, & Heaton, 2008) and musical pitch (Heaton, 2005; Mottron et al., 2000). In addition, although the sung and spoken stimuli differed in terms of rhythm, a rhythmic pattern was apparent in both the sung and spoken conditions. In the sung condition the use of meter was evident by the temporal regularity of the music, while the spoken stimuli displayed a sense of rhythmic quality not tied to a meter but produced by regularly stressed syllables. The rhythmic pattern provided a structure for the lyrics that could have potentially aided information encoding and word detection. This is consistent with research that has shown that recognition of word order by young infants is aided by the organizational framework of prosodic sentences compared to

the use of fragmented or part sentences (Mandel, Nelson, & Jusczyk, 1996). The commonality of the auditory input between the two conditions may have contributed to the maintenance and generalisation of the learning. Previous research has found song aids long-term recall (Rainey & Larsen, 2002); this study showed learning was maintained in the sung condition. Learning was also maintained following the spoken condition. Further research is required to gain a more sophisticated understanding of the impact of the musical elements of pitch and rhythm on the language processing of children with autism.

The intervention procedures in both conditions used strategies based on applied behavior analysis that have a strong evidence base. A number of these strategies have also been identified as features of typical language learning, such as the use of a familiar frame to cue the target word (Fernald & Mazzie, 1991; Fernald, McRoberts, & Swingley, 2001); reinforcing the target word in a singular format (Lew-Williams, Pelucchi, & Saffran, 2011), and the repetitive nature of the utterances (McRoberts et al., 2009). Furthermore, this intervention was presented using a computer interface. Given the responsiveness to computer instruction by children with autism (Moore & Calvert, 2000) the use of the computer interface may have contributed to the intervention outcomes in this study. The impact of using effective practices in conjunction with the infant-directed stimuli on language learning in young children with autism requires further consideration.

Limitations

There were a number of limitations to the study that should be considered when interpreting these results. The cross-over design and sample size helped to control for variability in performance across participants. However, no one intervention has been found to be effective for all children with ASD (Magiati et al., 2012) and caution is warranted in generalizing any intervention results to all children with autism.

A further limitation of this study was that the number of intervention sessions was dictated by the school calendar. Intervention studies frequently teach to criteria, even if that requires a large number of intervention sessions (see Grow et al., 2011). In this study, participants did not have the opportunity to reach predetermined learning criteria. As research has shown that music stimuli are engaging for children with autism, it would be interesting to determine if music could act as a mediating or moderating variable on performance in relation to intervention duration (Blackstock, 1978; Buday, 1995; Carnahan, Basham, et al., 2009).

This study compared sung and spoken interventions to teach receptive labelling skills to young children with autism. The results did not support the use of sung over spoken conditions to facilitate language learning in this context. Learning occurred in both conditions and natural forms of vocal stimuli used in the intervention and that occur during the prelinguistic stage of typical development may contribute to language learning in children with autism.

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Chapter 8: Study 2 - Engagement

This chapter presents the findings from Study 2, investigating the influence of the use of musical elements compared to non-musical elements relate to engagement and learning outcomes for children with autism and severe language delay in a receptive labelling task. The paper has been accepted for publication in the journal *Research in Autism Spectrum Disorders*. The paper has been formatted to meet the submission requirements of the journal *Research in Autism Spectrum Disorders* and includes the use of American spelling. The page numbers have been re-numbered to be consistent throughout the thesis. The Tables have been presented in-text and re-numbered with the preface of 8. Heading numbers have been re-numbered with the preface of 8.

The use of music to engage children with autism in a receptive labelling task

Children with autism are less engaged with social and non-social objects and activities than their typically developing peers, resulting in reduced learning opportunities. There is some support for the use of music to enhance the engagement of children with autism but there has been little research investigating the use of music to engage children in language learning tasks and determining if this impacts on learning outcomes. This study investigated the use of music to engage children with autism in a receptive labelling intervention. Twenty two children (mean age 5.9 yrs) participated in a randomised controlled cross-over design comparing sung and spoken conditions embedded into a computer based intervention. Child performance and observational data were analysed to determine relationships between music, engagement and learning outcomes. The findings from this research showed children with autism were more engaged in the sung condition compared to the spoken condition although there was considerable variability in levels of engagement between participants. Furthermore, a correlation between engagement and learning was found. Implications of these findings are discussed and recommendations made for future research.

Keywords: engagement, autism, music, language learning, intervention

Highlights:

- We compared an intervention using sung and spoken instructions
- Children with autism were more engaged in the sung condition
- There was a correlation between levels of engagement and language learning
- There was wide variability in engagement levels between participants

8.1.Introduction

Promoting and supporting engagement for children with Autism Spectrum Disorder (ASD) is viewed as a critical feature of effective learning interventions (Corsello, 2005; National Research Council, 2001). Children with ASD spend less time engaged in social and non-social activities than their typically developing peers and children with other developmental disabilities resulting in reduced learning opportunities (Kishida & Kemp, 2006; McWilliam & Bailey, 1995; Ruble & Robson, 2007). Identifying ways to promote engagement has been complicated by the variety of interpretations and definitions of engagement in the research literature. This is possibly due to the multidimensional construct of engagement combining behavioural, emotional and cognitive components (Fredricks, Blumenfeldm, & Paris, 2004; Keen, 2009). In learning programmes, engagement is generally assessed in behavioural terms and refers to an individual's sustained attention or appropriate interaction with people or objects in their environment (Hurth, Shaw, Izeman, Whaley, & Rogers, 1999; McWilliam & Bailey, 1995).

Engaging individuals with ASD in learning programmes may require deliberate manipulation of materials, activities and the environment. These include the use of activity schedules (Bryan & Gast, 2000); using motivational variables including the child's interests and preferences (Hurth et al., 1999; Rispoli et al., 2011) and providing choices (Ulke-Kurkcuoglu & Kircaali-Iftar, 2010); and treatment packages incorporating motivational variables (Koegel, Singh, & Koegel, 2010; Pelios, MacDuff, & Axelrod, 2003). Despite this there is still a limited understanding of engagement and how this can be promoted in learning tasks for children with ASD.

One way of increasing engagement that has been investigated is the use of music. When provided with auditory stimuli individuals with ASD have shown a preference for music over verbal stimuli (Blackstock, 1978; Buday, 1995). The use of music to target individual

goals or skills has been classified as an emerging evidence-based practice in the USA National Standards Project (National Autism Center, 2009).

Literature pertaining to the use of music to facilitate engagement in children with ASD has focused predominantly in the area of social-communicative behaviours (Edgerton, 1994; Stephens, 2008; Wimpory, Chadwick, & Nash, 1995; Wimpory, Hobson, & Nash, 2007). Interventions have included the use of music to increase peer interactions (Kern & Aldridge, 2006) and to increase responsivity and the initiation and duration of social engagement between children with ASD and adults (Finnigan & Starr, 2010; Kim, Wigram, & Gold, 2009).

Music has also been used in interventions to decrease challenging behaviours that may interfere with learning and to increase task engagement. For example, music has been used effectively with one child with ASD to reduce problem behaviour and increase on task behaviour during stressful situations (Orr, Smith Myles, & Carlson, 1998). Improvement in on task behaviour has also been achieved by using music as a reinforcer (Gunter & Fox, 1993). The effectiveness of music as a reinforcer for on task behaviour may, however, be dependent on the characteristics of the task as Gunter and Fox (1993) found task performance improved on vocational but not academic tasks. It may be that academic tasks were considered less desirable than vocational tasks by participants in this study and that music was not sufficiently reinforcing in this context. While music may provide a more engaging learning environment for children with ASD, there has been little research into the use of music to engage children with ASD in language learning activities.

Carnahan and associates incorporated music in a daily small group language arts lesson to investigate engagement in a group of children including five children with ASD, over an eight-week period (Carnahan, Basham, & Musti-Rao, 2009; Carnahan, Musti-Rao, & Bailey, 2009). Lessons using interactive books with music led to higher levels of

engagement compared to interactive books without music. Although engagement increased in the music context the authors did not report whether this impacted on the children's language learning during the activity. Buday (1995) found language learning increased when manual signs were taught in a song compared to a spoken context. Engagement was not measured in this study although the author made a personal observation that task engagement appeared to increase during the song condition. To date, research indicates that music may have the potential to facilitate engagement but no studies have considered the relationship between music, engagement levels and language learning outcomes. The limited research investigating the use of music to engage children with ASD in interventions to facilitate language acquisition is perhaps surprising considering speech used during infancy is sometimes referred to as 'musical' (Malloch, 1999; Trainor, Clark, Huntley, & Adams, 1997; Trehub & Nakata, 2001-2002). Terms such as 'motherese', 'babytalk', or 'infant-directed speech', refer to the particular speech caregivers ubiquitously use with infants characterised by elevated pitch, wider pitch range, shorter and repetitive utterances (Fernald & Simon, 1984). This speech serves the function of gaining the infant's attention, conveying communicative intent and facilitating language acquisition (Fernald, 1989; Singh, Nestor, Parikh, & Yull, 2009; Trainor, Austin, & Desjardins, 2000). Infant-directed speech is more effective in engaging and maintaining the attention of infants than adult-directed speech and this pattern continues into their second year of life (Cooper & Aslin, 1994; McRoberts, McDonough, & Lakusta, 2009; Werker & McLeod, 1989). The affective and prosodic characteristics of infant-directed speech appear to serve an attention getting function (Papoušek, Bornstein, Nuzzo, Papoušek, & Symmes, 2000; Stern, Spieker, Barnett, & MacKain, 1983) with the exaggerated pitch aiding speech processing for the prelinguistic listeners (Fernald & Kuhl, 1987; Fernald & Mazzie, 1991). These features continue to be used by toddlers to aid in

word recognition (Song, Demuth, & Morgan, 2010). Although children with ASD are less responsive to infant-directed speech than their typically developing peers, a relationship between the time children with ASD spend attending to audio presentations of infant-directed speech and their language performance has been reported (Kuhl, Coffey-Corina, Padden, & Dawson, 2005; Paul, Chawarska, Fowler, Cicchetti, & Volkmar, 2007). The relationship between attending to infant-directed material and language abilities may be dependent on the development age of the individual. Santarcangelo and Dyer (1988) found teenagers with ASD functioning at a developmental age below 3 yrs were more responsive to instructions delivered using speech characterised by infant-directed speech prosody compared to conversational speech. These studies raise the question of whether increasing the child's engagement with the affective and prosodic characteristics of infant-directed speech could result in improved language outcomes.

Characteristic features of infant-directed speech which include elevated pitch and slower tempo have also been noted in infant-directed song (Fernald, 1989; Trainor et al., 1997). Infant-directed song as with infant-directed speech also communicates affect and serves a function in regulating the young child's arousal state (Trainor, 1996; Trehub & Schellenberg, 1995; Trehub, Trainor, & Unyk, 1993). It would appear that pitch may impact on the infant's level of engagement with his/her external environment. Lullabies serve the purpose of soothing the infant and reducing their focus on the external world and tend to be sung at a lower pitch compared to playsongs that arouse the infant and increase their attention on their external world (Rock, Trainor, & Addison, 1999; Tsang & Conrad, 2010). In addition playsongs demonstrate a high rhythmicity highlighting the songs phrase structure (Trainor, 1996). Playsongs may therefore have the potential to increase engagement in learning activities and highlight linguistic structure.

