



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

Solo Project
Timeline: 5 months (2022)

'Hypothetical' Studio
Exhibited in RMIT University (2022)

Promote Video:
<https://vimeo.com/772746318>

RESEARCH: Inspiration & About ASD

Amazing Hallelujah

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

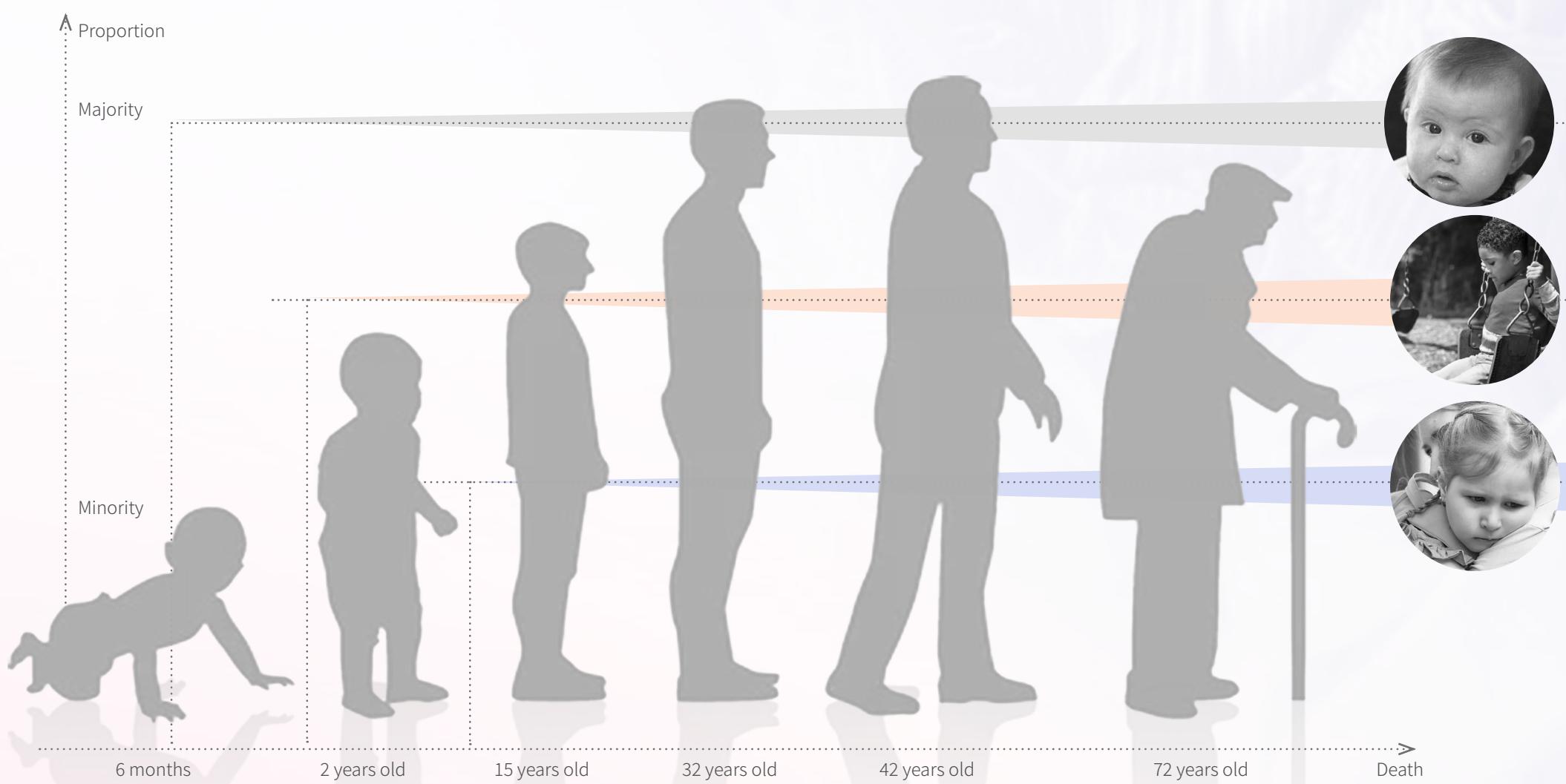
Music speaks to all when words fail.

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



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

Symptoms Revelation Timeline



PAGE 2

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.)

