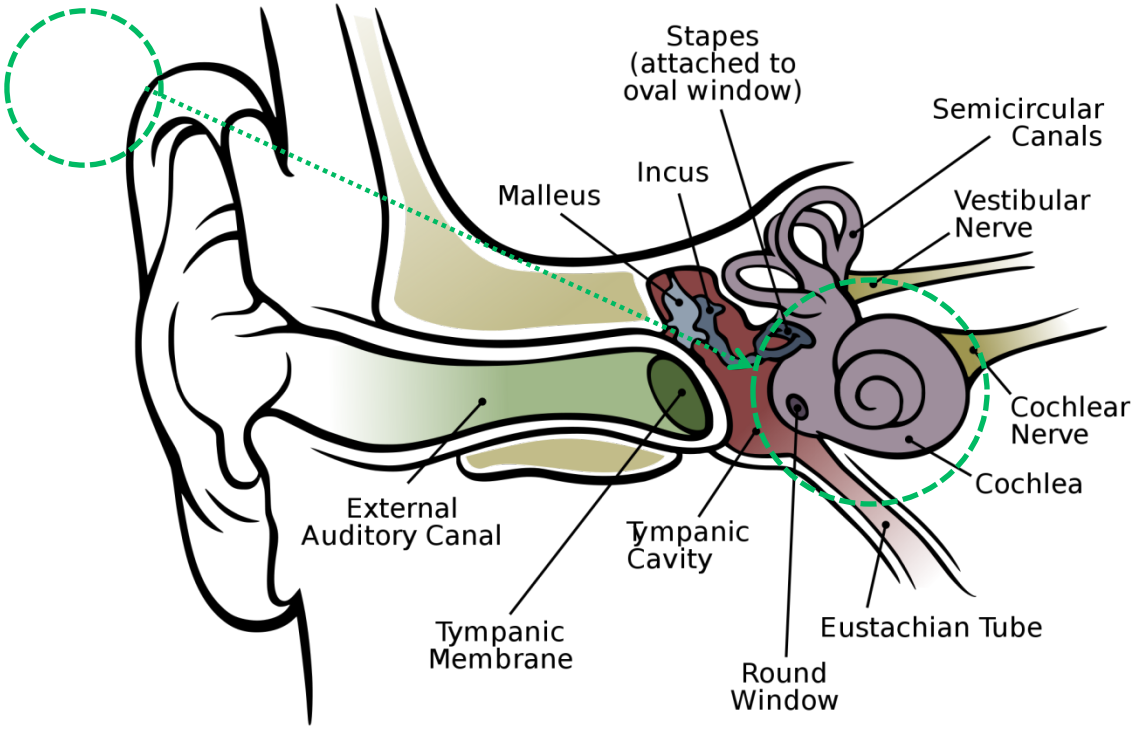
Musical auditory Habilitation for children with cochlear implants

Ramprasad S, Interaction design(2012-14)

Guided by Prof. Ravi Poovaiah

Introduction

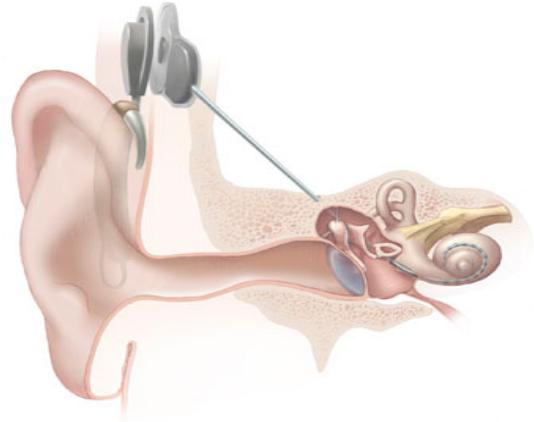
The EAR - Structure



Source : http://faculty.harford.edu/faculty/WRappazzo/bio203/laboratory/Ear_Marieb_Unlabelled.jpg

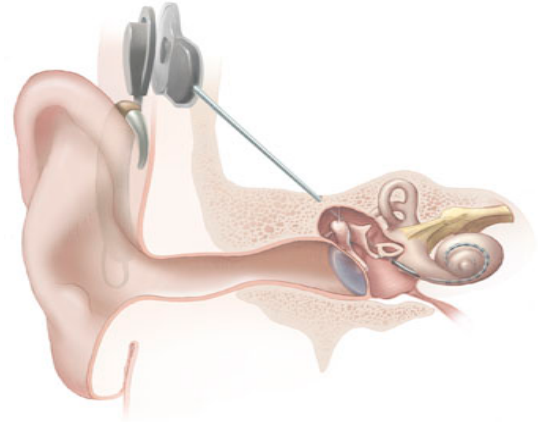
What is it?

A cochlear implant (CI) is a surgically implanted electronic device that provides a sense of sound to a person who is profoundly deaf or severely hard of hearing.



User groups

- Persons with prelingual deafness
- Persons with post-lingual deafness
- Persons with congenital deafness



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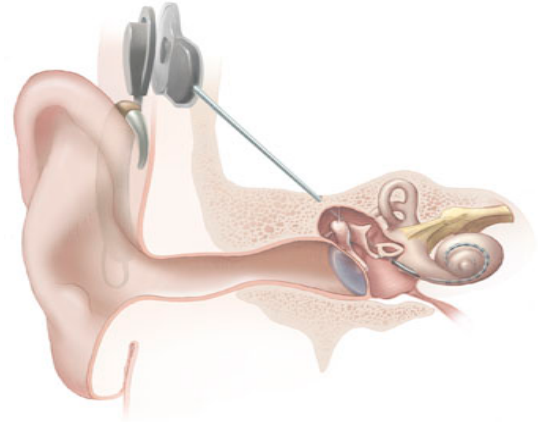
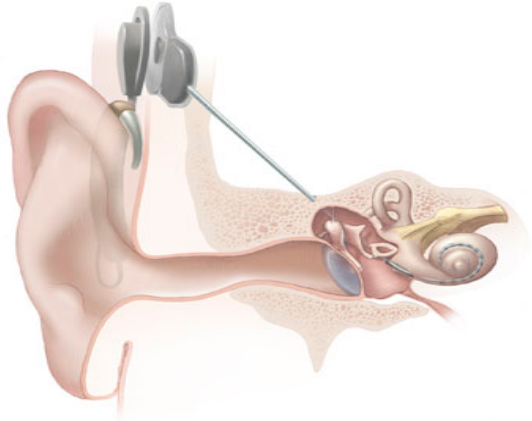




User groups

Children . . . (age 3-12 ?)