To date there has been no investigation comparing infant-directed song and infant-directed speech on the engagement levels of children with ASD, despite infant-directed song sustaining the attention of typically developing infants longer than infant-directed speech (Nakata & Trehub, 2004). Given the potential for music to engage children with ASD, enhancing the characteristics of infant-directed speech by adding the use of structural musical elements may increase their engagement in a language learning task. The purpose of this study was to investigate whether the use of music during task instruction facilitated engagement of children with ASD and to examine the relationships between music, engagement and learning outcomes.

8.2. Materials and methods

8.2.1. Participants

The participants were part of a larger study being conducted by the authors investigating music interventions with children with ASD. Twenty two children with ASD aged between 3½ years and 9 years (mean age 5.9 yrs) completed this study. In addition to a Paediatrician's diagnosis of Autism Spectrum Disorder, the children were assessed using the Social Communication Questionnaire (SCQ; Rutter, Bailey, Berument, Lord, & Pickles, 2003). All participants met criteria for ASD based on the cut off score of 15 on the SCQ. The Scales of Independent Behaviour Revised (SIB-R; Bruininks, Woodcock, Weatherman, & Hill, 1996) was used to assess children's adaptive behaviour skills. Scores on this test indicated children required frequent to pervasive support. Class teachers identified children as individuals with limited communication skills, requiring Alternative and Augmentative Communication systems. Additional information about the children's communication skills was gathered using the Expressive Vocabulary Test (EVT-2: Williams, 2007) and Peabody Picture Vocabulary Test (PPVT-4: Dunn & Dunn, 2007).

Only one participant scored above the 1st percentile on expressive language scores and all participants scored below the 1st percentile on receptive language scores.

This study was conducted with the approval of the State Government Department of Education and Training and the Human Research Ethics Committee of the authors' University. Teacher and parental/guardian permission was obtained prior to the commencement of the study. Children's permission was obtained prior to the commencement of each session using a picture communication symbol.

8.2.2. *Design*

A cross-over design (Hills & Armitage, 1979) was used to compare the effect of sung and spoken conditions on participant's engagement and learning during an intervention where they were required to label garden creatures. Children were randomly assigned to one of two groups. Group 1 received the sung intervention condition first followed by the spoken intervention condition while group 2 received the spoken condition first followed by the sung condition. The second intervention condition commenced one month after the cessation of the first intervention condition for both groups.

8.2.3. *Stimulus materials and setting*

Two sets of comparable materials were developed using vocabulary based on a garden theme and consisted of a contextual sentence, a request to touch a picture, and four creatures (see Table 8.1). The melody used for the sung condition was "Twinkle, Twinkle". Sung and spoken recordings for each set were made of a female musician performing the materials in the presence of infants to facilitate the emotional expressions observed in infant-directed speech and song (Trainor, 1996; Trainor et al., 2000). The sets were counterbalanced across the sung and spoken conditions to control for potential order and set effects.

Table 8.1.

Material sets

Set	Contextual sentence	Instruction	Creatures
1	In my garden come and find the little creature that I say.	Touch the ...	Daddylonglegs, Dragonfly, Stinkbug, Slug
2	Little creatures everywhere can you find the one I say?	Touch the ...	Prayingmantis, Cockatoo, Gecko, Wasp

The lyrics were performed as a playsong. The sung recordings were of 10 s duration, used a simple quadruple metre and displayed a melodic contour with a specific intervallic rise and fall. In contrast, the spoken recordings were not driven by a sense of metre and were delivered slightly faster (7 s) displaying a mellifluous contour. The pitch range recorded in the sung and spoken recordings was consistent with the pitch range evident in playsongs and infant-directed speech (McRoberts et al., 2009; Trainor et al., 1997). Thus the sung and spoken recordings differed only in the musical elements of melody and rhythm.

The creatures were represented using Picture Communication Symbols (PCS) selected from Boardmaker V. 6 (Mayer-Johnson, 2007). The PCS were displayed using a PowerPoint presentation embedded with either the infant-directed sung or the infant-directed spoken recordings. The PowerPoint was displayed on a 40cm touch screen monitor which the child activated by using his/her hand or finger. The audio materials were delivered through the computer speakers at normal conversational volume. Each individual session was conducted in a separate room within the participants' school. The participant sat at a table positioned in front of a touch screen monitor. The first author sat beside the participant. The video recorder was positioned on a tripod to the side of the participant to capture the participant's eye gaze.

8.2.4. *Procedure*

The sung and spoken intervention conditions followed an identical procedure. The intervention consisted of fifteen teaching sessions. During each session the four creatures in the set were randomly named three times. The audio file (contextual sentence, request and creature name) accompanied the picture presentation. The correct picture and two selected pictures from the set were displayed using a three picture horizontal array. Incorrect response or lack of response within a 10 s time period resulted in error correction using a least to most prompt hierarchy (Duker, Didden, & Sigafoos, 2004). Touching the correct picture (unprompted/prompted) activated the next slide displaying the correct creature PCS and simultaneously presenting the pre-recorded name of the creature. The order of presentation of creatures, the position of the PCS on the screen (left, centre, right) and the selection of the PCS array were randomly assigned across the session.

8.2.5. *Recording and coding procedure*

Videotape data was collected for each participant. Duration for each session ranged from 3 to 6 min depending on the participants' response time. Videotapes were analysed using 5 s intervals. In addition to occurrences of 'engagement', occurrences of 'challenging behaviour' were also recorded for each 5 s interval for each participant as these behaviours can occur frequently in children with ASD (Georgiades et al., 2011) and can interfere with children's optimal learning and engagement. Engagement was coded if for the duration of the 5 s interval, the child sat on the chair, at the table, looking at the computer screen, and responded to the instruction or prompts and if no challenging behaviours were coded during the interval. An interval was coded as challenging behaviour if, at any time during the 5 s interval, the child left the table; displayed destructive behaviour towards the test materials (e.g. hitting or pushing the screen with force) or aggressive behaviour towards the researcher or themselves (e.g. hitting, biting or scratching); or demonstrated disruptive

behaviour described as crying, screaming or non-compliance (not responding to full physical prompt).

Percentage of time engaged for each session was calculated by dividing the number of intervals the participant engaged in the behaviour by the total number of intervals in the session multiplied by 100. Due to the time required to undertake the detailed analysis and coding of the observational data collected, data from sessions 1, 5, 10, 15 were selected for analysis. These sessions provided a spread of intervals throughout the period of intervention.

Correct responses to the picture labelling task were recorded by the researcher. A response was recorded as correct if, within 10 s of giving the instruction, the participant selected the labelled picture unaided. The total number of correct responses for sessions 1, 5, 10 and 15 were recorded and used for analysis.

8.2.6. Reliability

Reliability was conducted on 30% of the video recordings for each participant in both conditions by a second observer trained in the data recording but blind to the purpose of the study. The video tape segments were randomly selected from the beginning, middle and end of each session and presented in random order to the second observer. The Kappa Measurement of Agreement value on engagement was .75 (occurrence 87%, nonoccurrence 88%) representing good agreement; and on challenging behaviour was .85 (occurrence 85%, nonoccurrence 91%) representing very good agreement (Peat, 2001). Only the data recorded by the primary observer were used for data analysis.

8.2.7. Data analysis

Data analysis was designed to compare the effect of the two intervention conditions, sung and spoken, at four time points across the intervention period (Sessions 1, 5, 10, 15), on

the level of engagement and behaviour in children with ASD in Group 1 (sung, spoken) and Group 2 (spoken, sung). The analyses, using IBM SPSS Version 20, were as follows:

- (1) A 2 x 2 x 4 (Group [1, 2] x Condition [sung, spoken] x Time[Sessions 1,5,10,15]) ANOVA was undertaken to determine whether engagement levels in either of the groups were significantly different for the two intervention conditions across time, and to determine if there was an interaction between order of presentation and condition across time.
- (2) Nonparametric tests were used on the behaviour data due to violation of parametric test assumptions of normality identified with the Shapiro-Wilk test. Wilcoxon Signed Rank was conducted to determine the main effect for condition (sung vs spoken); Mann-Whitney *U* test compared behaviour levels in Group 1 and Group 2; and Friedman tests were conducted on behaviour levels across time in the sung condition, and the spoken condition.
- (3) Pearson's correlation was used to determine the relationship between levels of engagement and correct responses. Spearman Rank Order Correlation was used to determine the relationship between levels of behaviour and correct responses because the data did not meet test assumptions.

3. Results

Participants' levels of engagement and behaviour were recorded as percentages of time.

The mean (*SD*) scores for Group 1 and Group 2 in both intervention conditions (sung and spoken) for session 1, session 5, session 10, and session 15, are presented in Table 2.

Participant's mean correct response scores and standard deviations are also displayed in Table 8.2.

Table 8.2.

Levels of engagement, challenging behaviour and correct responses

	Sung condition				Spoken condition			
	Session 1	Session 5	Session 10	Session 15	Session 1	Session 5	Session 10	Session 15
Group 1								
Engagement	63.18(17.05)	59.91(25.72)	38.18(18.51)	43.18(26.42)	39.36(19.81)	38.36(23.48)	39.36(23.15)	28.55(22.25)
Behaviour	7.55(4.61)	11.18(20.15)	17.73(20.32)	24.27(27.18)	16.91(17.80)	30.00(27.16)	15.36(17.89)	40.55(36.99)
Receptive	3.55(1.97)	4.18(3.34)	4.09(2.74)	3.36(3.50)	3.27(2.57)	2.18(1.60)	2.27(1.95)	2.55(2.77)
Group 2								
Engagement	46.82(23.54)	55.45(16.67)	54.91(26.45)	59.27(22.81)	46.36(19.04)	56.55(28.55)	46.55(26.35)	53.45(22.02)
Behaviour	17.82(26.20)	5.82(9.55)	6.91(12.24)	7.82(11.86)	9.09(19.06)	7.27(8.39)	10.00(21.15)	9.91(19.46)
Receptive	3.82(4.09)	6.09(4.66)	6.73(4.80)	6.27(5.42)	4.55(2.98)	6.18(3.63)	5.73(4.32)	6.45(4.03)

8.3.1. Comparison of condition, group and time on levels of engagement

A 2 x 2 x 4 (Condition [sung, spoken] x Group [1, 2] x Time[session1, 5, 10, 15])

ANOVA was applied to the data in Table 2 to compare participants' level of engagement in the sung and spoken intervention conditions between groups across the intervention period. A significant main effect for condition was obtained $F(1,20) = 4.57$, $p = .04$, $\eta^2 = .19$, identifying 19% of the variance in engagement levels was due to the condition with participants more engaged in the sung compared to the spoken condition. No significant main effect for group was found $F(1,20) = 1.79$, $p = .19$. No significant main effect for time was found $F(1,20) = 2.26$, $p = .09$. There was no significant interaction for group and condition, condition and time, and group, condition, and time. There was, however, a significant interaction for group and time $p = .003$. For Group 1 there was a decrease in engagement over time while Group 2 displayed fluctuating levels of engagement across the four time periods. In summary, the condition (sung or spoken) had an effect on levels of engagement and there were differences between the groups' level of engagement over the sessions regardless of condition.

