



A therapeutical Virtual Reality
musical game for children with
Autism Spectrum Disorder.

Amazing Hallelujah

This 'Hallelujah' is performed by a choir from a special school of Autism children. I was in tears watching those angels singing out their efforts, gifts & strengths.

Music speaks to all when words fail.

Inspired by this performance and my passion for music, I start my research on Music Therapy and Autism.



<https://www.youtube.com/watch?v=Bmx--WjeN7o>

What is ASD?

Autism Spectrum Disorder(ASD) is a neurological and developmental disorder that begins early in childhood and lasts lifelong.

By far, it is not curable. Early intervention is important for children.

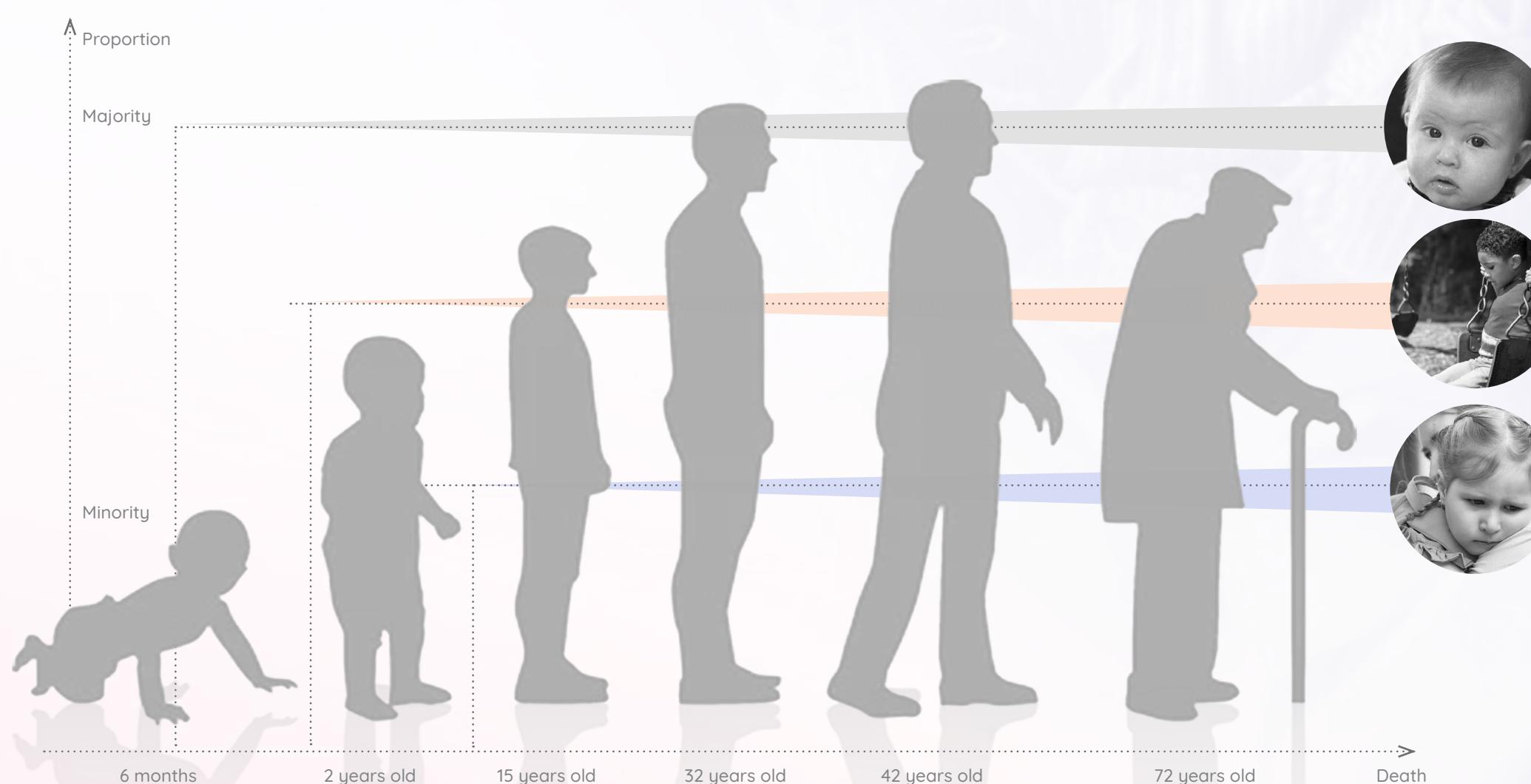
(Autism spectrum disorder - Symptoms and causes, n.d.)