Children are recommended to get implanted with cochlear implants from 10 months age.

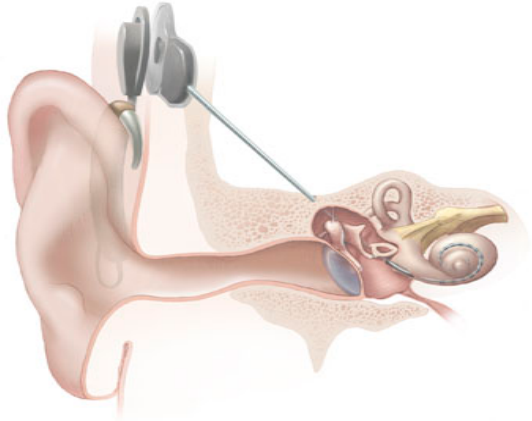
Children who have implants before 4 years age have shown to exhibit improved development than children with implants after 5 years age.

Source: Speech perception by prelingually deaf children using cochlear implants. Tyler RS, Fryauf-Bertschy H, Kelsay DM, Gantz BJ, Woodworth GP, Parkinson A.

User groups

Children . . .
(age 3-12 ?)

Around the age 2 to 3, normal children and children with cochlear implants finish learning atleast 50 words and start doubling words to form sentences. Hence age group between 3 to 12 is chosen to facilitate learning Music Basics along with language.



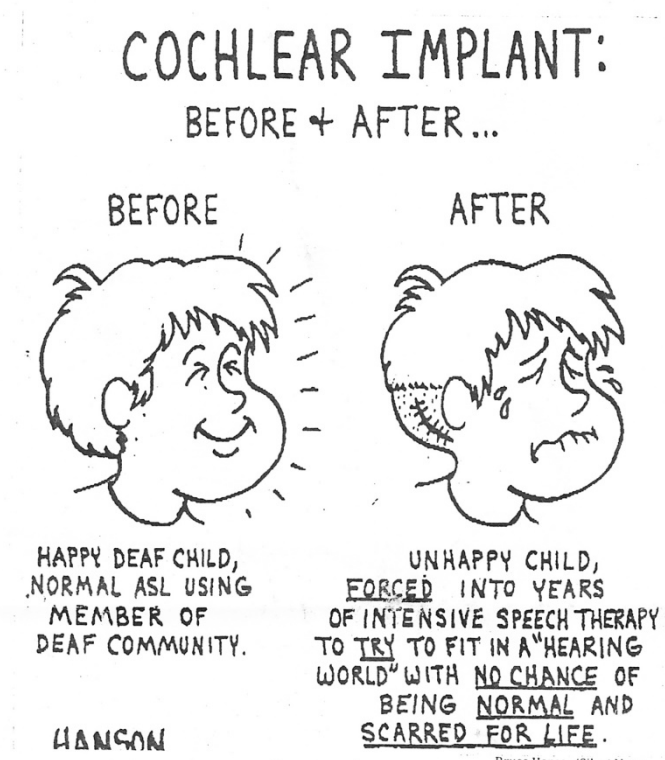
Cochlear Implants

Few Disadvantages

Children with cochlear implants have great difficulty perceiving music*.

Poor music perception impacts

- Their ability to understand music, especially melody.
- Their ability to use pitch to indicate emotion and intonation while speaking



A cartoon from Silent News, a newspaper for the deaf based in Rochester, showing one attitude towards the hearing world.

Source :*H. J. McDermott. Music perception with cochlear implants: A review. Trends In Amplication, 8:49-82,2004.

Cochlear Implants

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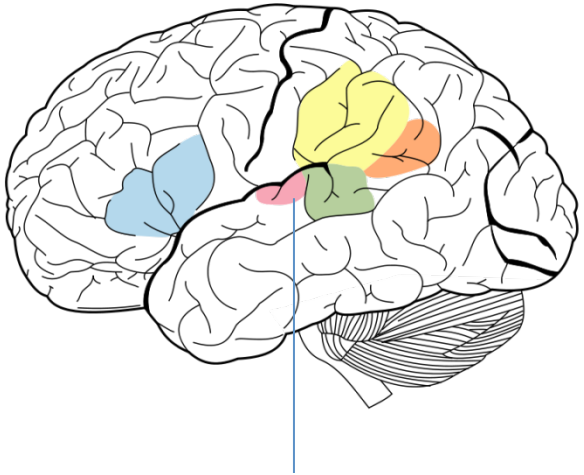
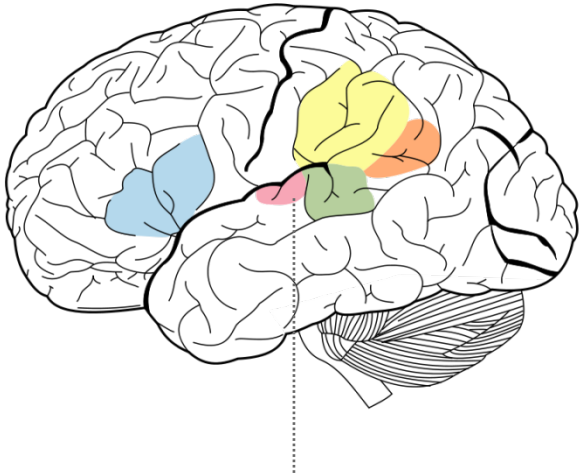


Primary Auditory Cortex

Source :*H. J. McDermott. Music perception with cochlear implants: A review. Trends In Amplication, 8:49-82,2004.