8.3.2. Comparison of condition, group and time on levels of challenging behaviour

The Wilcoxon Signed Rank Test revealed no significant difference in participants' levels of challenging behaviour between the sung and spoken condition $z = -1.84$, $p = .065$, $r = .23$. The Mann-Whitney U Test revealed a significant difference in the levels of challenging behaviour of Group 1 ($Md = 10$, $n = 88$) and Group 2 ($Md = 0.0$, $n = 88$), $U = 2378$, $z = -4.54$, $p < .01$, with a large effect $r = .5$. Friedman tests were conducted to compare levels of challenging behaviour for Group 1 and Group 2 during sung and spoken conditions across the four time periods. The Friedman tests showed no significant difference in challenging behaviour across the four time points in the sung condition for Group 1 $\chi^2(3, n = 11) = 3.19$, $p = .36$ but a significant difference in challenging behaviour

across the four time points in the spoken condition was found $\chi^2(3, n = 11) = 8.57, p = .03$. Further analysis was conducted to identify the difference across time for Group 1 in the spoken condition. Inspection of the median values showed a fluctuating performance in levels of challenging behaviour for Group 1 with an increase from session 1 ($Md = 7$) to session 5 ($Md = 18$) followed by a decrease at session 10 ($Md = 5$) and an increase at session 15 ($Md = 42$). The Friedman tests indicated no significant difference in challenging behaviour for Group 2 across the four time points in the sung condition $\chi^2(3, n = 11) = 1.01, p = .80$ or in the spoken condition $\chi^2(3, n = 11) = 3.42, p = .33$.

8.3.3. *Correlation between engagement, challenging behaviour and learning*

Important to this study was to investigate the relationship between engagement, challenging behaviour and learning. The relationship between total engagement scores and total correct response scores was investigated using Pearson's correlation coefficient.

There was a strong positive correlation between levels of engagement and correct responses in both the sung condition $r(20) = .64, p < .01$, and the spoken condition $r(20) = .71, p < .01$, with high levels of engagement associated with high rates of correct responding. Engagement accounted for 41% of the variance in correct responses in the sung condition and 50% of the correct responses in the spoken condition.

The relationship between total challenging behaviour scores and total correct response scores was investigated using Spearman Rank Order Correlation. There was no statistically significant correlation between challenging behaviour and correct responses in either the sung $r_s(20) = -.41, p = .06$ or spoken condition $r_s(20) = -.31, p = .16$.

8.4. Discussion

This study found the use of infant-directed singing was more engaging for children with ASD over infant-directed speech which is consistent with results from research conducted with typically developing children (Nakata & Trehub, 2004). Furthermore, there was a

positive correlation between engagement and learning. Whilst some children were consistently engaged across sessions others showed fluctuations in their levels of engagement across sessions.

Overall, this study found that using musical elements during an intervention to teach language skills to children with ASD enhanced engagement. This supports previous research indicating the use of music may provide a more engaging context for children with autism (Carnahan, Basham, et al., 2009; Carnahan, Musti-Rao, et al., 2009). This study extends previous research by identifying the musical elements which may contribute to promoting an engaging intervention, addressing a limitation identified in previous research on music interventions (review Simpson & Keen, 2011). The infant-directed song and infant-directed speech used in this study differed in terms of the musical elements of melody and rhythm. In the sung condition the lyrics were set to the melody “Twinkle Twinkle”. Several factors about this melody may have contributed to the engagement of the children with ASD who participated.

“Twinkle Twinkle” is a traditional children’s melody and has been used for a number of popular children’s songs including “Baa, Baa, Black Sheep” and the “ABC song”. This rhythmic melody displays repetitive musical elements that may be engaging. In addition, participants may have been familiar with the melody through prior exposure and there is some evidence that familiarity may have an impact on levels of engagement (Starr & Zenker, 1998).

Although there was no overall difference in levels of engagement between the groups, Group 1 displayed a decreasing trend in the levels of engagement from the first to the last session in both conditions. This indicates that as the intervention period progressed the participants in Group 1 became less engaged with the intervention task. Levels of challenging behaviour were also significantly higher in Group 1 compared to Group 2.

These findings suggest there may have been underlying differences between the participants in Group 1 and 2 which were not identified in this study, but impacted on the participants' response to the intervention.

In addition to differences between participants, levels of engagement may also have been impacted by the sequence order of the intervention conditions. Group 1 (sung/spoken) demonstrated significantly higher levels of challenging behaviour in the spoken condition (2nd condition) associated with a corresponding decrease in levels of engagement. A possible explanation is the levels of challenging behaviour increased when children went from an engaging learning activity (song condition) to a potentially less engaging (spoken condition) learning activity (Koegel et al., 2010).

Results from this study showed that increased engagement was strongly associated with an increase in correct responding regardless of intervention condition. Both intervention conditions included a computer interface and the use of evidence-based, applied behaviour analysis teaching strategies. It was not the purpose of this study to determine the relative contribution each of these might make to the child's engagement and learning but it would be reasonable to assume that the combination was beneficial based on findings from previous research (Moore & Calvert, 2000; National Autism Center, 2009; Pennington, 2010). In addition, both conditions involved the use of infant-directed stimuli which have been found to be more effective in engaging and maintaining the attention of typically developing infants. This may also be the case for the children with ASD who participated in this study, thereby enhancing levels of engagements and learning. Further research is required to determine if the auditory input in the form of infant-directed speech/song is more beneficial in promoting engagement and accuracy in receptive labelling tasks for children with ASD and severe language delay compared to alternate forms of auditory input.

There were a number of limitations that should be considered when interpreting these results. Although the engagement data demonstrated normality, the small sample size and wide variance across participants suggests caution in generalising these results to the broader population of children with ASD. The wide variance reported highlights the need to consider individual preference as not all children with ASD may find listening to music a positive experience (Devlin, Healy, Leader, & Reed, 2008).

In addition, this study used a small number of musical elements. The simple melody was sung without instrumental accompaniment. It would be interesting to manipulate musical elements and explore different music genres to better determine which musical features impact on levels of engagement and learning in children with ASD.

A challenge in this type of research is how to define and measure engagement. This study applied a behavioural definition of engagement which may at times have under-estimated engagement levels. For example, during an intervention session, one of the participants was out of his seat and not looking at the computer screen. However, at the auditory prompt to touch the named picture, he returned to the computer made a correct response, and then moved away. In this example, his behaviour while away from the table was coded as ‘challenging behaviour’ as it met the definition for this category, but his ability to respond appropriately to the instructions indicates that he was attending in some ways to the task. Furthermore his correct responding took less than five s, which was the threshold to define periods of engagement. Similar issues related to defining and measuring engagement have been reported by other researchers (Bagatell, 2012).

In conclusion, while some caution is warranted in generalising these results, this study supports the use of musical elements to facilitate engagement in a language learning task for children with ASD.

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Chapter 9: General Discussion

In this chapter, the findings from the studies undertaken as part of this thesis are drawn together and discussed. The contribution this research has made to our knowledge of receptive language development in children with autism and severe language delay is identified. The limitations of the research and future directions are discussed.

The purpose of this thesis was to determine if the musical elements evident in the prelinguistic language environment of typically developing infants were associated with receptive language outcomes and levels of engagement in children with autism and severe language delay. This research was developed from the various bodies of research literature relevant to language acquisition and engagement reviewed in Chapters 2 and 3. Prior to undertaking this research, the relationships between aspects of language learning and engagement were unknown. Results from this research, however, suggest that musical elements may play a role in learning and engagement for children with autism.

The overall findings from this research showed that music enhanced engagement for children with autism, but did not significantly increase the number of correct responses made during a receptive labelling intervention task. That children with autism seem to like music has been an observation frequently cited in the literature but little has been done in researching the specific aspects of music that may appeal and/or facilitate engagement for these children. From the results of this current study, some possible reasons can be offered to explain how music may be engaging and more specifically what musical elements may enhance engagement levels for children with autism. In this research, both intervention conditions contained musical elements, but differed from each other in respect of melody and rhythm. It is therefore likely that these musical elements play an important role in engaging children with autism. Familiarity of the melody is another reason why children found the interventions engaging. The melody used in this study was well known and may

have been familiar to a number of participants and there is some evidence that familiarity may impact on levels of engagement (Starr & Zenker, 1998). In addition, the rhythmic structure of the melody was tied to a simple quadruple meter generating regular patterns of frequency ratios which is consistent with western music culture. Infants and children have demonstrated attentional preferences for this form of music (Schellenberg & Trehub, 1996a, 1996b) and this may hold true for children with autism.

Despite the correlation found in this research between engagement and learning, and that children were more engaged in the sung condition, the addition of the musical elements of melody and rhythm in the sung condition did not result in superior performance on the labelling task compared with the spoken condition without melody and rhythm. This is in contrast to previous research that found melody enhanced word learning in typically developing children (Thiessen & Saffran, 2009). It is difficult to interpret this finding, but it may indicate that children with autism have a different learning process than typically developing children that is not aided by melody. Another possible explanation is that while melody did not advantage children with autism in learning receptive labelling, it may be beneficial in the acquisition of other communication skills not assessed in this research. Finally, although children were more engaged in the sung condition, increasing the salience of the auditory input by adding musical elements may have increased the complexity of the auditory input impacting on the participants' learning. This could be explained by stimulus overselectivity, a phenomenon which is evident in many individuals with autism although not unique to this population (review Ploog, 2010). Overselectivity refers to the selective attention to one stimulus within a compound stimulus (Lovaas, Schreibman, Koegel, & Rehm, 1971). This applies within and across modalities (Ploog, 2010). When presented with a compound auditory-visual stimulus, as was the case in this research, children with autism may have attended to their preferred sensory modality

(Kolko et al., 1980). Thus, while the familiar melody provided a more engaging environment, some children may have selectively attended to the musical elements rather than the critical linguistic information. These interpretations need further investigation to try to tease out why significantly increasing engagement levels through the use of melody and rhythm does not significantly increase learning on a receptive labelling task.

The effectiveness of both intervention conditions to increase receptive labelling in a group of children with significant impairments suggests that auditory characteristics common to both conditions positively influenced learning. Infant-directed speech and infant-directed song were both characterised by elevated pitch and emotional warmth. Children with autism are more proficient at discriminating pitch contours in speech and non-speech stimuli relative to controls (Heaton et al., 2008; Järvinen-Pasley, Peppé, King-Smith, & Heaton, 2008). Whether this can be used within a complex task to provide linguistic cues for the child requires further investigation. Little is known about the reception of prosodic information in children with autism and how this may impact on language development (review O'Connor, 2012). There is a need for further investigation to be done comparing infant-directed stimuli with other forms of auditory input to determine if the prosodic elements of infant-direct stimuli are more effective in facilitating language learning in children with autism.