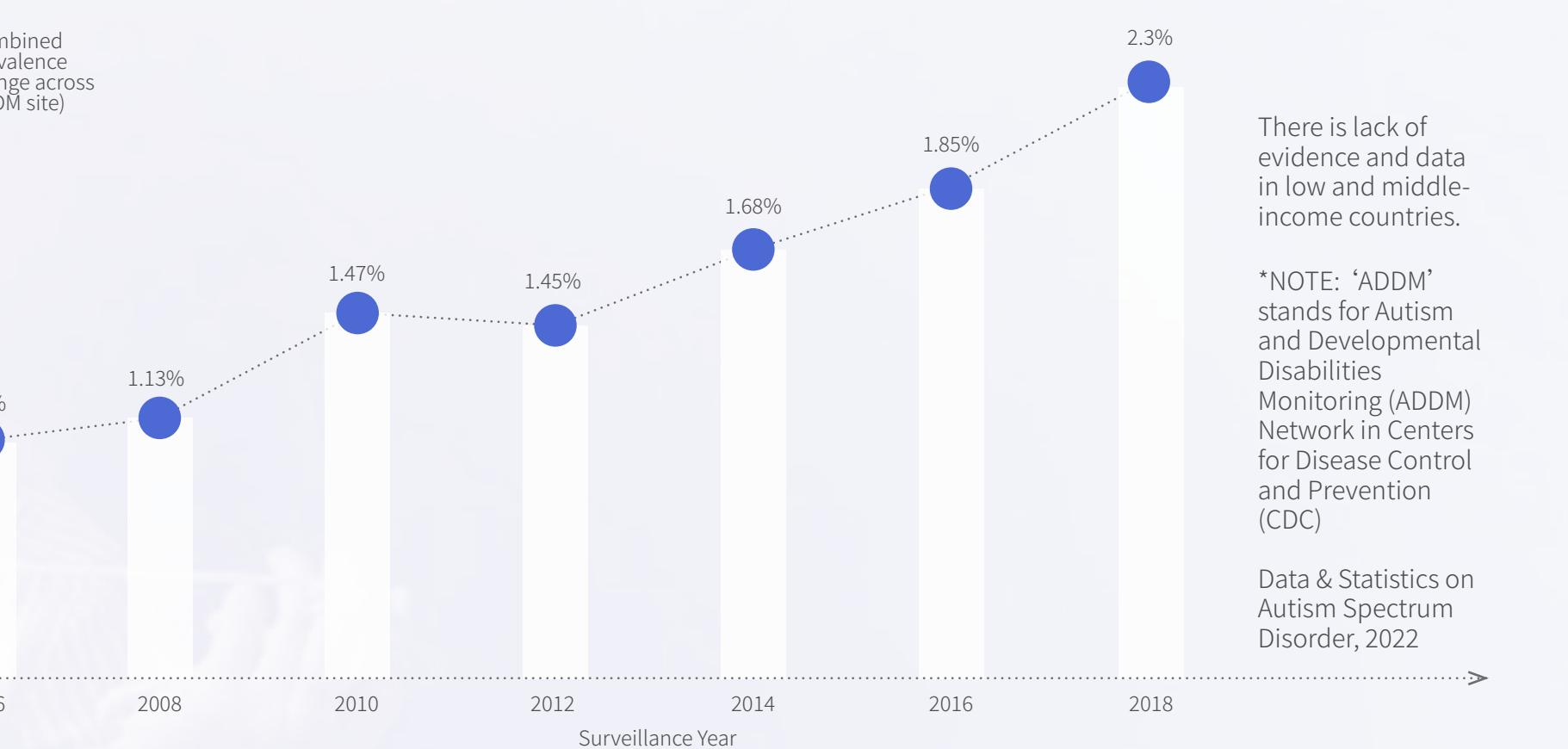
Diagnosis

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

(Begum and Mamin, 2019)