Dangers …

Permanent underdevelopment of a human quality ?



Primary Auditory Cortex

Cochlear implant vs Hearing aid

User Study & Research

About Hearing Loss individuals in General

User Research

Shri Patcheappane School For The Hearing Impaired

Thengaithittu , near Pondicherry.


SP SHI

About the School

Educating Children

- *focus on the training of the residual hearing of each student, an aural-oral program*

- *students from the age of 2.5 years to 15 (X Std). Special language and speech training is given for Children in pre-primary level (2.5 to 5.5 years age) after which students are recommended Tamil Nadu State Board Syllabus.*

Primary Research

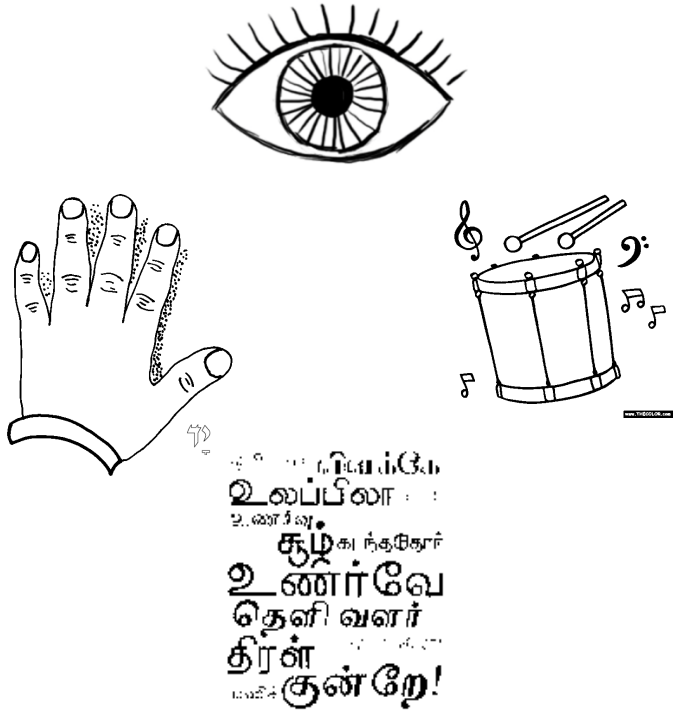
Shadowing Users

Children with Hearing loss

Feeling Sound

- *Visual*
- *Tactile sound*
- *Rhythm based*

+ Residual Hearing



Children with Hearing loss

Feeling Sound

Visual + Residual Hearing

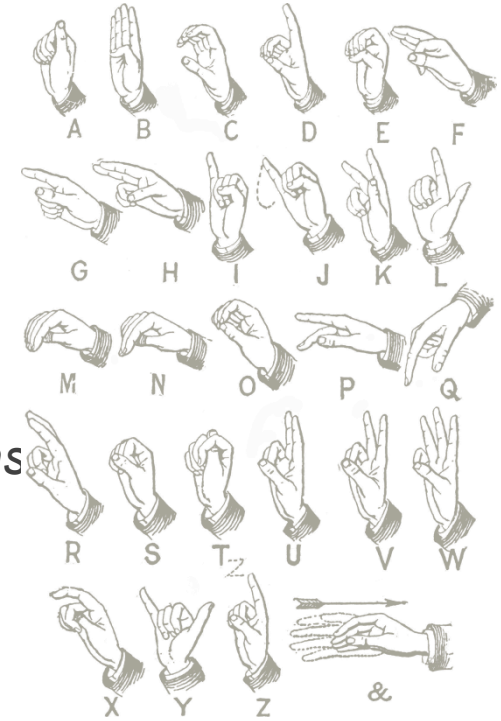
- *Gestures- body gestures and facial expressior*

Children with Hearing loss

Feeling Sound

Visual + Residual Hearing

- *Gestures- body gestures and facial expressions*
- *Sign Language*

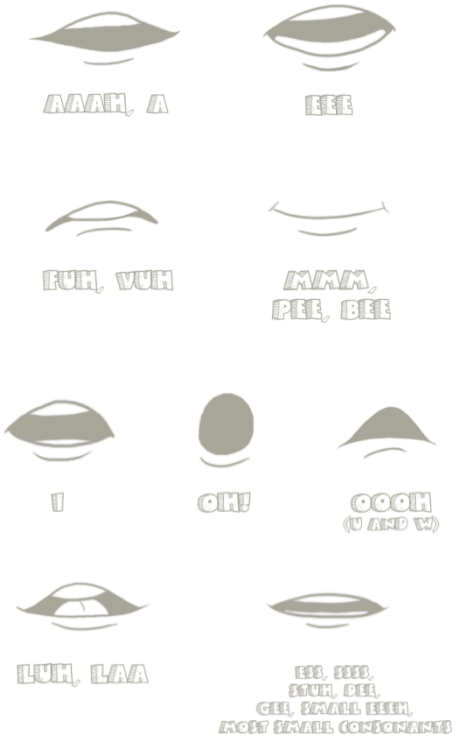


Children with Hearing loss

Feeling Sound

Visual + Residual Hearing

- *Gestures- body gestures and facial expressions*
- *Sign Language*
- *Lip reading*



Children with Hearing loss

Feeling Sound

Visual + Residual Hearing

- *Gestures- body gestures and facial expressions*
- *Sign Language*
- *Lip reading*
- *Images*

X	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	40	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

Children with Hearing loss

Feeling Sound

Visual + Residual Hearing

- *Gestures- body gestures and facial expressio*
- *Sign Language*
- *Lip reading*
- *Images*
- *Videos*