Although both intervention conditions were effective in increasing correct responses of the groups involved in the study, there was still considerable variability between participants' correct responses and levels of engagement in both intervention conditions. Some children appeared to do better than others, but there was no significant relationship found between performance and child characteristics as measured using standardised assessments. It is well understood that no one treatment suits all and it is important to identify what interventions work best for which children to maximise the

potential for learning (Odom et al., 2012; Stahmer, Schreibman, & Cunningham, 2011). Particularly for the subgroup of children in this study who performed poorly in both conditions, using a wider range of measures that are more sensitive to the child's level of functioning may help to identify variables that influence performance.

Apart from child characteristics, engagement in the task and overall performance of individual children may also be differentially influenced by modifying aspects of the intervention itself such as the instructional procedures or auditory input. The variability evident across individual children in the study suggests that the use of music may not be engaging for all participants and highlights the need to consider individual preference. Gathering data about a range of child characteristics, using instruments that are sensitive to small differences, and conducting preference assessments would assist in efforts to modify interventions so that they are more effective for particular individuals.

The research undertaken here was driven by the demands placed on intervention resources due to the increased prevalence rates of autism, the prolific growth in programs and interventions being implemented with little evidence to support them, and the availability of funding. There is a pressing need to identify effective interventions, particularly in the core impairments of autism including receptive language development which was the focus of this thesis.

This was the first study of its kind that has investigated the relationship between infant-directed song and receptive labelling for children with autism. Furthermore, it was the first study to compare the use of infant-directed song and infant-directed speech with children with autism. These two forms of auditory stimuli are present in the prelinguistic language environment of infants and young children and this thesis has extended our understanding of factors that may influence language acquisition for this population.

The findings from this study add to the current research knowledge investigating the use of music with children with autism. There is a widespread view that children with autism like music. The current literature (Chapter 3) highlighted that more research is required to substantiate this claim, to evaluate the relative effectiveness of music programs and to determine instructional components and targeted skills. One of the problems of previous research investigating the use of music has been the limited identification of musical elements and intervention techniques. In this study, clear descriptions were provided of the musical elements compared in this study creating a baseline for future research. In addition, the instructional methods were visible making it possible to reproduce this intervention. As a result this allows the research findings to be evaluated and compared with previous and future research.

Identifying methods of increasing the engagement of children with autism in learning activities is a priority. This study has confirmed and extended the current understandings of engaging children with autism in learning activities. The use of music compared to non-musical elements when used in a multi-component intervention provided a more engaging learning context for the individuals in this study. Furthermore, engagement as measured in this study correlated with learning outcomes. Demonstrating that musical elements can be embedded in interventions in a way that makes the task more engaging is an important contribution of this thesis.

This study demonstrated one approach incorporating music within a multi-component intervention. As learning occurred in both conditions this underlines the importance of service providers carefully considering the components used when creating an intervention. This intervention was delivered in a one-to-one situation. The evidence-based instructional methods of time delay and least-to-most prompts were used in a simple-conditional discriminative task. The materials were presented using a computer.

Although the individual components were not evaluated in terms of impacting on learning they did combine to create an innovative learning task which was effective in teaching receptive communication skills to some children with autism. Incorporating elements of the prelinguistic language environment with evidence-based practice and preferred materials displayed how an intervention can be created using relevant age themes to teach receptive labelling skills to children with autism.

Limitations and Implications for Further Research

This was an exploratory study for the purpose of identify potential influences on receptive language development in children with autism. It was the first study of its type investigating the influence of musical elements in the prelinguistic language environment on receptive language learning. This study highlights the need to systematically explore factors which may moderate learning outcomes. In addition there were a number of limitations identified.

Matching groups of participants in order to conduct a comparative study can be challenging and the heterogeneity of the autism population helps to explain the popularity of single-case research designs in this field. The cross-over design allowed for a comparative group study to be conducted with children with autism using an alternate research design. The design and sample size helped to control for variability in performance across participants. In addition, standardised tests including the SCQ, SIB-R, PPVT and EVT were used to describe the characteristics of the participants. Notwithstanding, between group differences were identified. Age, gender, adaptive functioning, receptive and expressive language abilities and severity of autism, as measured in this study, failed to identify any between group differences. In future research, a larger sample size and the use of standardised measures which are more sensitive to early developmental skills including characteristics not measured in this study will strengthen

the research findings. Due to the variability between participants, caution is warranted in generalising any intervention results to all children with autism and severe language delay.

As previously mentioned, this study is the first study conducted to date comparing the influence of infant-directed song and infant-directed speech on receptive skills. The studies reviewed with typically developing children, and comparative studies across different child populations have focused on the use of infant-directed speech and language outcomes. In order to determine the potential influence of the musical elements found in infant-directed song, it is recommended that future research include comparative studies with different populations including typically developing children.

The musical elements investigated in this study were determined by the characteristics of infant-directed stimuli. These elements were clearly defined allowing for comparative studies. Manipulating musical elements and exploring different music genres would increase the existing knowledge on the use of music features and levels of engagement and learning in children with ASD.

Conclusion

This exploratory study investigated the influence of musical elements in the prelinguistic language environment on receptive communication skills in children with autism and severe language delay. As such, it provides an initial investigation comparing musical elements evident in infant-directed song with the absence of these elements in the form of infant-direct speech. The findings from this research offer support for the use of the musical elements of melody and rhythm to be used within a multi-component intervention to create an engaging learning context to teach receptive labelling skills to children with autism with severe language delay. This study has extended the theoretical knowledge base relating to facilitating receptive labelling skills in children with autism

and severe language delay while providing interventionists with a multi-component intervention in which to teach receptive labelling skills to these children.

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Zuriff, G. (1985). *Behaviorism: A conceptual reconstruction*. New York, NY: Columbia University Press.

Appendix A

Research Portfolio

Publications

Simpson, K., & Keen, D. (2011). Music interventions for children with autism: Narrative review of the literature. *Journal of Autism and Developmental Disorders*, 41, 1507-1514. doi: 10.1007/s10803-010-1172-y

Simpson, K., Keen, D., & Lamb, J. (2013). The use of music to engage children with autism in a receptive labelling task. *Research in Autism Spectrum Disorders* (accepted for publication Ref. No.: RASD-D-13-00114R1)

Simpson, K., Keen, D., & Lamb, J. (under review). Teaching receptive labelling to children with autism: A comparative study using infant-directed song and infant-directed speech. *Journal of Speech, Hearing and Language Research*

Copyright Declaration

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Statement of Contribution of Others

Paper 1

Simpson, K., & Keen, D. (2011). Music interventions for children with autism: Narrative review of the literature. *Journal of Autism and Developmental Disorders*, 41, 1507-1514. doi: 10.1007/s10803-010-1172-y

In the case of Paper 1, the nature and extent of my contribution to the work was to a) conduct the search, identify the articles, apply the selection criteria, review the articles, and b) draft the paper and make edits. The extent of my contribution was 80%. The following co-author contributed to the work:

Name	Nature of contribution
Professor Deb Keen	Provided advice on the direction of the paper and where to publish. Reviewed, revised and provided feedback and edits on the paper

Candidate's signature



Date 18.10.2013

Declaration by Co-Authors

The undersigned hereby certify that:

The above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.

Signature



Date 20.10.2013

PAPER 2

Simpson, K., Keen, D., & Lamb, J. (2013). The use of music to engage children with autism in a receptive labelling task. *Research in Autism Spectrum Disorders* (accepted for publication Ref. No.: RASD-D-13-00114R1)

In the case of Paper 2, the nature and extent of my contribution to the work was to a) undertake the study and collect the data, (b) conduct data analysis and interpretation,

c) draft paper and make edits. The extent of my contribution was 80%. The following co-author contributed to the work:

Name	Nature of contribution
Professor Deb Keen	Provided advice on the direction of the paper, where to publish. Provided data interpretation. Reviewed, revised and provided feedback and edits on the paper
Dr Janeen Lamb	Provided assistance with analysis and interpretation of data. Reviewed and provided feedback on the paper.

Candidate's signature



Date 18.10.2013

Declaration by Co-Authors

The undersigned hereby certify that:

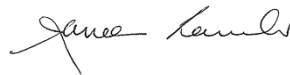
The above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.

Signature



Date 20.10.2013

Signature



Date 18.10.2013

Paper 3

Simpson, K., Keen, D., & Lamb, J. (under review). Teaching receptive labelling to children with autism: A comparative study using infant-directed song and infant-directed speech. *Journal of Speech, Hearing and Language Research*

In the case of Paper 3, the nature and extent of my contribution to the work was to
a) undertake the study and collect the data, b) conduct data analysis and interpretation,
c) draft paper and make edits. The extent of my contribution was 80%. The following co-author contributed to the work:

Name	Nature of contribution
Professor Deb Keen	Provided advice on the direction of the paper, where to publish. Provided data interpretation. Reviewed, revised and provided feedback and edits on the paper.
Dr Janeen Lamb	Provided assistance with analysis and interpretation of data. Reviewed and provided feedback on the paper.

Candidate's signature



Date 18.10.2013

Declaration by Co-Authors

The undersigned hereby certify that:

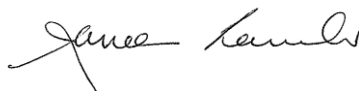
The above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.

Signature



Date 20.10.2013

Signature



Date 18.10.2013

Additional Publications

Simpson, K., Keen, D., & Lamb, D. (2012, May). *Teaching receptive labelling to children with autism using sung or spoken interventions*. Poster session presented at the International Conference of Innovative Research in Autism, Tours, France.