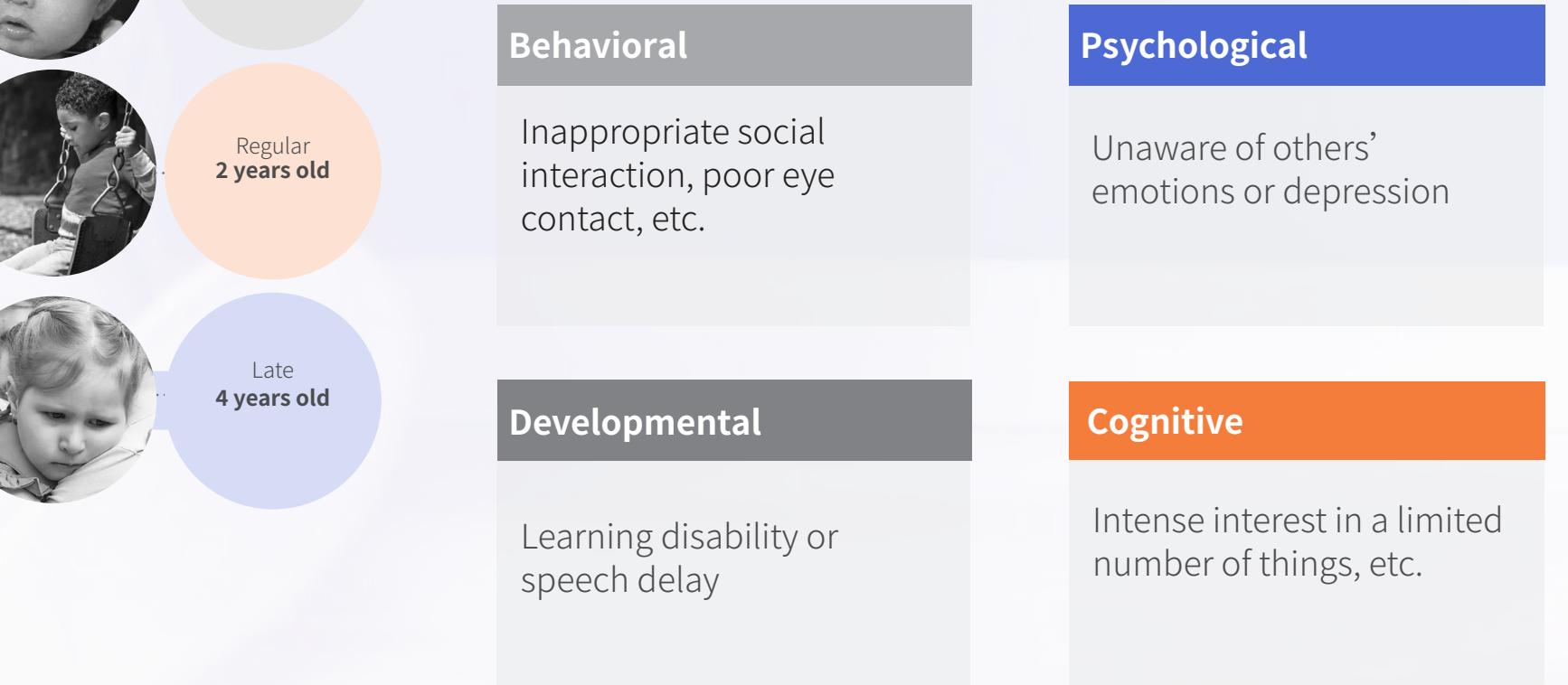
Chart: Identified Prevalence of Autism Spectrum Disorder

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



Main symptoms of ASD

Spotting the signs of Autism in early childhood can be complicated due to unstable symptoms.



RESEARCH: About Music Therapy & Gamification

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)

What is music?

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

(Berger, 2002; Radocic & Boyle, 2003)

Gamifications

Video games have been studied in psychological and cognitive research.



ENGAGING PLATFORM

A solution for intermittent 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

Orange & Green: (Li et al., 2018) Blue: (Anguera et al., 2013)

Underscores of Music Therapy

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 Training



The **common mechanism** of pattern perceptions in music and language

Innate Ability of Music Perception



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

Orange: (Lai, Pantazis, 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. It's hard to balance the intense care and your own life."

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

Unavoidable extra cost upon economy, time for parents who have already been impacted by ASD prevalence.



FOR CAREGIVERS

Trained music therapists for ASD children are in short worldwide.

Cuckoo: Next Paradigm of Music Therapy for Autism Kids

RESEARCH: Market Research & Analysis

Current solution & shortages

 Government subsidy
✓ Economical support
✗ Undeveloped system in many developing countries: limits on audience demography

 Educational Institution
✓ Professional clinicians support
✗ The training time for therapists is too long to cope with the increasing need of ASD patients

 Volunteers
✓ YouTube streaming well-approach some
✗ Relatively small group Missing social context approach

 Robotic platform <small>(Feng, Mahoor & Dino, 2022)</small>
✓ Pilot study has potential for further approach
✗ Less engaging than human characters • Missing social context approach

Pinpoints of improvement

Economical & more trained therapists : accessibility
Maintain the high engagement of musical games
Support ASD research by providing more related data

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 practiced largely when gaming
(Lima and Castro, 2012)

Case Study: Therapeutic gamification on Executive Functioning

Source:

Li, B., Atyabi, A., Kim, M., Barney, E., Ahn, A., & Luo, Y. et al. (2018) Social Influences on Executive Functioning in Autism.

Set-shifting game

Theory: **Wisconsin Card Sorting Test**

Set-shifting thinking may be a general deficit in ASD, spanning across both **social and non-social domains**.