Children with Hearing loss

Feeling Sound

Tactile + Residual Hearing

- *Approaching Train, bus, other vehicles*

Children with Hearing loss

Feeling Sound

Tactile + Residual Hearing

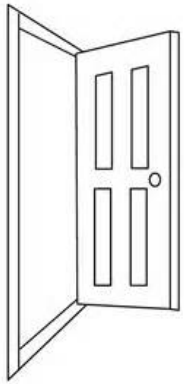
- *Approaching Train, bus, other vehicles*
- *Whispering close to ears*

Children with Hearing loss

Feeling Sound

Tactile + Residual Hearing

- *Approaching Train, bus, other vehicles*
- *Whispering close to ears*
- *Environment sounds, doors, thunder etc.*



Children with Hearing loss

Feeling Sound

Tactile + Residual Hearing

- *Approaching Train, bus, other vehicles*
- *Whispering close to ears*
- *Environment sounds, doors, thunder etc.*
- *Acoustic Music Instruments*

Children with Hearing loss

Effect of training

- *Training helps greatly in sharpening the residual hearing. Continuous training brings remarkable improvement.*

- *Training required for each individual will vary depending on the degrees of hearing impairment.*

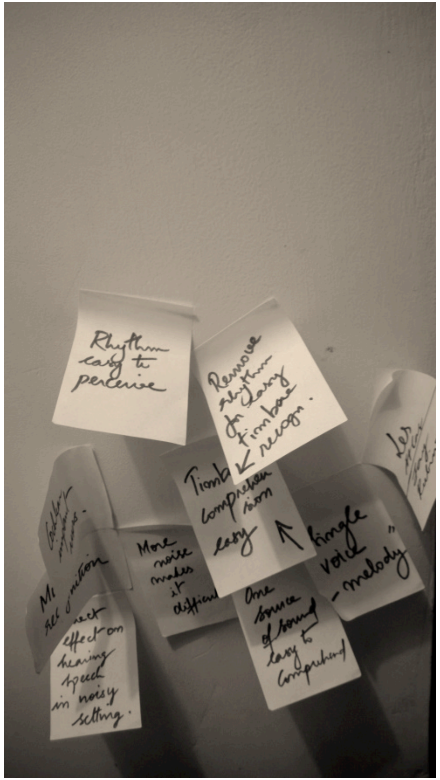
About Cochlear Implant Users

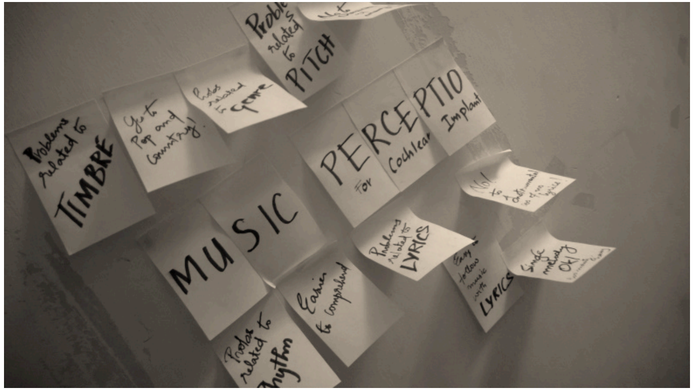
Secondary Research

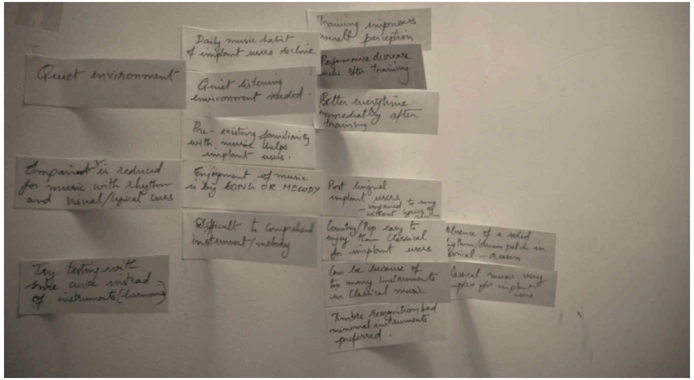
Children with Cochlear Implant

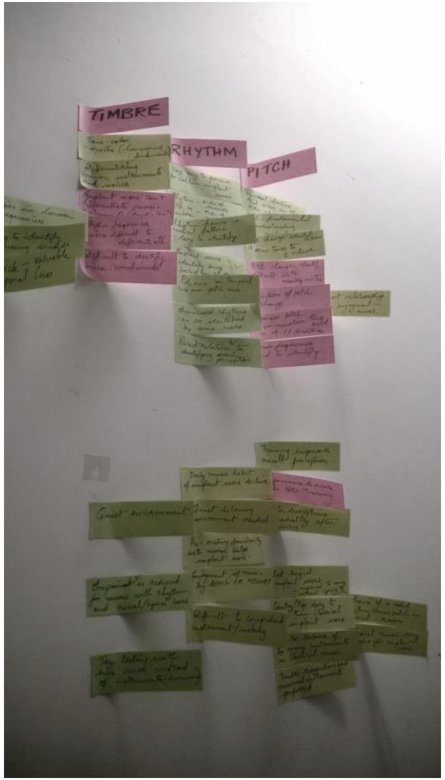
Perceiving Music

http://www.youtube.com/watch?v=SpKKYBkJ9Hw


Rhythm easy to perceive
Remove rhythm for easy timbre recogn.
Timbre comprehension easy
More noise makes it difficult
One source of sound easy to comprehend
Single voice - melody
effect on hearing speech in noisy setting.