Diagnosis

- No definite medical test due to its complicated causes
- More relevant data-collection is required

(Begum and Mamin, 2019)

Symptoms Revelation Timeline



What is Music Therapy?

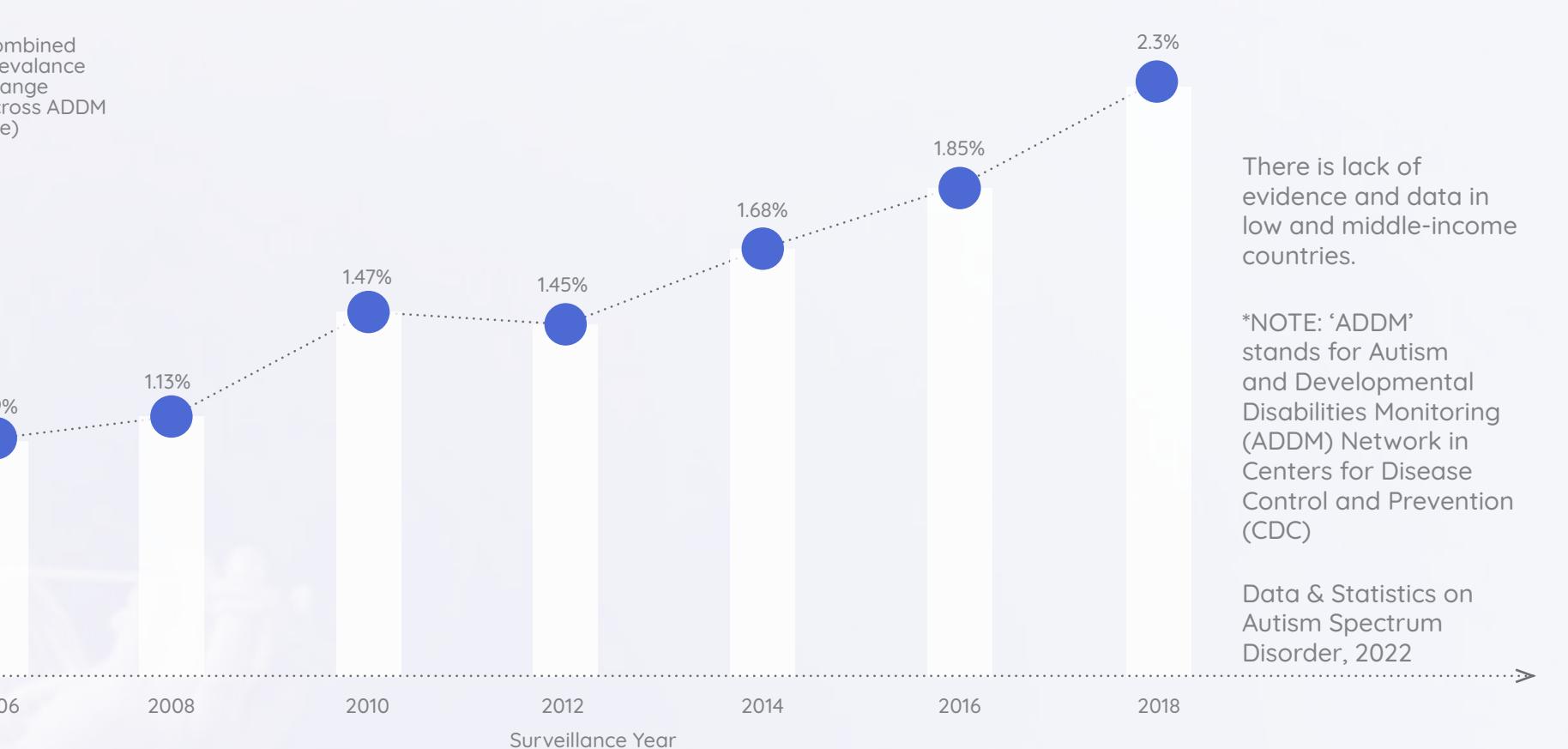
Music Therapy is the clinical & evidence-based use of musical engaging interventions within a therapeutic relationship.