Appendix B

Excluded Music Studies

Table B1

Articles not published in a peer reviewed journal

-
- Clauss, E. L. (1994). *Effects of music on attention and self-stimulatory behaviors in autistic people*. Unpublished doctoral dissertation, Hofstra University.
- Farmer, K. (2003). *The effect of music vs. nonmusic paired with gestures on spontaneous verbal and nonverbal communication skills of children with autism between the ages 1-5 (Master's thesis)*. Tallahassee, FL: Florida State University (School of Music).
- Kim, M. (2006). Intentionality of autistic individuals expressed while engaged in the creative music making process. Unpublished thesis, Dissertation Abstracts International: Section B: *The Sciences and Engineering*, 66(12-B), p. 6943.
- Laird, P. D. (1997). *The effect of music on cognitive/communicative skills with students diagnosed with autism, autistic like characteristics and other related pervasive developmental disorders*. Unpublished master's thesis, The Florida State University, Tallahassee.
- Lim, A. H. (2008). The effect of "developmental speech-language training through music" on speech production in children with autism spectrum disorders. *Dissertation Abstracts International Section A: Humanities and Social Sciences*, 68(12-A), p. 5013.
- O'Loughlin, R. (2000). *Facilitating prelinguistic communication skills of attention by integrating a music stimulus within typical language intervention with autistic children*. Unpublished doctoral dissertation, University of Toledo.
- Osei, A. (2010). Beginning with Brandon's interest: The experience of the influence of nature and music on one autistic student's learning. *Dissertation Abstracts International Section A: Humanities and Social Sciences*, 70(10-A), p. 3810.
- Pasiali, V. (2002). *The use of prescriptive therapeutic songs to promote social skills acquisition by children with autism: Three case studies*. Research poster session presented at annual conference of the American Music Therapy Association, Atlanta, GA.
- Reitman, M. R. (2006). Effectiveness of music therapy interventions on joint attention in children diagnosed with autism: A pilot study. Unpublished thesis. Dissertation Abstracts International: Section B: *The Sciences and Engineering*. Vol 66(11-B), p. 6315.
- Summa-Chadwick, M. (2009). The power of music. *The Exceptional Parent*, 39, 38-42.
- Webb, K. W. (2010). Does change in timbre alter stereotypy movements exhibited by three persons with diagnosis of mental retardation and autism spectrum disorder: Three case studies. *Dissertation Abstracts International Section A: Humanities and Social Sciences*, 70(10-A), p. 3791.
- Wood, S. R. (1991). *A study of the effects of music on attending behavior of children with autistic-like syndrome*. Unpublished master's thesis, San Jose State University.
-

Table B2

Adult Population

-
- Allen, R., & Heaton, P. (2010). Autism, music, and the therapeutic potential of music in alexithymia. *Music Perception*, 27, 251-261
- Allen, R., Hill, E., & Heaton, P. (2009). 'Hath charms to soothe...': An exploratory ASD experience music. *Autism*, 13(1), 21.
- Boso, M., Emanuele, E., Minazzi, V., Abbamonte, M, M., & Politi, P. (2007). Effect of long-term interactive music therapy on behavior profile and musical skills in young adults with severe autism. *The Journal of Alternative and Complementary Medicine*, 13(7), 709-712.
- Clarkson, G. (1998-1999). The spiritual insights of a guided imagery and music client with autism. *Journal of the Association for Music & Imagery*, 6, 87-103.
- Keats, L. (1995). Doug. The rhythm in his world. *Canadian Journal of Music Therapy*, 3, 53-69.
- Lundqvist, L., Andersson, G., Viding, J. (2009). Effects of vibroacoustic music on challenging behaviors in individuals with autism and developmental disabilities. *Research in Autism Spectrum Disorders*, 3(2), 390.
- Rory, A., Hill, E., & Heaton, P. (2009). "Hath charms to soothe...": An exploratory study of how high-functioning adults with ASD experience music. *Autism: The International Journal of Research and Practice*, 13, 21-42.
- Shields-Wolfe, J. & Gallagher, P. A. (1992). Functional utilization of splinter skills for the employment of a young adult with autism. *Focus on Autistic Behavior*, 7(4), 1-16.
- Toigo, D. A. (1992). Autism: Integrating a personal perspective with music therapy practice. *Music Therapy Perspectives*, 10(1), 13-20.
- Wager, K. M. (2000). The effects of music therapy upon an adult male with autism and mental retardation: A four-year case study. *Music Therapy Perspectives*, 18(2), 131-140.
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Table B3

Savant Ability

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- Bonoldi, I., Emanuele, E., & Politi, P. (2009). A piano composer with low-functioning severe autism. *Acta Neuropsychiatrica*, 21(1), 2-3.
- Heaton, P., Pring, L., & Hermelin, B. (1999). A pseudo-savant: A case of exceptional musical splinter skills. *Neurocase*, 5(6), 503-509.
- Henley, D. R. (2003). Review of bright splinters of the mind: A personal story of research with autistic savants. *Art Therapy*, 20(3), 178-180.
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- Pring, L. (2006). Savant talent. *Developmental Medicine and Child Neurology*, 47(7), 500-504.
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Table B4

Studies that did not display experimental design

-
- Baken, M., Koen, B., Kobylarz, F., Morgan, L., Goff, R., Kahn, S., & Bakan, M. (2008). Following Frank: Response-ability and the co-creation of culture in a medical ethnomusicology program for children on the Autism Spectrum. *Ethnomusicology*, 52(2), 163.
- Dellatan, A. K. (2003). The use of music with chronic food refusal: A case study. *Music Therapy Perspectives*, 21(2), 105-109.
- Hoelzley, P. D. (1993). Communication potentiating sounds: Developing channels of communication with autistic children through psychobiological response to novel sound stimuli. *Canadian Journal of Music Therapy*, 3, 53-69.
- Kern, P., Wakeford, L., & Aldridge, D. (2007). Improving the performance of a young child with autism during self-care tasks using embedded song interventions: A case study. *Music Therapy Perspectives*, 25(1), 43-51.
- Kissinger, L., & Wolery, D. W. (2008). Using the harp as a communication channel with children with autism. *International Journal of Special Education*, 23, 156
- Starr, E., & Zenker, K. (1998). Understanding autism in the context of music therapy: Bridging theory and practice. *Canadian Journal of Music Therapy*, 6(1), 1-19.
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Table B5

Articles that did not have an intervention focus

-
- Accordino, R., Comer, R., & Heller, W. B. (2007). Searching for music's potential: A critical examination of research on music therapy with individuals with autism. *Research in Autism Spectrum Disorders*, 1(1), 101-115.
- Aigen, K. (1995). Cognitive and affective processes in music therapy with individuals with developmental delays: A preliminary model for contemporary Nordoff-Robbins practice. *Music Therapy*, 13(1), 13-45.
- Allgood, N. (2005). Parents' perceptions of family-based group music therapy for children with autism spectrum disorders. *Music Therapy Perspectives*, 23(2), 92-99.
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- Baker, F. (2003). Review of music therapy, sensory integration and the autistic child. *International Journal of Disability, Development and Education*, 50, 351.
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- Boso, M., Emanuele, E., Prestori, F., Politi, P., Barale, F., D'Angelo, E. (2010). Autism and genius: Is there a link? The involvement of central brain loops and hypotheses for functional testing. *Functional Neurology*, 25, 15-20.
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Table B5 (*continued*)

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- Donaldson, A. I., Heavner, K. S., & Zwolan, T. A. (2004). Measuring progress in children with autism spectrum disorder who have cochlear implants. *Archives of Otolaryngology – Head & Neck Surgery*, 130(5), 666-672.
- Donnell, N. E. (2007). Messages through the music: Musical dialogue as a means of communicative contact. *Canadian Journal of Music Therapy*, 13(2), 74-102.
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- Gasalberti, D. (2006). Alternative therapies for children and youth with special health care needs. *Journal of Pediatric Health Care*, 20(2), 133-136.
- Gerritsen, J. (2008). Response to "Brief Report: The effects of tomatis sound therapy on language in children with autism", July 3, 2007, Journal of Autism and Developmental Disorders. *Journal of Autism and Developmental Disorders*, 38(3), 567.
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- Griggs-Drane, E. R., & Wheeler, J. J. (1997). The use of functional assessment procedures and individualized schedules in the treatment of autism: Recommendations for music therapists. *Music Therapy Perspectives*, 15, 87-93.
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- Harms, M. (2007). The development of autism: A self-regulatory perspective. *Focus on Autism and Other Developmental Disabilities*, 22(2), 127-128.
- Heaton, P. (2003). Pitch memory, labeling, and disembedding in autism. *Journal of Child Psychology and Psychiatry*, 44, 543-551.
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- Holck, U. (2004). Interaction themes in music therapy: Definition and delimitation. *Nordic Journal of Music Therapy*, 13(1), 3-19.
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Table B5 (*continued*)

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- Honig, A. S. (2007). Ten power boosts for children's early learning. *Young Children*, 62(5), 72-78.
- Hourigan, R. & Hourigan, A. (2009). Teaching music to children with autism: understandings and perspectives. *Music Educators Journal*, 96, 40-47.
- Hughes, J. R. (2008). A review of recent reports on autism: 1000 studies published in 2007. *Epilepsy and Behaviour*, 13(3), 425-437.
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- Kaplan, R. S. (2004). Music therapy, sensory integration and the autistic child. *Music Therapy Perspectives*, 22 (1), 56-58.
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- Harshbarger, D. (2006). The evening news and the behavioral blues: Comments on Joseph Wyatt and Donna Midkiff's biological psychiatry: A practice in search of science and Stephen Wong's behavior analysis of psychoanalysis of psychotic disorders—Scientific dead end or casualty of the mental health political economy? *Behavior and Social Issues*, 50(2), 199-201.
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- Matthews, B. (2005). Review of Beyond the wall: Personal experiences with autism and asperger syndrome. *Autism*, 9(1), 119.
- Nicoll, D. (2008). Review of music therapy groupwork with special needs children: The evolving process. *The Arts in Psychotherapy*, 35(3), 234.
- Noordhof, P. (2008). Expressive perception as projective imagining. *Mind & Language*, 23(3), 329-358.
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- Shore, S. M. (2002). The language of music: Working with children on the autism spectrum. *Journal of Education*, 183(2), 97-108.
- Silverman, M. J. (2008). Nonverbal communication, music therapy, and autism: A review of literature and case examples. *Journal of Creativity in Mental Health*, 3(1), 3.
- Trevarthen, C. (2002). Autism, sympathy of motives, and music therapy. *Enfance*, 54(1), 86-99.
- Umbarger, G. T., III (2007). State of evidence regarding complimentary and alternative medical treatments for autism spectrum disorders. *Education and Training in Developmental Disabilities*, 43(4), 437-446.
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Table B5 (*continued*)

-
- Walworth, D. (2009). Using the SCERTS model assessment tool to identify music therapy goals for clients with autism spectrum disorder. *Journal of Music Therapy*, 46(3), 204-217.
- Walworth, D. (2007). The use of music therapy within the SCERTS model for children with Autism Spectrum Disorder. *Journal of Music Therapy*, 44(1), 2-22.
- Whipple, J. (2004). Music intervention for children and adolescents with Autism: A meta-analysis. *Journal of Music Therapy*, 41(2), 90-106.
- Wigram, T. (2000). A method of music therapy assessment for the diagnosis of autism and communication disorders in children. *Music Therapy Perspectives*, 18(1), 13-22.
- Wimporly, D. C., & Nash, S. (1999). Musical interaction therapy-therapeutic play for children with autism. *Child Language Teaching and Therapy*, 15, 17-28.
- Zeedyk, S. M. (2008). *Promoting Social Interaction for Individuals with Communicative Impairments: Making Contact*. London, England: Jessica Kingsley Publishers.
-

Table B6

Assessment

-
- Boso, M., Politi, P., Barale, F., & Emanuele, E. (2006). Neurophysiology and neurobiology of the musical experience. *Functional Neurology*, 21(4), 187-91.
- Chin, C. S. (2003). The developmental of absolute pitch: A theory concerning the roles of music training at an early developmental age and individual cognitive style. *Psychology of Music*, 31(2), 155-171.
- Happé, F. (1999). Autism: cognitive deficit or cognitive style? *Trends in Cognitive Sciences*, 3(6), 216-222.
- Heaton, P., Allen, R., Williams, K., Cummins, O., & Happe, F. (2008). Do social cognitive deficits curtail musical understanding? Evidence from autism and Down syndrome. *British Journal of Developmental Psychology*, 26(2), 171-182.
- Heaton, P., Williams, K., Cummins, O., & Happe, F. (2007). Beyond perception: Musical representation and on-line processing in autism. *Journal of Autism and Developmental Disorders*, 37(7), 1355-1360.
- Järvinen-Pasley, A., & Heaton, P. (2007). Report: Evidence for reduced domain-specificity in auditory processing in autism. *Developmental Science*, 10(6), 786-793.
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-