Problems related to TIMBRE
Up-to Pop and Country
Problems related to PITCH
MUSIC PERCEPTIO
For Cochlear Implant
Problems related to LYRICS
Easier to comprehend
Problems related to Rhythm


Quiet environment
Daily music habit of implant users decline
Training improves overall perception
Performance decrease after training
Quiet listening environment needed.
Better everytime immediately after training
Pre-existing familiarity with music helps implant users.
Impairment is reduced for music with rhythm and visual/lyrical cues
Enjoyment of music is by SONG OR MELODY
Post lingual implant users
Difficult to comprehend instrument/melody
Country/Pop easy to enjoy than Classical for implant users
Try testing with sine wave instead of instruments (harmony)
Can be because of too many instruments in Classical music
Timbre recognition had minimal instruments preferred.
Classical music very complex for implant users


TIMBRE
RHYTHM
PITCH
Quiet environment

Children with Cochlear Implants

Perceiving Music

Perceiving the fundamentals

- *Rhythm*
- *Pitch*
- *Timbre*

Children with Cochlear Implants

& Rhythm

Rhythm generally describes the temporal features of music that typically occur on the order of seconds (as opposed to the fine scale temporal features that occur on the order of milliseconds that are crucial in the perception of pitch and timbre).

Source :*H. J. McDermott. Music perception with cochlear implants:

Children with Cochlear Implants

Perceiving Rhythm

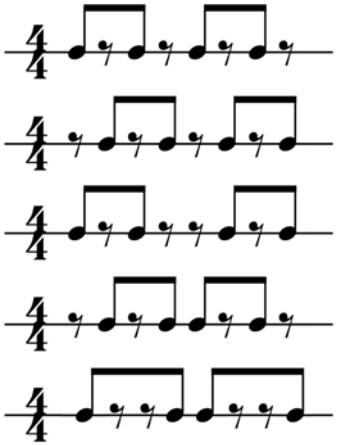
- *Rhythm is easier to perceive for Users(than the other two parameters).*
- *Song identification is therefore done based on rhythm identification[1].*
- *Reliance on temporal cues better with cochlear implants than pitch cues[2].*
- *Improvised rhythm patterns easy to differentiate[3].*
- *Direct relation to speech perception (rhythm of words pronounced) [3].*

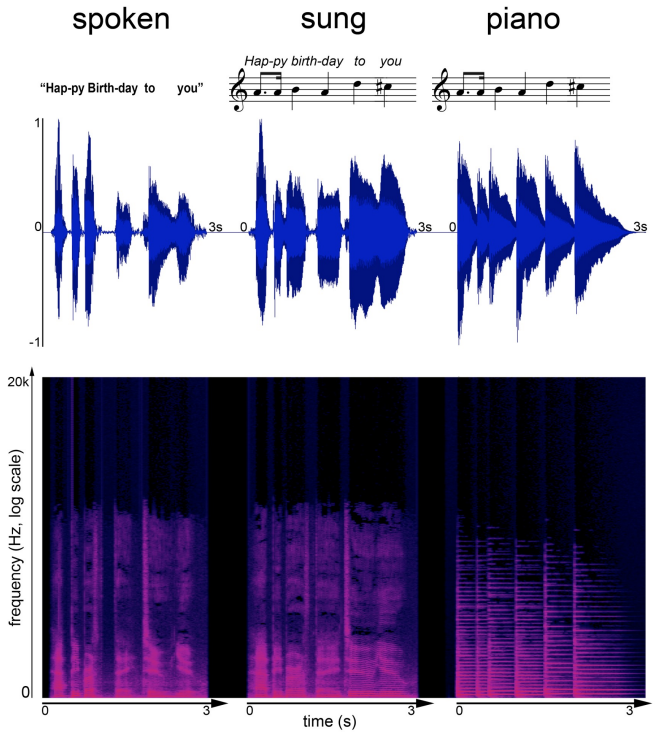
[1]Gfeller, Turner, et al., 2002
[2]Kong, Cruz, et al. 2004
[3]Leal, Shin, et al., 2003)

Source :*H. J. McDermott. Music perception with cochlear implants:

Children with Cochlear Implants

Perceiving Rhythm





Children with Cochlear Implants

Insights

Rhythmic patterns can often frame a musical passage yielding basic perception in spite of poor or erroneous perception of pitch, timbre, or other music aspects.

To make Users understand the other aspects of music, it is important for us to remove rhythmic qualities in the music sample given for testing.

Children with Cochlear Implants

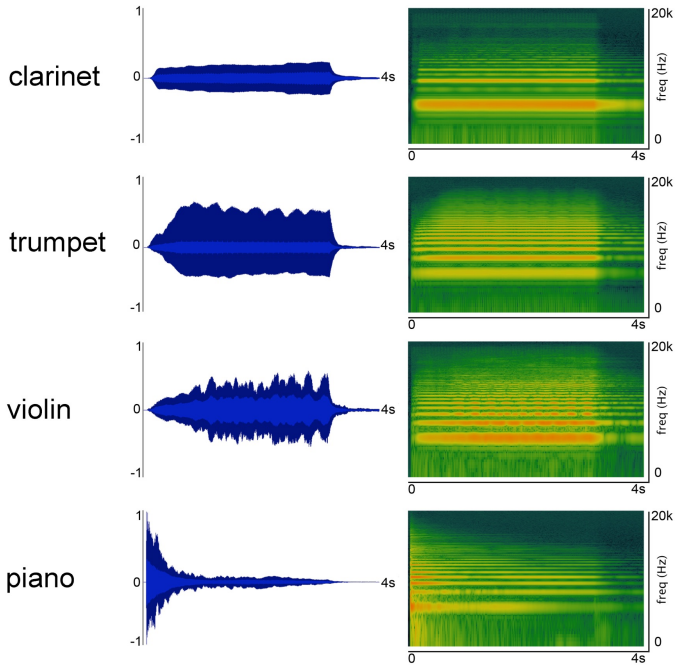
& Timbre

Timbre, or tone-color is derived from the acoustic properties of spectra (the ratios of the harmonics to the fundamental frequency) and timing (envelope) of each harmonic constituent.