It has been effectively used in ASD intervention by many.

(Wigram, 2000)

Chart: Identified Prevalence of Autism Spectrum Disorder

1 in 44 children has ASD. The number is still increasing.



What is music?

Music is composed of separate yet interconnected components such as:
Rhythm / Melody / Vocal

(Berger, 2002; Radocy & Boyle, 2003)

Gamifications

Video games have been studied in psychological and cognitive research.



ENGAGING PLATFORM

A solution for intermitting participation of ASD prevalence.



Construct Target Data

Quantitative relevant data for research which is urgently required

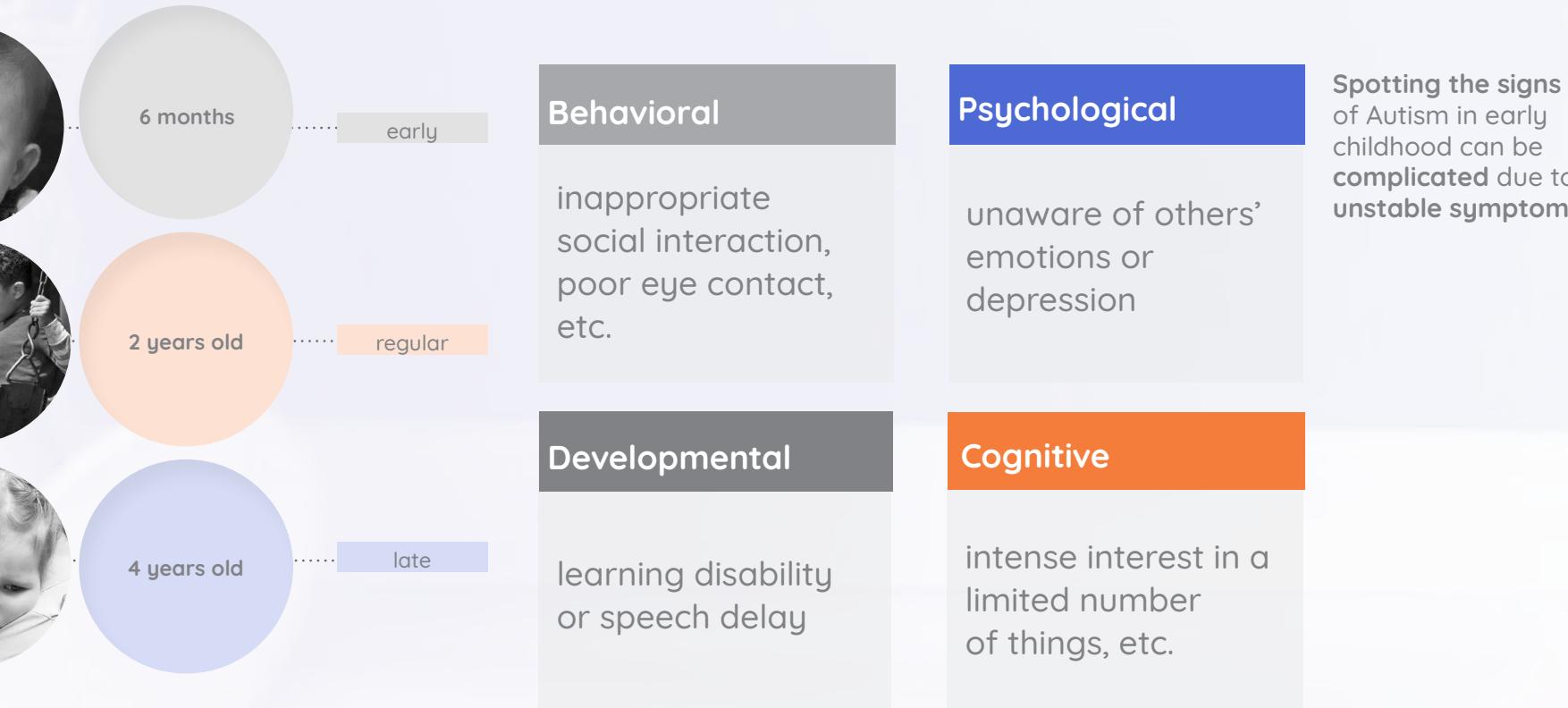


Prevent Aging Effect

Assess aging effect on cognitive function in senior people

Underscore of Music Therapy

Main symptoms of ASD



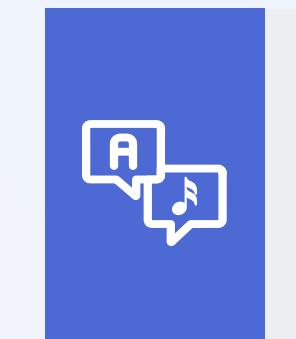
Less Constraint on Audience

Age of participants, selection of music or goal area are not differentiated



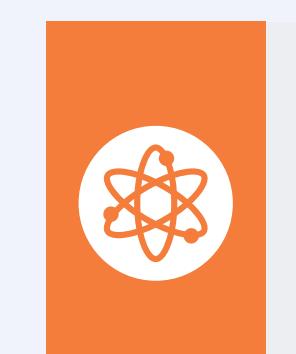
Engagement with Children

Music strongly engage participants to be involved



Effective Language & Skills Training

The common mechanism of pattern perception in music and language may benefit vocal development



Innate Ability of Music Perception

Strong cortical speech and auditory areas in ASD prevalence (5-22 years old)

Orange: (Lai, Pantazatos, Schneider & Hirsch, 2012) (Wigram, 2000) | Blue: (Thaut, 1999) | Green: (LaGasse, 2014) | Grey: (Kaplan & Steele, 2005; Whipple, 2004)

Interview: The stress on family caregivers



"My experience as a mom is vastly different."

Open discussion upon occurred difficulties, conflicts, and facts after her child being diagnosed with ASD.

Insights: Music Therapy for Autism



ECONOMY EXPENSE

High rate of Music Therapy class far exceeds a median hourly earnings worker in US.



HIRING

Demand > Supply



FOR CAREGIVERS

Trained music therapist for ASD children are in short worldwide.

Pinpoints of improvement

Economical & more trained therapists : accessibility

Maintain the high engagement of musical games

Support ASD research by providing more related data

Current solution & shortages

Government subsidy	Educational institution
✓ Economical support	✓ Professional clinicians support
✗ Undeveloped system in many developing countries: limits on audience demography	✗ The training time for therapists is too long to cope with the increasing need of ASD patients

Volunteers	Robotic platform (Feng, Mahoor & Dino, 2022)
✓ Youtube streaming well-approach some	✓ Pilot study has potential for further approach
✗ Relatively small group Missing social context approach	✗ <ul style="list-style-type: none"> • Less engaging than human characters • Missing social context approach

Advantages of VR

Feasible cost (Oculus: ~500\$ / Average salary: ~4000\$)