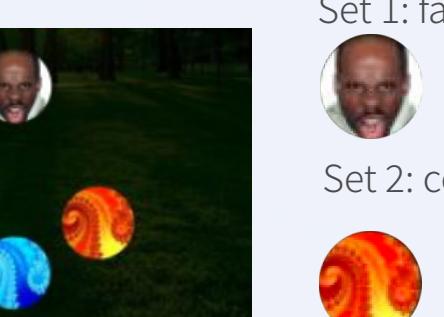
Aim: Set-shifting skills practice

Go/Non-go task

Presence of an angry face as “stop touching screen” sign.

Salient emotional expressions that may yet provide an effective **method** for the **external regulation** of behavior in children with ASD.

Aim: Inhibitory Control practice (social factor)



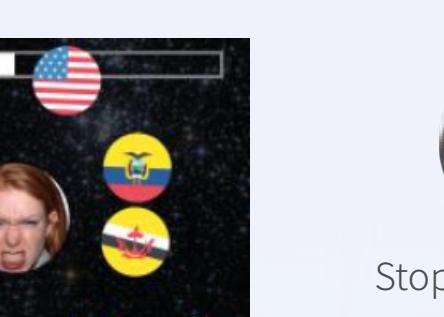
Set 1: face

Set 2: color

Red circle

Blue circle

Shifting Game: player has to guess the rule associated with the correct answer. Rule changes within few seconds.



Stop sign: angry face

Inhibitory Control: when angry face appears, player is required to stop touching screen when face gone.