Table B6 (*continued*)

-
- Pfordresher, P. & Brown, S. (2009). Enhanced production and perception of musical pitch in tone language speakers. *Attention, Perception and Psychophysics*, 71(6), 1385-1398.
- Wigram, T. (2007). Music therapy assessment: Psychological assessment without words. *Psyke & Logos*, 28(1), 333-357.
- Wigram, T., & Gold, C. (2006). Music therapy in the assessment and treatment of autistic spectrum disorders: clinical application and research evidence. *Child Care, Health and Development*, 32(5), 535-542.
-

Table B7

Unsupported Practices

-
- Bettison, S. (1996). The long-term effects of auditory training on children with autism. *Journal of Autism and Developmental Disorders*, 26(3), 361-374.
- Edelson, S., Arin, D., Bauman, M., Lukas, S., Rudy, J., Sholar, M. et al. (1999). Auditory integration training: A double-blind study of behavioral and electrophysiological effects in people with autism. *Focus on Autism and other Developmental Disabilities*, 14(2), 73-81.
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- Link, H. M. (1997). Auditory integration training (AIT): Sound therapy? Case studies of three boys with autism who received AIT. *British Journal of Learning Disabilities*, 25(3), 106-110.
- Macias, M. (2007). Auditory integration training and other sound therapies for autism spectrum. *Journal of Developmental and Behavioral Pediatrics*, 28(3), 255-261.
- Mudford, O., Cross, B., Breen, S., Cullen, C., Reeves, D., Gould, J., et al. (2000). Auditory integration training for children with autism: No behavioral benefits detected. *American Journal of Mental Retardation*, 105(2), 118-129.
- Rimland, B., & Edleson, S. (1994). The effects of auditory discrimination training on autism. *American Journal of Speech-Language Pathology*, 5, 16-24.
- Rimland, B., & Edleson, S. (1995). Brief report: A pilot study of auditory integration training in autism. *Journal of Autism and Developmental Disorders*, 25(1), 61-70.
- Ziring, P. R., Brazdziunas, D., Cooley, W. C., Kastner, T. A., et al. (1998). Auditory integration training and facilitated communication for autism. *Pediatrics*, 102(2), 431-433.
- Zollweg, W., Palmk, D., & Vance, V. (1997). The efficacy of auditory integration training: A double blind study. *American Journal of Audiology*, 6, 39.
-

Appendix C

Additional Excluded Music Studies 2010-2912

Table C1

Articles not published in a peer reviewed journal

-
- Osei, A. (2010). Beginning with Brandon's interest: The experience of the influence of nature and music on one autistic student's learning. *Dissertation Abstracts International Section A: Humanities and Social Sciences*, 70(10-A), p. 3810.
- Wood, S. R. (1991). *A study of the effects of music on attending behavior of children with autistic-like syndrome*. Unpublished master's thesis, San Jose State University.
-

Table C2

Adult Population

-
- Allen, R., & Heaton, P. (2010). Autism, music, and the therapeutic potential of music in alexithymia. *Music Perception*, 27, 287-295.doi. 10.1525/MP.2010.27.4.251
-

Table C3

Savant Ability

Nil

Table C4

Studies that did not display experimental design

-
- Goldstein, T., & Winner, E. (2012). Enhancing empathy and theory of mind. *Journal of Cognition and Development*, 13, 19-37.
- Lim, H., & Draper, E. (2011). The effects of music therapy incorporated with applied behavior analysis verbal behavior approach for children with autism spectrum disorders. *Journal of Music Therapy*, 48, 532-550.
- Greher, G., Hillier, A., Dougherty, M., & Poto, N. (2010). SoundScape: An interdisciplinary music intervention for adolescents and young adults on the autism spectrum. *International Journal of Education & the Arts*, 11, (9), 1-28.
-

Table C5

Articles that did not have an intervention focus (using music)

-
- Arntzen, E., Halstadtro, L., Bjerke, E., & Halstadtro, M. (2010). Training and testing music skills in a boy with autism using a matching-to-sample format. *Behavioral Interventions*, 25, 129-143. doi. 10.1002/bin.
- Dimitriadis, T., & Smeijsters, H. (2011). Autism spectrum disorder and music therapy: Theory underpinning practice. *Nordic Journal of Music therapy*, 20, 108-122.
- Gadberry, A. L. (2011). A survey of the use of aided augmentative and alternative communication during music therapy sessions with persons with autism spectrum disorders. *Journal of Music Therapy*, 48, 74-89.
- Haesler, E. (2011). Music therapy for autistic spectrum disorder. *International Journal of Child Health and Human Development*, 4, 241-243.
- Keglon, J. (2011). Camp Thunderbird: Taking flight with dance and physical education for special populations. *Journal of Physical Education, Recreation & Dance*, 82, 32-34.
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- Mahoney, J. F. (2010). Interrater agreement on the Nordoff-Robbins Evaluation Scale 1: Client-therapist relationship in musical activity. *Music and Medicine*, 2, 23-28.
- Montgomery, J., Storey, K., Post, M., & Lemley, J. (2011). The use of auditory prompting systems for increasing independent performance of students with autism in employment training. *International Journal of Rehabilitation Research* 34, 330-335.
- Mullet, E., Morales, M., Guadalupe, E., Makris, I., Roge, B., & Munoz Sastre, M. (2012). Functional measurement: An incredibly flexible tool. *Psicologica: International Journal of Methodology and Experimental Psychology*, 33, 631-654.
- Raglio, A., Traficante, D., & Oasi, O. (2011). Autism and music therapy. Intersubjective approach and music therapy assessment. *Nordic Journal of Music Therapy*, 20, 123-141.
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Table C6

Assessment

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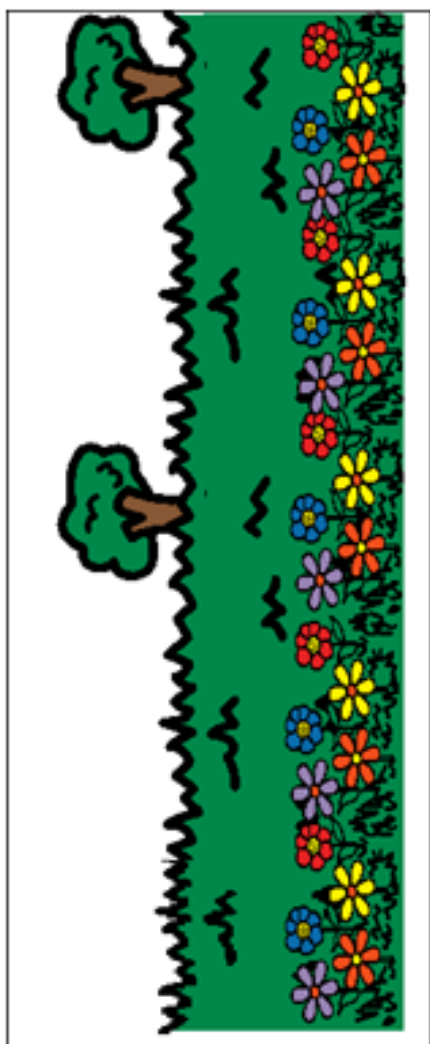
Table C7

Unsupported Practices

NIL

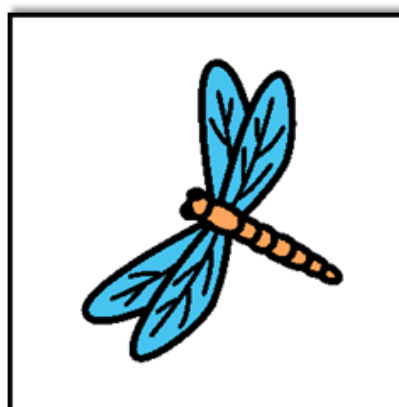
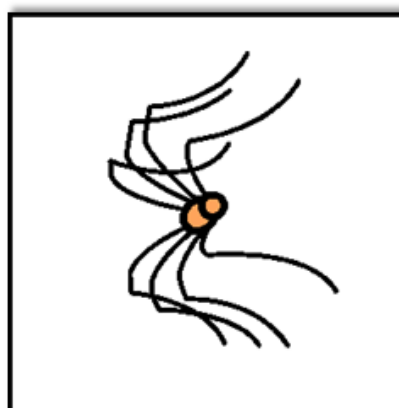
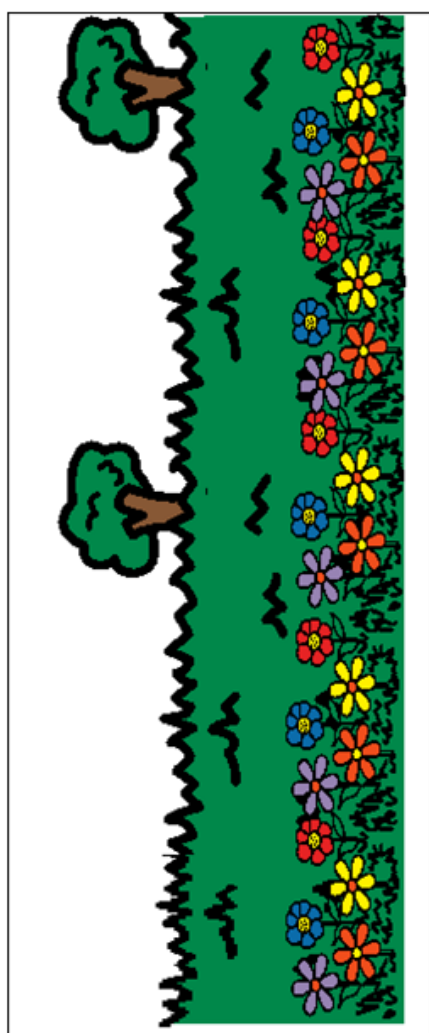
Appendix D

Screen Display Training Session



Appendix E

Screen Display Teaching Session



Appendix F

Ethics

1. Australian Catholic University – Human Research Ethics Committee
2. Department of Education and Training

Human Research Ethics Committee
Committee Approval Form

Principal Investigator/Supervisor: Professor Deb Keen Brisbane Campus

Co-Investigators:

Student Researcher: Ms Kathryn Simpson Brisbane Campus

Ethics approval has been granted for the following project:

The use of music elements to influence the teaching of receptive communication skills in children with autism. (Using music to help children with autism learn)

for the period: 4 March 2011 to 31 December 2011

Human Research Ethics Committee (HREC) Register Number: Q2010 66

Special Condition/s of Approval

Prior to commencement of your research, the following permissions are required to be submitted to the ACU HREC:

Education Queensland and Autism Queensland

The following **standard** conditions as stipulated in the *National Statement on Ethical Conduct in Research Involving Humans (2007)* apply:

- (i) that Principal Investigators / Supervisors provide, on the form supplied by the Human Research Ethics Committee, annual reports on matters such as:
 - security of records
 - compliance with approved consent procedures and documentation
 - compliance with special conditions, and
- (ii) that researchers report to the HREC immediately any matter that might affect the ethical acceptability of the protocol, such as:
 - proposed changes to the protocol
 - unforeseen circumstances or events
 - adverse effects on participants

The HREC will conduct an audit each year of all projects deemed to be of more than low risk. There will also be random audits of a sample of projects considered to be of negligible risk and low risk on all campuses each year.