(Statista, 2022)

High-stimuli of interaction & support social circumstance

(Lima and Castro, 2012)

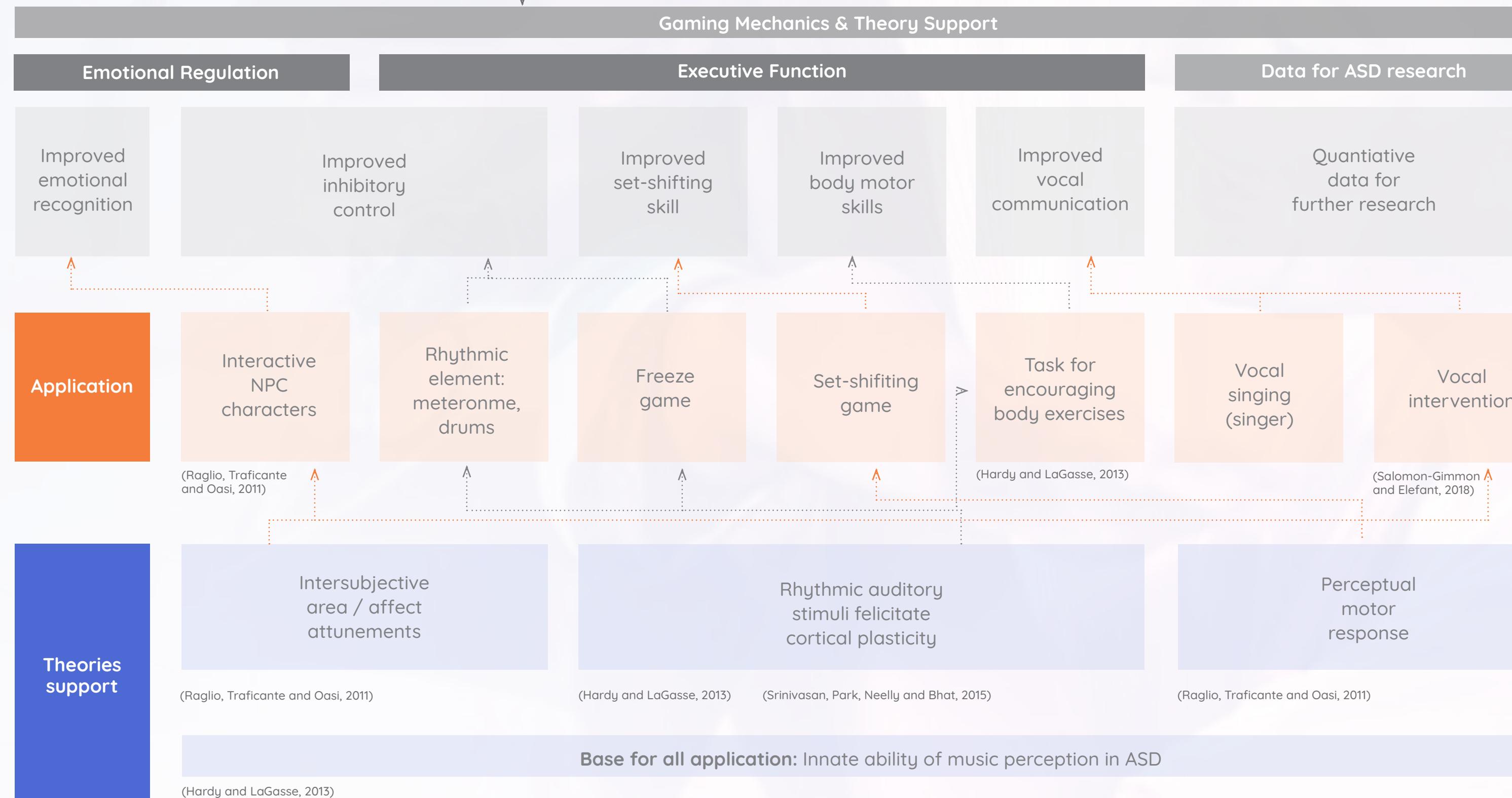
Data of habitual movement by hand controllers / headset