Children with Cochlear Implants

& Timbre

The psychoacoustic property of timbre permits us to differentiate between two musical instruments playing at the same pitch and volume level.



Source :*H. J. McDermott. Music perception with cochlear implants:

Children with Cochlear Implants

Perceiving Timbre

- *Difficult to identify voice/music instrument in noisy setting[1].*
- *Single melody sans the rhythm is easier for identifying timbre[1].*
- *In some users, differentiating instruments from different families also is difficult*.*
- *High-pitched notes – Difficult to identify timbre*.*
- *Easier to identify percussive instruments like the piano/xylophone than violin*.*

Source :*H. J. McDermott. Music perception with cochlear implants:

[1]Joshua H. Goldwyn, Eric Shea-Brown, Jay T. Rubinstein: Encoding and decoding amplitude-modulated cochlear implant stimuli - a point

Children with Cochlear Implants

Insights

Two or more melodic instruments at a time make timbre perception cumbersome.
Silence and single sound source, the best to train in the beginning.

To make beginner Users understand pitch , it is important for us to remove timbre qualities in the music sample(raw frequency sans harmonics) given for testing.

The raw frequency given can preferably be percussive(like piano sound).

Children with Cochlear Implants

& Pitch

Pitch processing is fundamental to the perception, identification, and enjoyment of music. Pitch describes the absolute frequency of a musical note framed within the
context of a musical scale.

Source :*H. J. McDermott. Music perception with cochlear implants:

Children with Cochlear Implants

& Pitch

A musical phrase, or melody, is created when a series of pitches are sequentially and temporally organized into patterns of varying musical contour and interval.

The perception of melody requires the fine discrimination of changes in pitch, including both the direction of change (up or down) and the degree of change (interval size).

Source :*H. J. McDermott. Music perception with cochlear implants:

Children with Cochlear Implants

Perceiving Pitch

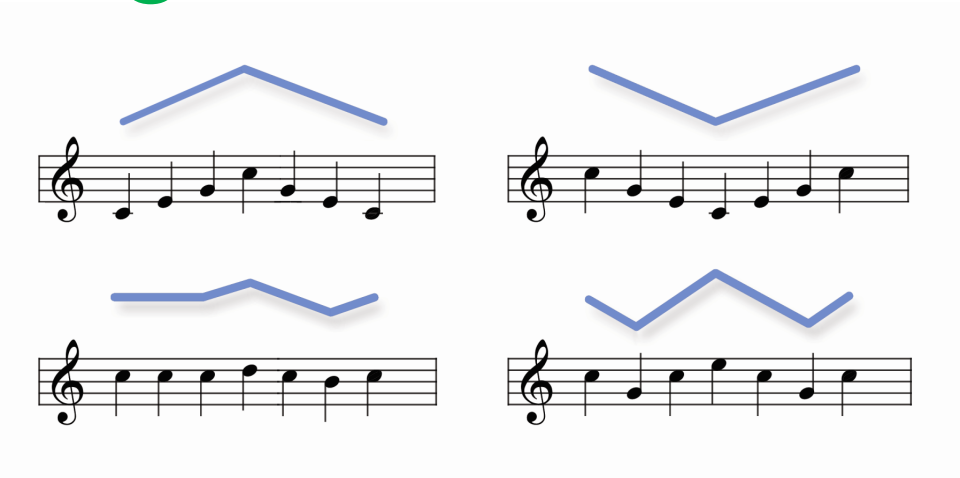
- *Difficult to identify Pitch in noisy setting.*
- *Range identifiable in most of the users (not less than 4 semitones)[1].*
- *In severe cases, the next octave pitch is also not identifiable[1].*
- *Difficult to identify direction of pitch change and contour[2].*
- *Low-pitched Notes are difficult to identify.*
- *Melody enjoyment not possible because of bad pitch perception[2].*

[1](Fujita and Ito, 1999)
[2] Galvin JJ, Fu QJ, Nogaki G. Melodic contour identification by cochlear implant listeners.Ear and Hearing 2007; 28: 302-319.

Source :*H. J. McDermott. Music perception with cochlear implants:

Children with Cochlear Implants

Perceiving Pitch



[2] Galvin JJ, Fu QJ, Nogaki G. Melodic contour identification by cochlear implant listeners.Ear and Hearing 2007; 28: 302-319.

Source :*H. J. McDermott. Music perception with cochlear implants:

Children with Cochlear Implants

Insights

By designing a level-based approach in pitch perception training, one can slowly
reduce the semitone-differentiation-range from over an octave to just one semitone.

The low pitched notes can be taught much later in increasing order of diffculty.