EARLY GENERATIVE: Diagram Synthesis

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



Virtual Reality Stimuli

Disadvantages

Severe motion sickness

Might gaming too much

Real-life alike stimuli

Body Exercises

Data traced from user habitual movement

Advantages

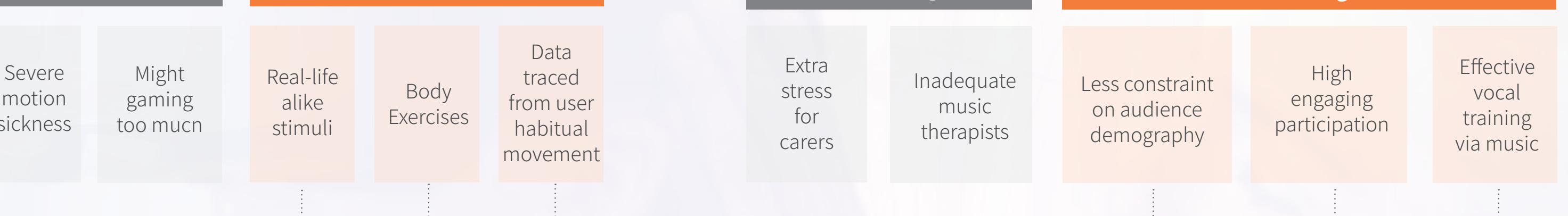
Extra stress for carers

Inadequate music therapists

Less constraint on audience demography

High engaging participation

Effective vocal training via music



Gaming Mechanics & Theory Support

Emotional Regulation

Improved emotional regulation

Interactive NPC characters

Rhythmic element: metronome, drums

Freeze game

Set-shifting game

Executive Function

Improved inhibitory control

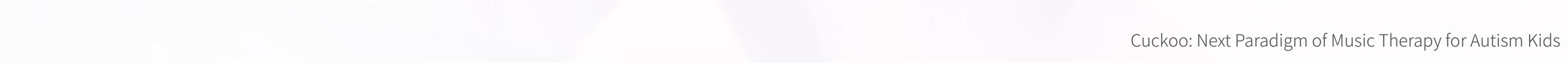
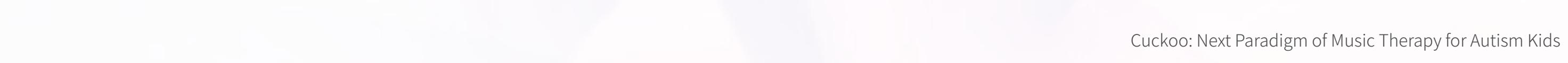
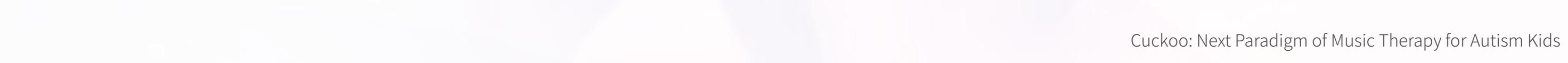
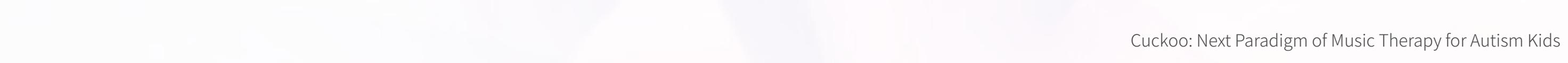
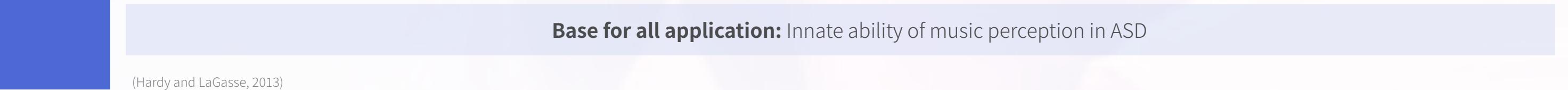
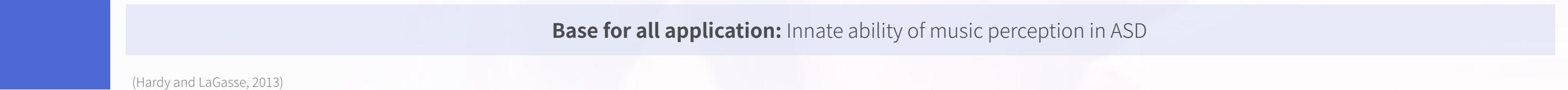
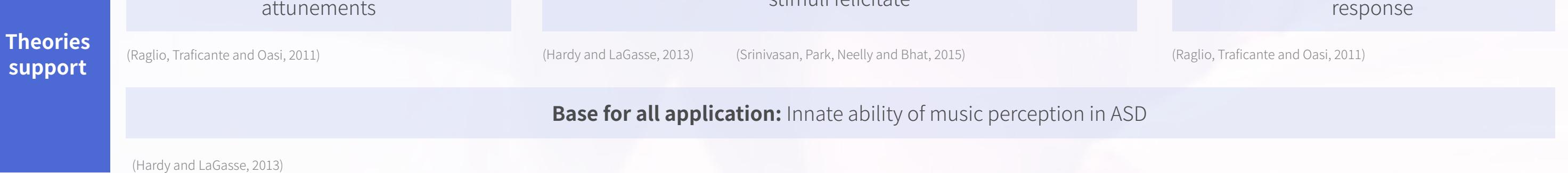
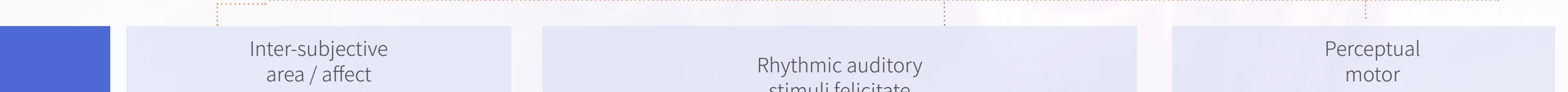
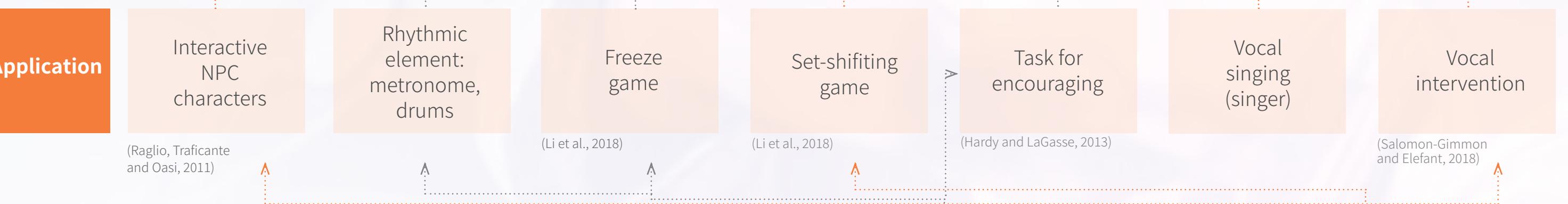
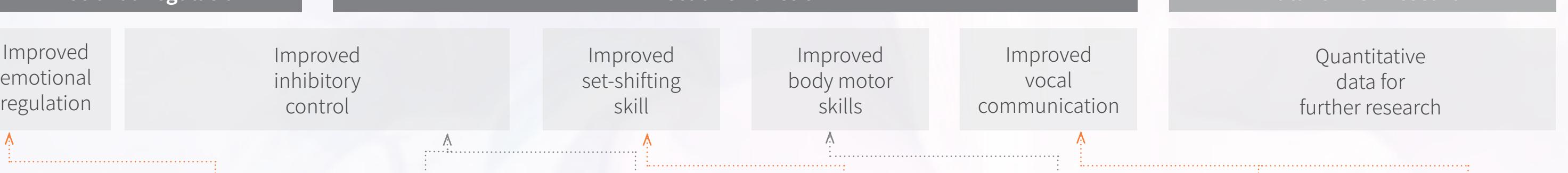
Improved set-shifting skill

Improved body motor skills

Improved vocal communication

Data for ASD research

Quantitative data for further research



IDEATION: Conceptualization

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.