(Lima and Castro, 2012)

Impaired motor skills are practised largely when gaming

(Lima and Castro, 2012)

With the advantages of high-stimuli interactive environment, embedded Executive Function intervention in gaming mechanics in musical ambience



IDEATION: Conceptualisation

CUCKOO

To promote the accessibility of Music Therapy for more ASD children, 'CUCKOO' is practical, clinically-relevant, interactive musical Virtual Reality game to develop Autism children in impaired Emotional Regulations and Executive Functions.

With broader accessibility of Music Therapy for Autism children, supported by VR hand controllers habitual data extraction, we wish to contribute in ASD research for next generation.

Keywords

Autism Spectrum Disorder
Executive Functioning
Emotional Regulations
Human Computer Interaction

CUCKOO

'CUCKOO' is a dynamic, onomatopoeic name with good wishes inspired by cuckoo birds.



*Note: Low-functioning autism are not recommended. If seeking for music therapy, real life lesson fits better with more agile trained human therapists.

IDEATION: Persona & User Flow

CUCKOO

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Target Audience

Children with ASD

- possessing simple verbal ability
- have simple comprehensive ability able to developmentally understand the game rules

Age: 5-18 years old (golden time to develop cortical connection)

Aim

- **For children:** Desirable, practical application
- **For family:** Reduce the negative impacts on family of ASD
- **For Music Therapy:** Promote the accessibility of Music Therapy for ASD children
- **For next-generation:** Contributing next-generation quantitative data with therapeutic systems to effect positive behavioral change & early diagnosis



Sarah (Sanya's caregiver)

Female, 35 years old
Marriage Status: Divorced
Employment: Full-time employed
Wage: 3000 USD monthly



Sanya (child with ASD)

Gender: Female
Age: 3 years old

ASD symptoms
Avoiding eye contact
Repetitive behavior
Impaired inhibitory control

Stage

Goal

Steps

Get in touch

Know about the aim and vision of 'Cuckoo'

-Sarah gets a VR headset

- Sarah knows how to use a VR headset

Giving Instructions

Sarah knows the user flow and gaming mechanics

After watching instructions video and reading the brochure, Sarah knows the mechanics of the 'Cuckoo'

-Sarah fills in the questionnaire at the beginning, specifying Sanya's symptoms

-Sarah sets up verbal level of songs for Sanya

Setting Up

Targeted improvement for individual through 3 different roles

Practicing Instructions

Short-term:

- Engaging participation
- Improved cognitive skills & emotional regulation

Long-term

- Social engagement
- Collaborative skills

-Sanya plays firstly with Sarah's guidance

-As Sanya scores higher at games, Sanya invites her real life friends to create music together with 'Cuckoo'