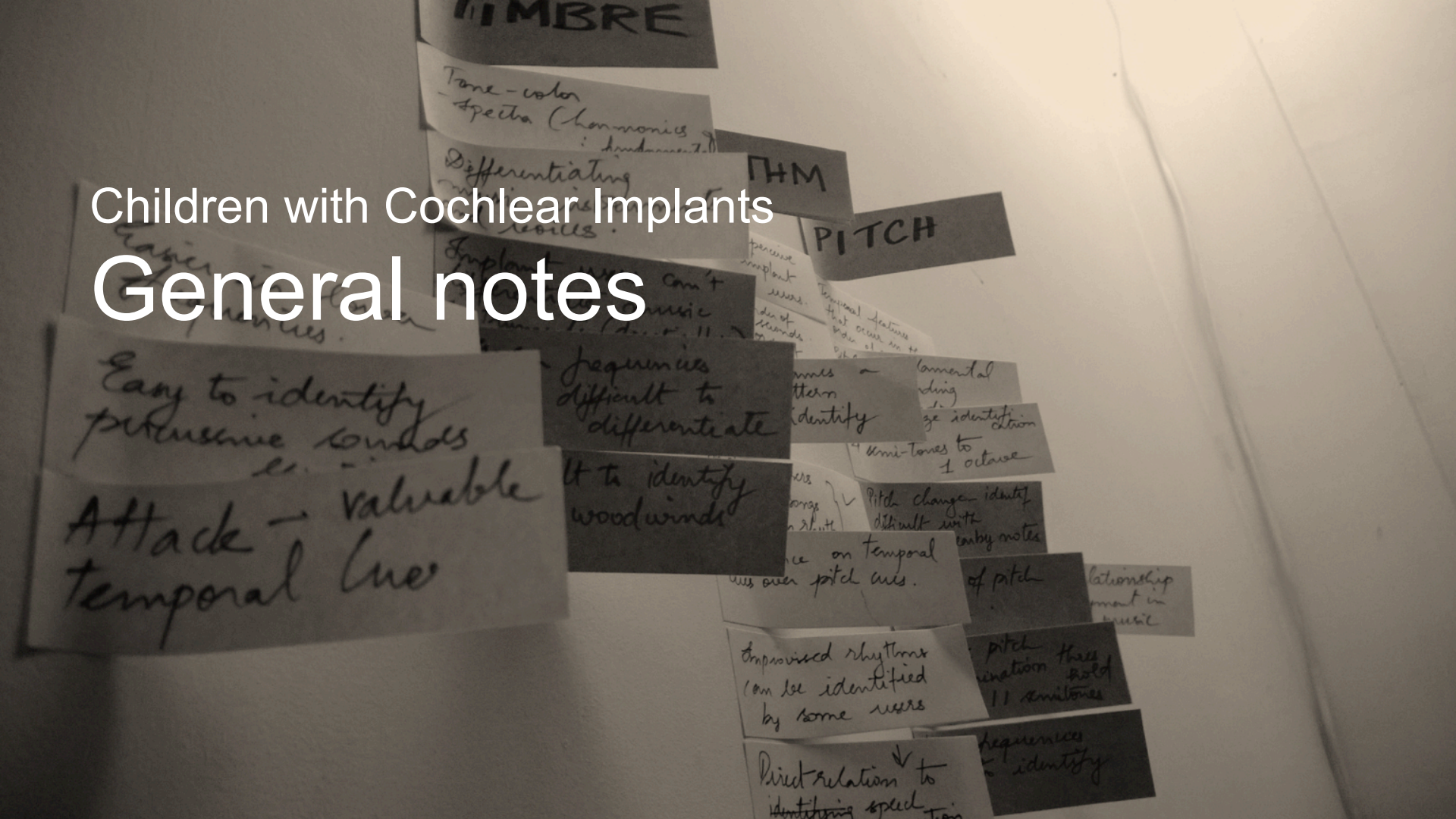
While designing for pitch perception: rhythm, timbre and more than one instrument/music source can be avoided.

Children with Cochlear Implants

Perceiving Music

Perceiving the fundamentals

- *Rhythm*
- *Pitch (Problem area)*
- *Timbre (Problem area)*



Children with Cochlear Implants

General notes

Children with Cochlear Implants

General notes

Children with Cochlear implants often prefer silent environments and listen to one sound source at a time.

Music Perception impairment is reduced for music with rhythm and visual/lyrical cues.

Post-lingually deafened children exhibit better music perception as they were familiar to music prior to deafening.

Children with Cochlear Implants

General notes

Providing continuous training to children with implants has found to give profound improvement in their music perception.

Enjoyment of music is because of the rhythmic lyrics in a song and they don't prefer instrumental or melody.

Children find Country and Pop music easier to enjoy than Classical Compositions that sound "complex" to them.

Source :*H. J. McDermott. Music perception with cochlear implants:

The project

Objective

The project

Objective

Designing Interactive means to allow children, with cochlear implants, learn and practice pitch perception and production, timbre perception and melody perception and production.

1. Listening to pitch and Timbre and finer differences within them.
2. Learning to sing single note as well as a whole melody.

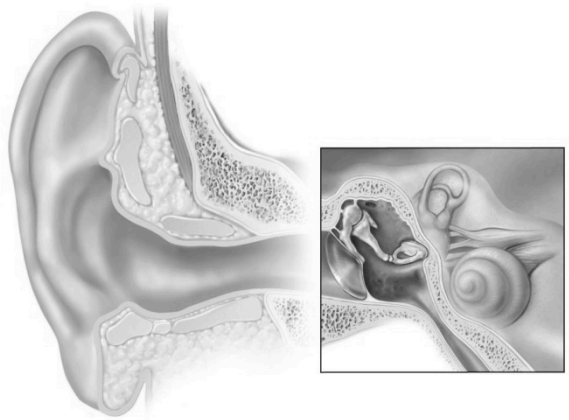
The project

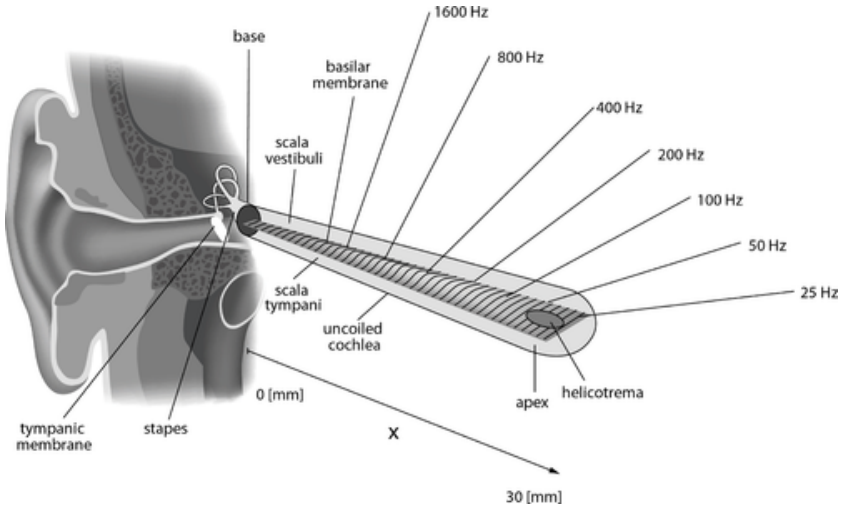
Scope

The solution should make it easier for Pre-lingually deafened children with cochlear Implants to learn and practise perceiving, understanding and producing pitch, timbre and melody by evaluating their performance and communicating them their progress.