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.



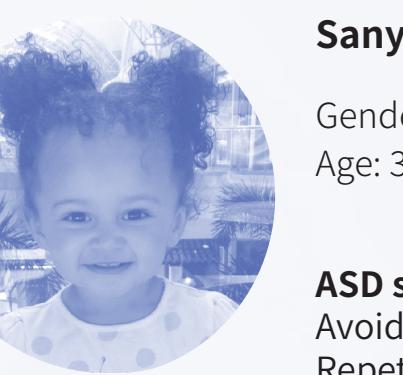
*Note: Low-functioning autism are not recommended. If seeking for music therapy, real life lesson fits better with more agile trained human therapists.

IDEATION: Persona & User Flow



Sarah (Sanya's caregiver)

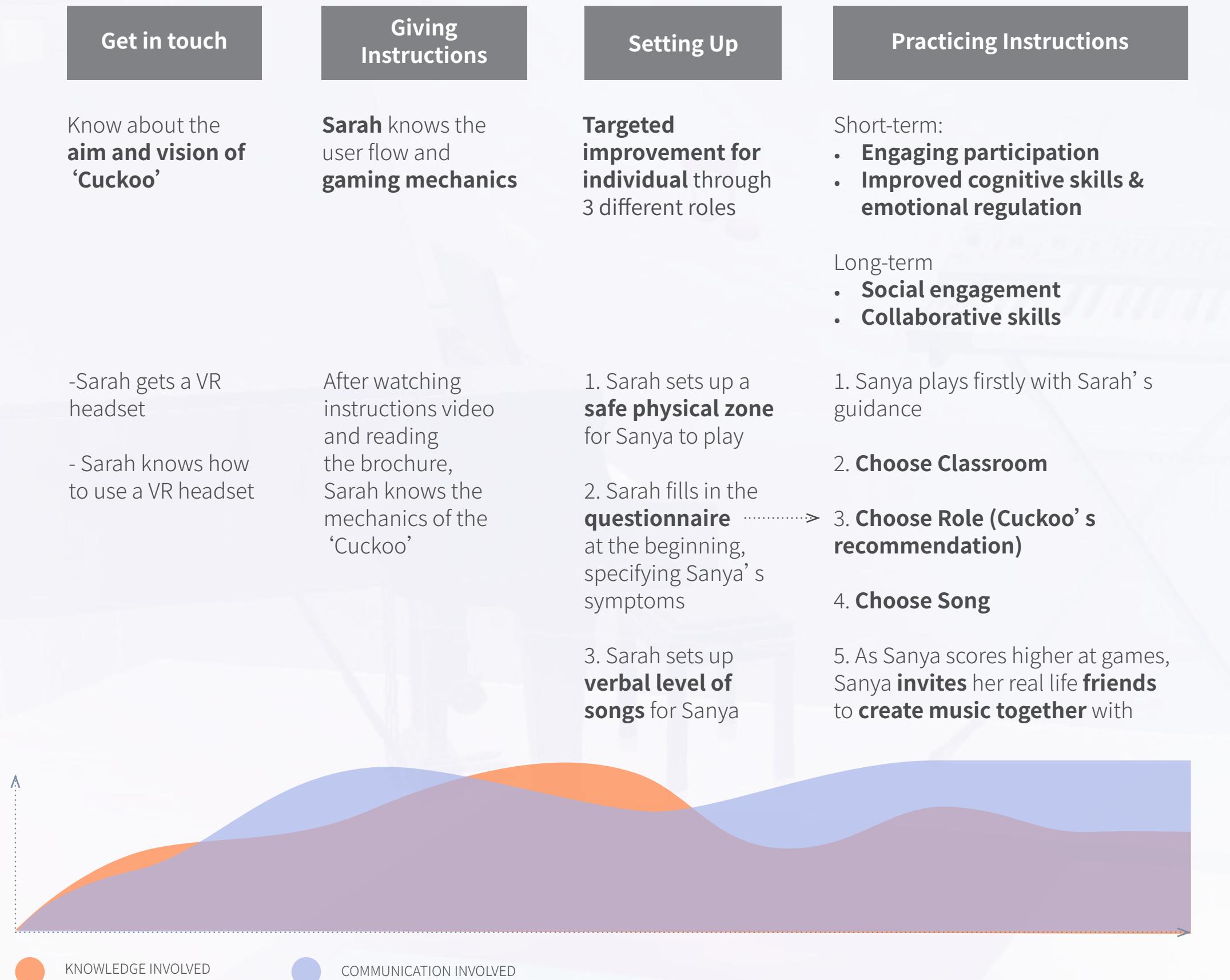
Female, 35 years old
Marriage Status: Divorced
Employment: Full-time employed
Wage: 3000 USD monthly



