



# Music Inspired Framework for Remediating Emotional Deficits in Autism

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## Abstract

Autism Spectrum Disorders (ASD) is a lifelong communication disorder that limits the abilities of diagnosed individuals to relate socially and interpret emotional cues. Thus, it is important to have early interventions in the domains of social and affective functioning. Recent research efforts have focused on the innovative applications of Assistive Technologies (AT) for rehabilitation efforts. However, despite excellent preliminary findings, the efficacy of AT remains limited. This paper aims to fill the identified efficacy gap by proposing a framework incorporating music as a therapy which will be developed into a technological application to help children with autism to deal with their emotional dysfunctions. The proposal is also based on findings which show that this special population prefers and has successfully used technological devices such as the iPad for learning new skills.

*Keywords:* Autism, Adaptive Living, Brain, Music Therapy, Social and Communicative Deficits

## 1 Introduction

Autism Spectrum Disorders (ASD) is a lifelong developmental disorder characterized by impairments in social interaction, communication and presence of restricted repetitive behaviors (Rogers et al., 2013). Particularly, they have problems with identification of emotions from facial expressions and tone of voice (Stewart et al., 2013). Erratic identification and inappropriate expressions of emotion puts the affected individuals at a comparative social disadvantage as these impairments hinder social adjustments and affects cognitive learning negatively.

Individuals with autism exhibit peculiar cognitive strengths (which we could harness for promoting their wellbeing) such as keen attention to details, islets of musical capability and other well developed abilities in the domain of numbers, auditory pitch processing and keen use of computer applications (Itzchak et al., 2013). Therefore different types of Assistive Technologies (AT) have been proposed to remediate these emotional deficits (Ploog et al., 2013). The technologies are aimed towards teaching recognition of emotional cues in facial expressions. A challenge inherit in these technologies, is the

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generalization of learning. It is still unclear whether individuals with autism are able to successfully transfer their learned skills across domains (de Marchena et al., 2015). We aim to fill this gap by developing a framework for rehabilitation of their emotional deficits based on one of their cognitive strengths, that is, affinity for music. This paper describes the theoretical framework and charts the course of typical and atypical emotional development. We then propose an experimental design to validate our new framework.

## 2 Review on Emotions: Implications for Autism

Infants from early on are confronted with the task of making sense of auditory stimuli that enters their cognitive systems such as classifying an episode of auditory stimulation as a speech or non-speech stimulus. As they get older and have amassed more experience, they learn to provide linguistic labels to these bits of ‘speech’ stimulation, for instance, labeling consonants versus vowels. These linguistic labels get increasingly complex with age (e.g. words). Parallel developments also occur for the domain of emotions. Infants are able to ‘interpret’ emotions from music and the tone of voice as they navigate the social world. The undifferentiated understanding of emotions from music and tone of voice implies that these two systems are not differentiated in the early stage of life (McMullen & Saffran, 2004). What leads to the differentiation? The infant is gradually able to understand that speech is often coated with paralinguistic cues where differences in the way a word is produced signals different emotions, e.g., the use of high pitched voice signal anger.

In a nutshell, the inference of emotions at the early stages occur in a pre-linguistic manner where these ‘emotions’ are devoid of language labels. The constant coupling of babies’ facial emotional expressions, reflecting their inner state, and their mother’s imitation of these expressions forms the basis for later emerging emotion labeling ability (Allen & Heaton, 2010). However, socially communicative cues like the tone of voice and the use of facial expressions are less informative for children with ASD. This reduced inability puts these children at a disadvantage for kick-starting the process of emotion labeling. At advanced developmental stages, much later than the typical developmental milestone, some children with autism who are high on verbal IQ (Quintin et al., 2011) may be able to hack this process or develop compensatory strategies. Most of the children with autism are unable to partition their inner emotional milieu and categorize it with the help of labels making them susceptible to problems for overt communication and inner emotional regulation. This is because linguistic labels attached to particular all-encompassing emotion experiences helps a typical individual bring the ‘labeled’ experience to the forefront of his consciousness in order to be able to talk about it for the purpose of communication or ponder over it internally for emotional regulation.

## 3 Assistive Technologies for Autism

Research has shown that these special individuals prefer technological applications over people as applications are simple and easy to manipulate after discovering the underlying patterns. It is thus understandable why communicating with people is difficult as in most instances human communication is not patterned by a rule book. In this context, ATs have been developed to closely align with their keenness for using technological applications. It has been found that individuals with autism are good at systematizing (Baron-Cohen, 2010). For this reason, computer based methods for teaching emotion recognition (e.g. methods that focus on distinguishable emotional signatures like a downturned mouth for sad) has shown some degree of success (Golan et al., 2006). But emotional recognition is much more than just dissection of fragments of emotional signatures as many modalities enrich an ‘emotional episode’ in the real world. These episodes encompass both the expression as well as detection of emotions. The modalities support emotional recognition and expression, both of which

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