PROTOTYPE: Visual Identity & User Interface

Visual Identity

Typeface

Lapsus Pro

Title Body

CUCKOO

Logo



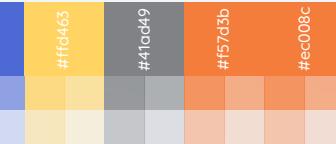
NPC



Final Logo

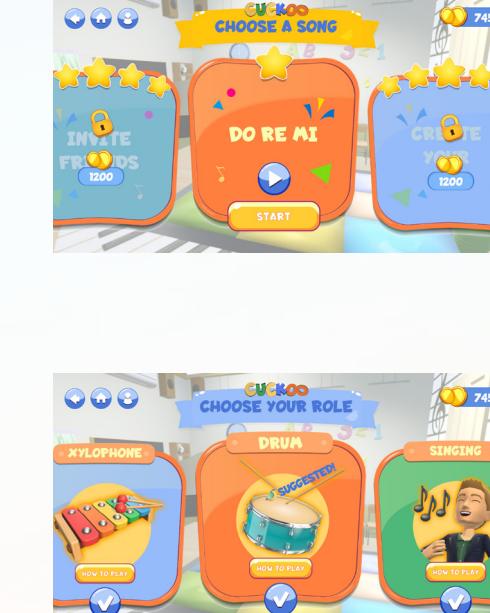
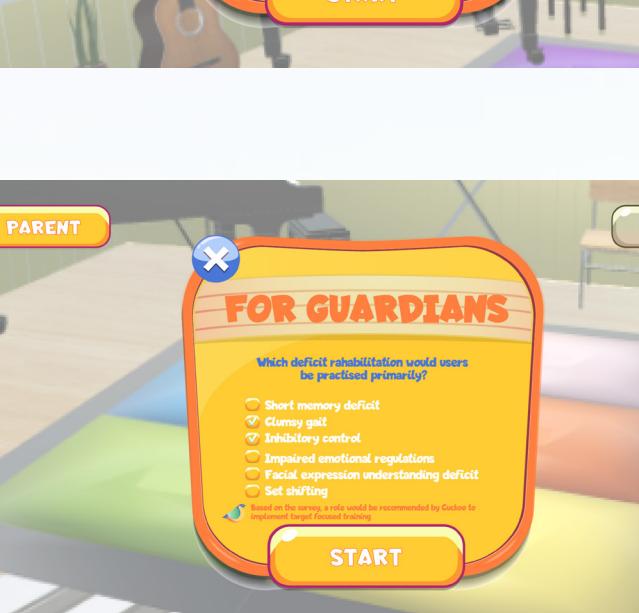
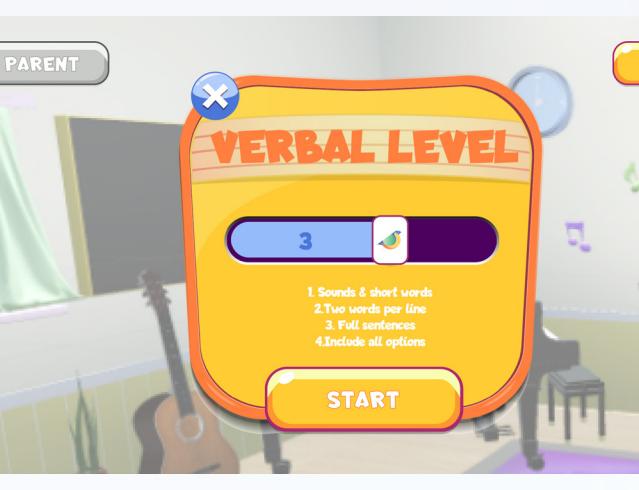
CUCKOO

Colour Palette



Teacher will play the piano and conduct user.
Others will role-play with user together.