Sanya (child with ASD)

Gender: Female
Age: 3 years old

ASD symptoms
Avoiding eye contact
Repetitive behavior
Impaired inhibitory control



PROTOTYPE: Visual Identity & User Interface

Visual Identity

Typeface

Lapsus Pro

Title Body
CUCKOO

Logo



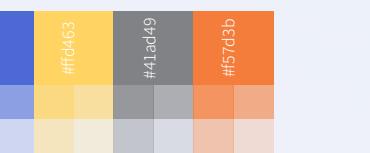
NPC



Final Logo

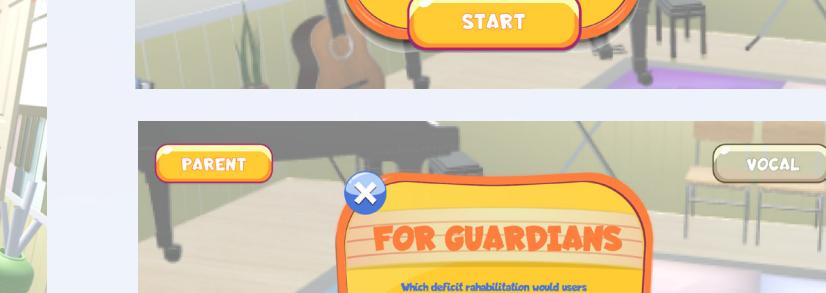
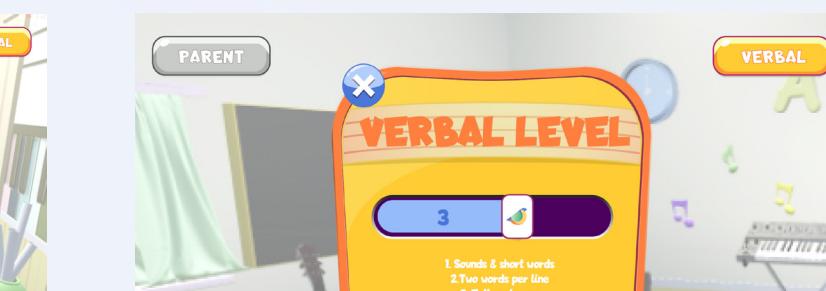
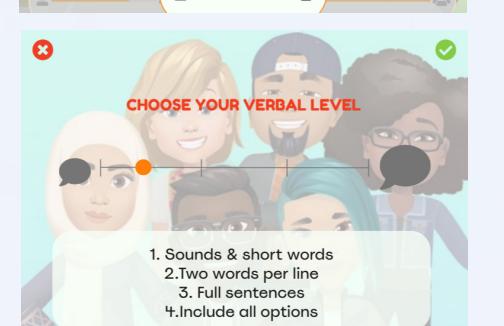
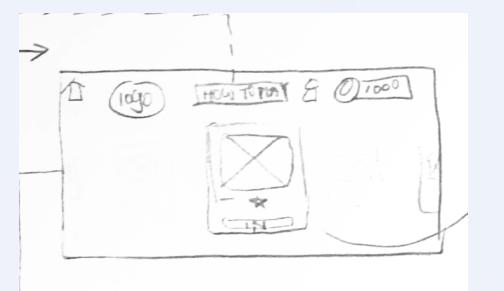
CUCKOO

Colour Palette



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

UI in VR (Lofi)



PROTOTYPE: VR Scenario Models

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 autistic.
- Materials:** Modular furniture are preferable. (Thuong, 2018)