Within one month of the conclusion of the project, researchers are required to complete a *Final Report Form* and submit it to the local Research Services Officer.

If the project continues for more than one year, researchers are required to complete an *Annual Progress Report Form* and submit it to the local Research Services Officer within one month of the anniversary date of the ethics approval.



Signed:Date: 04.03.2011.....
(Research Services Officer, McAuley Campus)

28 March 2011

Mrs Kathryn Simpson
19 Upper Cairns Tce
RED HILL QLD 4059

Department of
Education and Training

Dear Mrs Simpson

Thank you for your application seeking approval to conduct research titled *"Using music to help children with autism to learn"* in Queensland State schools. I wish to advise that your application has been approved.

You can approach principals of the schools nominated in your application and invite them to participate in your research project. As detailed in the Department's research guidelines the following applies to the study:

- You need to obtain consent from the relevant principals before your research project can commence.
- Principals have the right to decline participation if they consider that the research will cause undue disruption to educational programs in their schools.
- Principals have the right to monitor any research activities conducted in their facilities and can withdraw their support at any time.

This approval has been granted on the basis of the information you have provided in your research proposal and is subject to the conditions detailed below.

- Perusal of and adherence to the department's standard *"Terms and Conditions of Approval to Conduct Research"* in departmental sites is required as outlined in the document at: http://education.qld.gov.au/corporate/research/terms_conditions.pdf
- Any changes required by your institution's ethics committee must be submitted to the Department of Education and Training for consideration before you proceed.
- Any variations to the research proposal as originally submitted, including changes to data collection, additional research undertaken with the data, or publication based on the data beyond what is normally associated with academic studies, should be submitted to the contact officer via email. Significant variations will require the submission of a new application.
- Papers and articles intended for publication that are based on data collected from Queensland state schools and/or departmental sites should be provided to the department for comment before release.
- Under no circumstances should any publications disclose the names of individuals or schools.
- You are required to contact the Department if you are contacted by the media about research activities conducted on Departmental sites or if you intend to use a media release about the study.

- At the conclusion of your study you are required to provide this Office and principals of participating schools with a summary of your research results and any associated published papers or materials in hard copy. You are also requested to submit the documents in electronic format, or provide a link to an online location if possible, to research.stratpol@deta.qld.gov.au. **Failure to provide a report on your research will preclude you from undertaking any future research in Queensland State schools.**

Please note that this letter constitutes approval to invite principals to participate in the research project as outlined in your research application. This approval does not constitute ethics approval or support for the general and commercial use of an intervention or curriculum program, software program or other enterprise that you may be evaluating as part of your research.

Should you require further information on the research application process, please feel free to contact Dr Karen Barnett, Principal Research Officer, Strategic Policy and Research on (07) 3238 3176. Please quote the file number 550/27/1047 in future correspondence.

I wish your study every success.

Yours sincerely



Dr John Dungan
Director
Strategic Research
Strategic Policy and Research
Trim ref: 11/65568

INFORMATION LETTER TO PRINCIPALS

TITLE OF PROJECT: Using music to help children with autism learn

PRINCIPAL SUPERVISOR: Professor Deb Keen

STUDENT RESEARCHER: Kate Simpson

Dear

We are inviting your setting to participate in the research project identified above being conducted by Kate Simpson from Australian Catholic University. Kate is currently doing her Doctor of Philosophy and is supervised by Professor Deb Keen and Dr Janeen Lamb. Any question regarding the information in this letter should be directed to

Professor Deb Keen

Phone: 3623 7531. Email deb.keen@acu.edu.au

Why is this research being done?

Communication impairment is a core characteristic of autism and many of these individuals have severe language delay. Impairments in communication can impact on an individual's social relationships and quality of life. This current study will investigate possible environmental influences that may influence learning receptive communication skills. The emphasis of the study is to expand the current understanding of receptive communication learning in children with autism and identifying effective interventions.

Are there any risks involved in this research?

There are no anticipated risks to your setting or to children participating in this research. The research intervention is typical of education practices employed during a school day.

What would you have to do?

Participation in the research will involve the use of your setting to recruit participants and to conduct the research project. You would be required to provide teachers with the information and consent form. In consultation with consenting class teachers you would be required to identify students who meet the research criteria i.e. aged between 4-8 yrs, diagnosis of autism and severe language delay (candidate for augmentative and alternative communication); and inform the researcher of the number of potential participants. On receipt of the parent information and consent packs you would be required to distribute the packs to the families of potential participants. During the assessment and intervention phase (two 5 week blocks) you would be requested to provide a space where the research can be conducted.

What would children have to do?

Prior to the commencement of the research children who meet the research criteria and have parental permission will participate in an initial assessment to determine their communication skills. If these children continue to meet the research criteria

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they will commence the research. The research consists of two intervention phases. Each intervention phase requires the participant to attend 15 individual teaching sessions. Each session will be of approximately 5 minutes duration and will be conducted within a 5 week period. One intervention phase uses a song presentation, while the other intervention phase uses a spoken presentation. During the sessions children will be asked to identify picture symbols presented on the computer during an interactive song/story. The research will require the children to participate in both intervention phases. Each session will be videotaped. A follow-up session will be conducted one month after the completion of the intervention phase. During the research period the participant's teacher will be requested to show the participant 4 picture symbols on a daily basis. The intervention session is typical of learning experiences for children with autism. All activities will be completed one on one within the school environment. The tasks will occur during children's attendance at school in consultation with their class teacher.

What are the benefits of the research to your setting, students, and to the education of children with autism?

A potential benefit of participation is that we will improve our knowledge of the specific conditions under which participating children are likely to achieve learning outcomes relating to his/her communication. Additionally, students attending your setting will have the opportunity to participate in an interactive activity likely to assist in gaining new symbol knowledge. The results may assist class teachers with an understanding of learning environments that may aid participating students. At the completion of the research a report of the findings will be made available to you. Due to the research design and quality of data collection, it is expected that results from this project will be accepted in international and Australian educational journals. Results may also be presented at Australian and international conferences and may provide content for teacher in-service training and development.

Your consent

By signing the consent form you are indicating your willingness for your setting to participate in the research project as it is explained in this letter. However, you are free to refuse consent altogether without having to justify that decision, or to withdraw your consent after first giving it and discontinue participation in the study at any time without giving a reason.

How will your confidentiality be protected?

All responses and information will be kept strictly confidential and will be de-identified once collected. This will be achieved by assigning a code and not names to all data collected. As soon as data collection and analysis is complete, codes connecting your setting and participants to written data will be destroyed. A de-identified copy of this data may be used for other research or teaching purposes. At no time will the school or the school location be identified, nor will any information identify participants.

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Ethics

This study has been evaluated and approved by the Human Research Ethics Committee at the Australian Catholic University.

Complaints about the research

In the event that you have any complaint or concern about the conduct of this research, or if you have any query that the Investigator has not been able to satisfy, you may write to the Chair of the Human Research Ethics Committee:

Queensland Chair, HREC
C/- Research Services Office
Australian Catholic University
Brisbane Campus
PO Box 456
Virginia QLD 4014
Tel: 07 3623 7429
Fax: 07 3623 7328

Any complaint or concern will be treated in confidence and fully investigated. The participant will be informed of the outcome.

What do you have to do?

If you would like to participate, please complete the attached consent forms. One is for your records and should stay with this Information Letter. The other is to be returned to the Researcher. This can be returned in the reply paid envelope attached.

Thank you for considering this invitation and we look forward to hearing from you.

Professor Deb Keen
Principal Supervisor

Kate Simpson
Student Researcher

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PRINCIPAL'S CONSENT FORM

TITLE OF PROJECT: Using music to help children with autism learn

SUPERVISOR: Professor Deb Keen

STUDENT RESEARCHER: Kate Simpson

STATEMENT OF CONSENT:

I (*Principal*) have read and understood the information provided in the Information Letter to the Principals. Any questions I have asked have been answered to my satisfaction. I agree that the education setting, nominated below, may participate in this research activity during the 2011 school year for a period of ten weeks. I give permission for teachers to participate in this research and will provide teachers with the teacher information and consent form. I give permission for participants to be recruited through this setting, realising that I can withdraw my consent at any time and do not have to give a reason for withdrawing. I will identify the number of students at this setting who meet the research criteria (diagnosis of autism, aged between 4-8yrs, and severe language delay i.e. a candidate for augmentative and alternative communication). I will inform the Researcher of the number of identified students and I agree to forward the Parent/guardian information and consent forms to the parents of the participants when I receive them. During the 10 week research period I will provide the researcher with an area where the research can be conducted. I acknowledge that research data collected for this study may be published or provided to other researchers or used in teaching programs in a form that does not identify the participants, staff or setting in any way. To consent I will sign both copies of the consent form. I understand one copy of the consent form is for me to keep and the other copy is for me to return to the Researcher. I will forward my consent form and the teacher consent forms to the Researcher using the prepaid envelope attached.

NAME OF SETTING:

PRINCIPAL (print)

SIGNATURE: **DATE:**.....

NUMBER OF POTENTIAL PARTICIPANTS (i.e. students who meet the research participant criteria and attend a class where the teacher has consented to participate in the research study)

.....

SIGNATURE OF SUPERVISOR:.....

DATE: 21st March 2011

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INFORMATION LETTER TO TEACHERS

TITLE OF PROJECT: Using music to help children with autism learn

PRINCIPAL SUPERVISOR: Professor Deb Keen

STUDENT RESEARCHER: Kate Simpson

Dear Teacher

We are inviting you and students meeting research criteria to participate in the research project identified above being conducted by Kate Simpson from Australian Catholic University. Kate is currently doing her Doctor of Philosophy and is supervised by Professor Deb Keen and Dr Janeen Lamb. Any question regarding the information in this letter should be directed to

Professor Deb Keen

Phone: 3623 7531. Email deb.keen@acu.edu.au

Why is this research being done?

Communication impairment is a core characteristic of autism and many of these individuals have severe language delay. Impairments in communication can impact on an individual's social relationships and quality of life. This current study will investigate possible environmental influences that may influence learning receptive communication skills. The emphasis of the study is to expand the current understanding of receptive communication learning in children with autism and identifying effective interventions.

Are there any risks involved in this research?

There are no anticipated risks to you or to students participating in this research. The research intervention is typical of education practices employed during a school day.

What would you have to do?