User Interface in VR



Beginner (Music Classroom)**Design principles for space (Autism)**

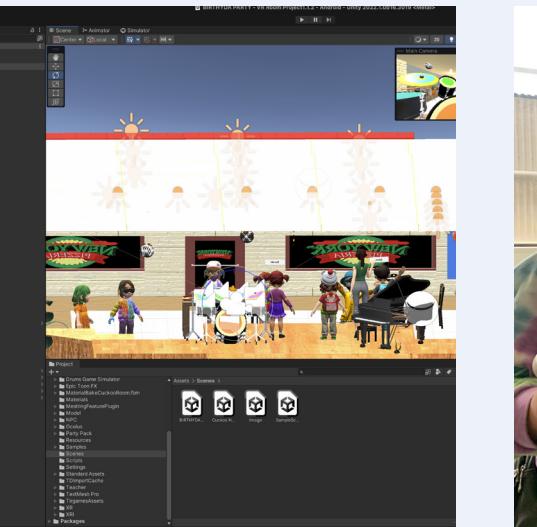
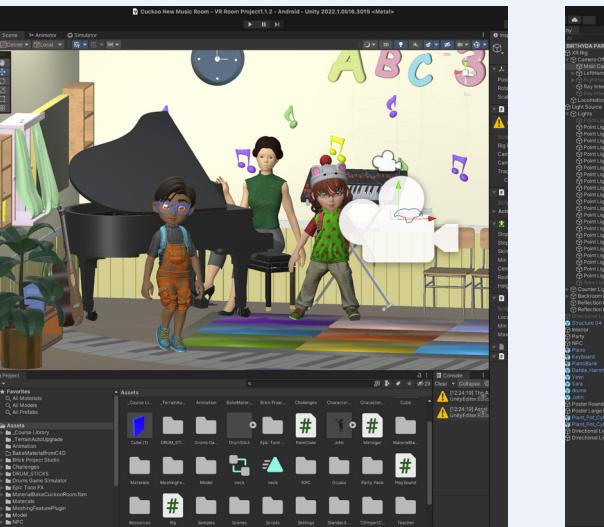
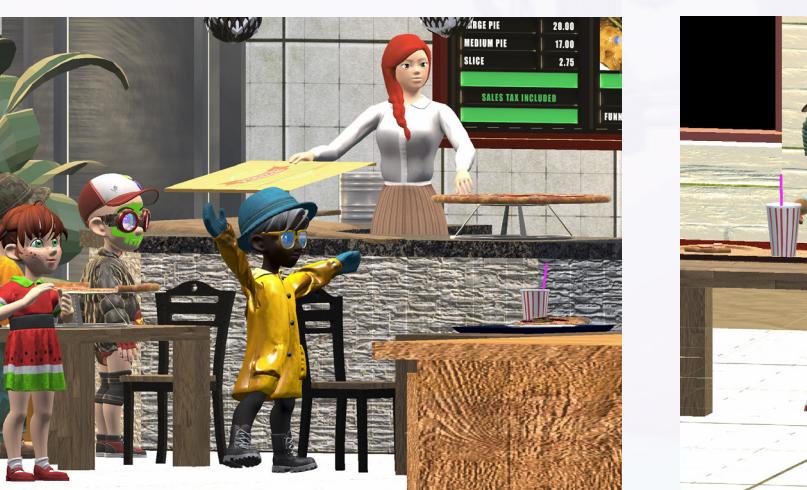
- Acoustics.** Autistic people are painfully sensitive to sounds.
- Lighting.** Light, color affect mood, and cognitive behavior
- Spatial configuration.** Ordered space is easier for the autismism.
- Materials.** Modular furniture are preferable. (Thuong, 2018)

Familiar scenario as a start is **sanguine** for adaption.

**Advanced (Lucy's Birthday Party)**

There are other guests, shop workers in the pizza shop! We are going to perform on the stage to celebrate her!

The purpose of putting audience: improve social skills & impaired emotional regulation



Selected student project in 'Hypothetical' Studio, RMIT University, 2022
Exhibited in RMIT University

**User Testing 01:**

Robert

Gender: Male
Age: 15 years old
Health: Healthy
Occupation: Student

Game flow understanding	● ● ● ● ●
Motion Sickness	● ● ● ● ●
Drum Sound Activation	● ● ● ● ●
Time used for first successful hit	3 mins

This game provides an immersive and realistic experience. Reaction time of each movement can be improved since the interval between the signal is too short, and user is difficult to adjust it.

**Using Testing 02**

Han

Gender: Female
Age: 18 years old
Health: Healthy
Occupation: Student

Game flow understanding	● ● ● ● ●
Motion Sickness	● ● ● ● ●
Drum Sound Activation	● ● ● ● ●
Time used for first successful hit	2 mins

The characters and scenarios are engaging. The 'Drummer' role-play is interesting with real-sounds. User Interface is effective design and straightforward-guiding.

**Video Trial**

<https://vimeo.com/759713435>