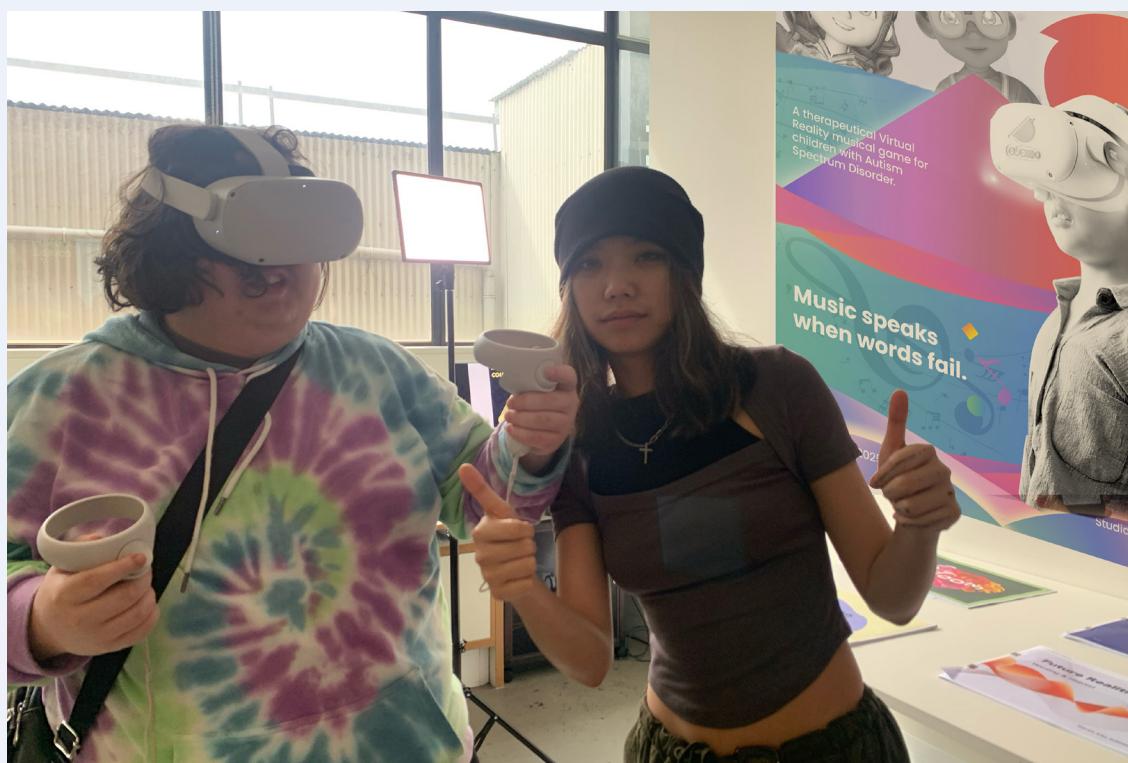
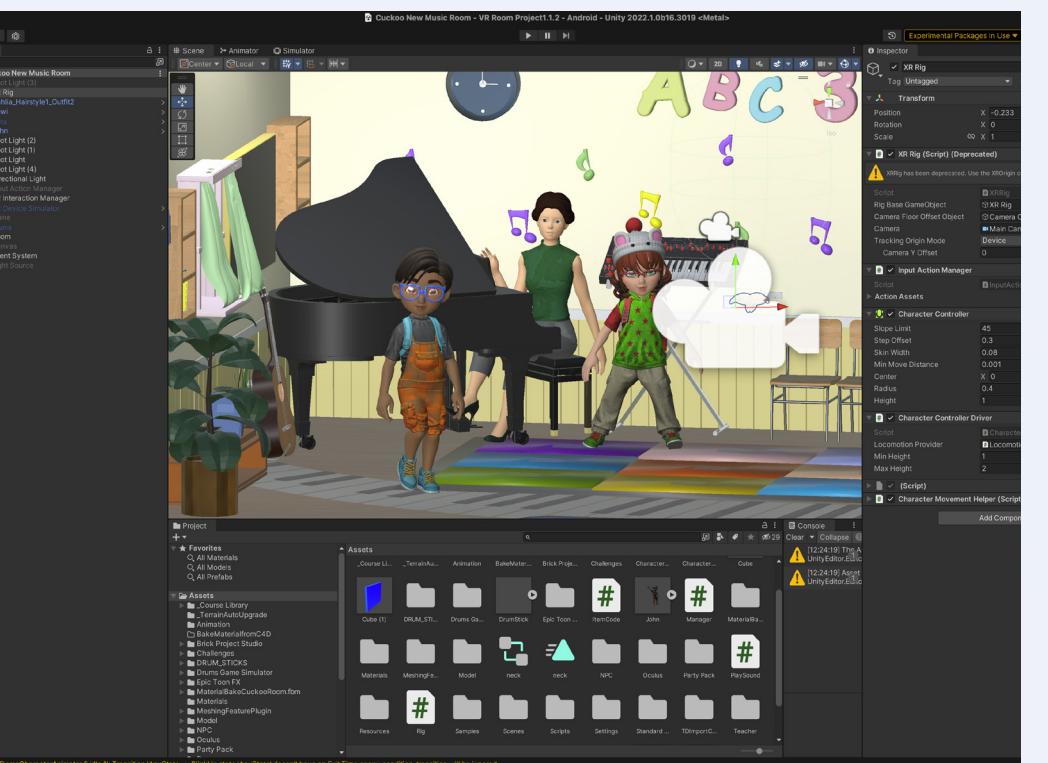
Familiar scenario as a start is sanguine for adaption.

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**



USER TESTING: Early Testing & Feedbacks



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



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



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



Game Sample Video