Participation in the research will require you to assist in identifying children in your class who meet the research criteria i.e. a verified diagnosis of autism, aged between 4-8 years, and have a severe language delay (is a candidate for Augmentative and Alternative Communication). You would be required to negotiate with the researcher convenient times when children would be available to participate in the research for the assessment session, the two 15 session intervention phases and the follow-up session. During the intervention phase you would be required to show the participating children a booklet of four picture symbols on a daily basis.

What would children have to do?

Prior to the commencement of the research children who meet the research criteria and have parental permission will participate in an initial assessment to determine

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their communication skills. If these students continue to meet the research criteria they will commence the research. The research consists of two intervention phases. Each intervention phase requires the participant to attend 15 individual teaching sessions. Each session will be of approximately 5 minutes duration and will be conducted within a 5 week period. One intervention phase uses a song presentation, while the other intervention phase uses a spoken presentation. During the sessions children will be asked to identify picture symbols presented on the computer during an interactive song/story. The research will require the children to participate in both intervention phases. Each session will be videotaped. A follow-up session will be conducted one month after the completion of the intervention phase. During the research period the participant's teacher will be requested to show the participant 4 picture symbols on a daily basis. The intervention is typical of learning experiences for children with autism. All activities will be completed one on one within the school environment. The tasks will occur during children's attendance at school in consultation with their class teacher.

What are the benefits of the research to your setting, students, and to the education of children with autism?

A potential benefit of participation is that we will improve our knowledge of the specific conditions under which participating children are likely to achieve learning outcomes relating to his/her communication. Additionally, students in your class will have the opportunity to participate in an interactive activity likely to assist in gaining new symbol knowledge. The results may assist you with an understanding of learning environments that may aid participating students. At the completion of the research a report of the findings will be made available to you. Due to the research design and quality of data collection, it is expected that results from this project will be accepted in international and Australian educational journals. Results may also be presented at Australian and international conferences and may provide content for teacher in-service training and development.

Your consent

By signing the consent form you are indicating your willingness for you and students in your class to participate in the research project as it is explained in this letter. However, you are free to refuse consent altogether without having to justify that decision, or to withdraw your consent after first giving it and discontinue participation in the study at any time without giving a reason. Refusal or withdrawal from this study will not affect your terms of employment.

How will your confidentiality be protected?

All responses and information will be kept strictly confidential and will be de-identified once collected. This will be achieved by assigning a code and not names to all data collected. As soon as data collection and analysis is complete, codes connecting your work setting and participants to written data will be destroyed. A de-identified copy of this data may be used for other research or teaching purposes. At no time will the school or the school location be identified, nor will any information identify participants and teachers.

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Ethics

This study has been evaluated and approved by the Human Research Ethics Committee at the Australian Catholic University.

Complaints about the research

In the event that you have any complaint or concern about the conduct of this research, or if you have any query that the Investigator has not been able to satisfy, you may write to the Chair of the Human Research Ethics Committee:

Queensland Chair, HREC
C/- Research Services Office
Australian Catholic University
Brisbane Campus
PO Box 456
Virginia QLD 4014
Tel: 07 3623 7429
Fax: 07 3623 7328

Any complaint or concern will be treated in confidence and fully investigated. The participant will be informed of the outcome.

What do you have to do?

If you would like to participate, please complete the attached consent forms. One is for your records and should stay with this Information Letter. The other is to be returned to your Principal who will forward it to the Principal Supervisor.

Thank you for considering this invitation and we look forward to hearing from you.

Professor Deb Keen
Principal Supervisor

Kate Simpson
Student Researcher

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TEACHER CONSENT FORM

TITLE OF PROJECT: Using music to help children with autism learn

SUPERVISOR: Professor Deb Keen

STUDENT RESEARCHER: Kate Simpson

STATEMENT OF CONSENT:

I (*teacher*) have read and understood the information provided in the Information Letter to the Teachers. Any questions I have asked have been answered to my satisfaction. I agree to participate in this research activity by assisting in the identification of potential participants. I agree to allow the opportunity for students in my class who meet the research criteria and have parental consent to participate in this research. During the intervention period I agree to show a booklet containing four symbols to the participating students on a daily basis. I understand that I can withdraw my consent at any time and do not have to give a reason for withdrawing and this will not impact on my employment.

NAME OF SETTING

NAME OF TEACHER (print)

SIGNATURE **DATE:**

SIGNATURE OF SUPERVISOR:.....



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INFORMATION LETTER TO PARENTS/GUARDIANS

TITLE OF PROJECT: Using music to help children with autism learn

PRINCIPAL SUPERVISOR: Professor Deb Keen

STUDENT RESEARCHER: Kate Simpson

Dear Parent/Guardian

We are inviting your child to participate in the research project identified above being conducted by Kate Simpson from Australian Catholic University. Kate is currently doing her Doctor of Philosophy and is supervised by Professor Deb Keen and Dr Janeen Lamb. Any questions regarding the information in this letter should be directed to

Professor Deb Keen

Phone: 36237531. Email: deb.keen@acu.edu.au.

Why is this research being done?

Difficulties with communication are characteristic of autism, and many individuals with autism have severe language delay. These difficulties can affect an individual's relationships and their quality of life. This current study will investigate possible influences that may help children with autism learn communication skills. The focus of the study is to expand the current understanding of communication learning in children with autism and identify ways that may help their learning.

Are there any risks involved in this research?

There are no anticipated risks to your child by his/her participation in this research. The research is typical of education practices that can be used during a school day.

What would your child have to do?

Prior to the commencement of the research your child will be assessed to determine his/her communication skills. The research consists of two stages. One stage uses a song presentation, while the other stage uses a spoken presentation. The research will require your child to participate in both stages. Each stage consists of your child participating in 15 individual teaching sessions. Each session will last approximately 5 minutes and will be conducted within a 5 week period. During the teaching session your child will be asked to identify picture symbols presented on the computer during an interactive song/story. Each session will be videotaped. A follow-up session will be conducted one month after the completion of each stage. All activities will be conducted within the school environment. The research will occur during the child's attendance at

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school in consultation with his/her class teacher. The teaching session is typical of learning experiences for children with autism.

What would you have to do?

To confirm your child's diagnosis and to gather information about his/her skills, you would be required to participate in two short standardised interviews. The first interview will take 10 mins and the second interview will take 20 mins. These would be conducted at your convenience and can occur by phone or face to face.

What are the benefits of the research to you, your child, and to the education of children with autism?

A potential benefit of participation is that we will improve our knowledge of the specific conditions under which your child is likely to achieve goals relating to his/her communication. Additionally, your child will have the opportunity to participate in an interactive activity likely to assist in gaining new picture symbol knowledge. The results may assist your child's teacher with an understanding of what conditions may aid your child. At the completion of the research a report of the findings will be made available to you. Due to the research design and quality and standard of data collection, it is expected that results from this project will be accepted in international and Australian educational journals. Results may also be presented at Australian and international conferences and may provide content for teacher in-service training and development.

Your consent

By signing the consent form you are indicating your willingness for your child to participate in the research project as it is explained in this letter. However, you are free to refuse consent altogether without having to justify that decision, or to withdraw your consent after first giving it and discontinue participation in the study at any time without giving a reason. Refusal to participate in this study or withdrawal from this study will not affect your relationship with the school or with your child's education.

How will your confidentiality be protected?

All responses and information will be kept strictly confidential. To achieve this, your child will be given a code. This code will be used on your child's data. As soon as data collection and analysis is complete, codes connecting you and your child to written data will be destroyed. Coded data may be used for other research or teaching purposes. At no time will the school or the school location be

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identified, nor will any information provided by you be identifiable by your name or your child's name.

Ethics

This study has been evaluated and approved by the Human Research Ethics Committee at the Australian Catholic University.

Complaints about the research

In the event that you have any complaint or concern about the conduct of this research, or if you have any query that the Investigator has not been able to satisfy, you may write to the Chair of the Human Research Ethics Committee:

Queensland Chair, HREC
C/- Research Services Office
Australian Catholic University
Brisbane Campus
PO Box 456
Virginia QLD 4014
Tel: 07 3623 7429
Fax: 07 3623 7328

Any complaint or concern will be treated in confidence and fully investigated and you will be informed of the outcome.

What do you have to do?

If you would like you and your child to participate, please complete the attached consent forms. One is for your records and should stay with this Information Letter. The other is to be returned to the Researcher. You can return it in the supplied reply paid envelope attached.

Thank you for considering this invitation and we look forward to hearing from you.

Professor Deb Keen
Principal Supervisor
Researcher

Kate Simpson
Student

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PARENT/GUARDIAN CONSENT FORM

TITLE OF PROJECT: Using music to help children with autism learn

SUPERVISOR: Professor Deb Keen

STUDENT RESEARCHER: Kate Simpson

STATEMENT OF CONSENT:

I (parent/guardian) have read (or, where appropriate, have had read to me) and understood the information provided in the Information Letter to the Families. Any questions I have asked have been answered to my satisfaction. I agree that my child, nominated below, may participate in this activity during the 2011 school year for two 5 week blocks, and give permission for him/her to be videotaped. I understand that I can refuse to provide permission for my child to participate in this study and that I can withdraw my consent at any time without affecting my child's education and my relationship with the school. I agree that research data collected for the study may be published or may be provided to other researchers or used in teaching programs in a form that does not identify my child in any way. I agree to provide information that describes my child's diagnosis and their skills and abilities by participating in two standardised interviews. I understand the first interview will take approximately 10 minutes while the second interview will take 20-30 minutes. I can choose to participate in the interview by phone or face to face. I have provided a contact phone number, times I can be contacted and my preferred way of taking part in the interviews. I understand one copy of the consent form is for me to keep and the other copy is for me to return to the Researcher using the prepaid envelope attached.

CHILD'S

(print).....

NAME

NAME OF PARENT/GUARDIAN (print)

.....

SETTING

.....

SIGNATURE

.....**DATE**.....

Faculty of Education

PO Box 456
Virginia QLD 4014

T: (07) 3623 7531 **F:** (07) 3623 7431 **E:** deb.keen@acu.edu.au

Australian Catholic University Limited
ABN 15 050 192 660
CRICOS registered provider:
00004G, 00112C, 00873F, 00885B

CONTACT NUMBER

**CONVENIENT
TIME**

**I would prefer to conduct the interview
(Please tick the box indicating your choice)**

In person ☐

By phone ☐

SIGNATURE OF SUPERVISOR



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Consent form to be read to parents at the beginning of the interview.

Interview 1 – Social Communication Questionnaire

This interview requires you to answer ‘yes’ or ‘no’ to a series of questions relating to your child’s behaviour. It is anticipated the interview will take 10 minutes to complete. You may stop the interview at any point and do not need to provide a reason. Do you consent to commence this interview?

Parent’s name:

Child’s name:

Consent (circle) Yes No

Date:

Interview 2 – Scales of Independent Behavior-Revised, Early Development Form

This interview is conducted to determine your child’s current level of functioning. It is anticipated the interview will take 20 - 30 minutes to complete. You may stop the interview at any point and do not need to provide a reason. Do you consent to commence this interview?

Parent’s name:

Child’s name:

Consent (circle) Yes No

Date:

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