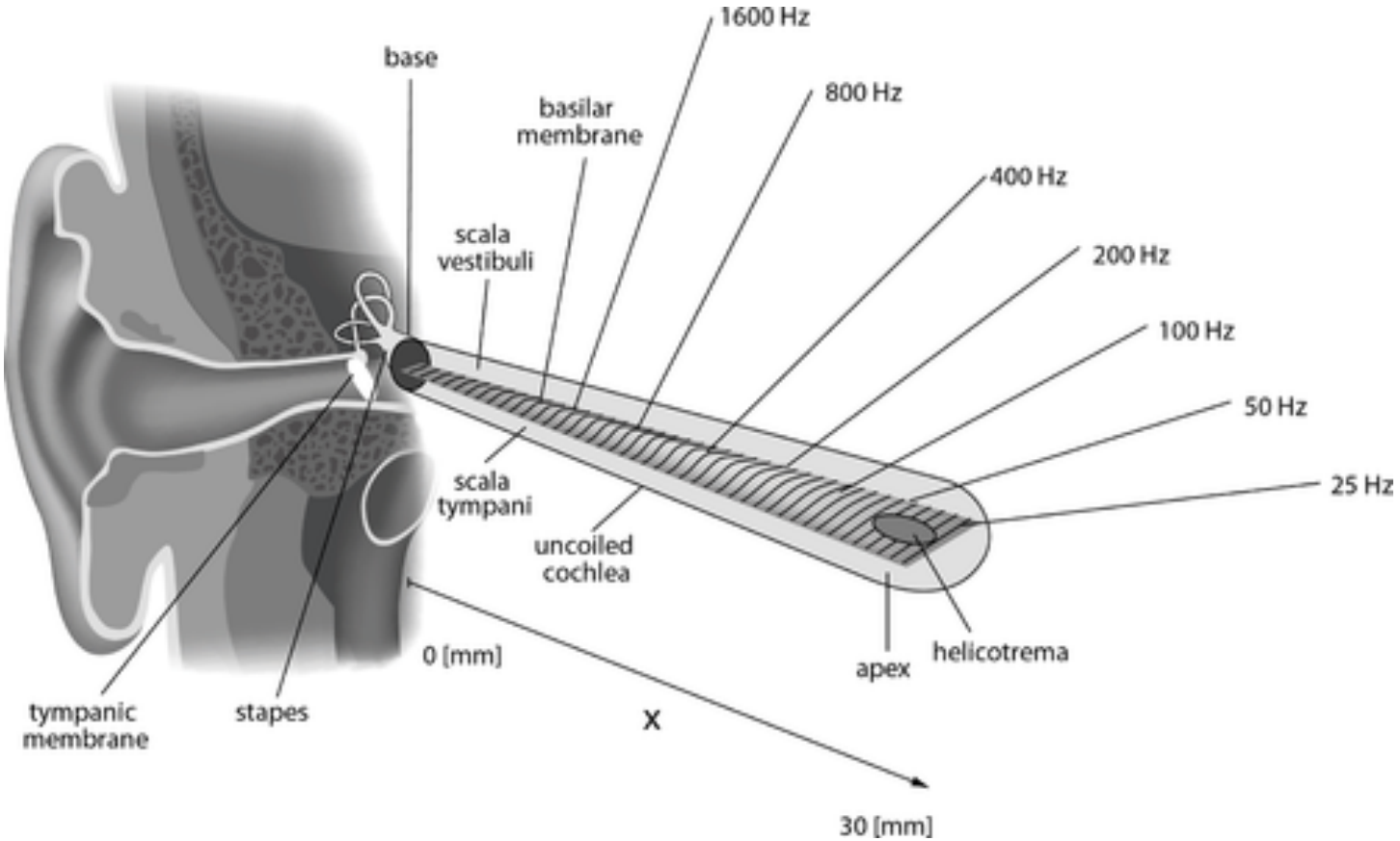
Pitch and timbre

Why can’t they perceive?





Source: http://upload.wikimedia.org/wikipedia/commons/thumb/6/65/Uncoiled_cochlea_with_basilar_membrane.png/500px-Uncoiled_cochlea_with_basilar_membrane.png



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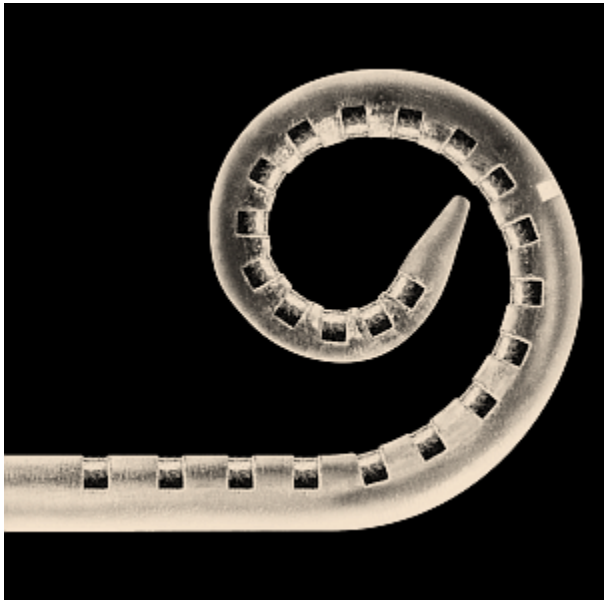
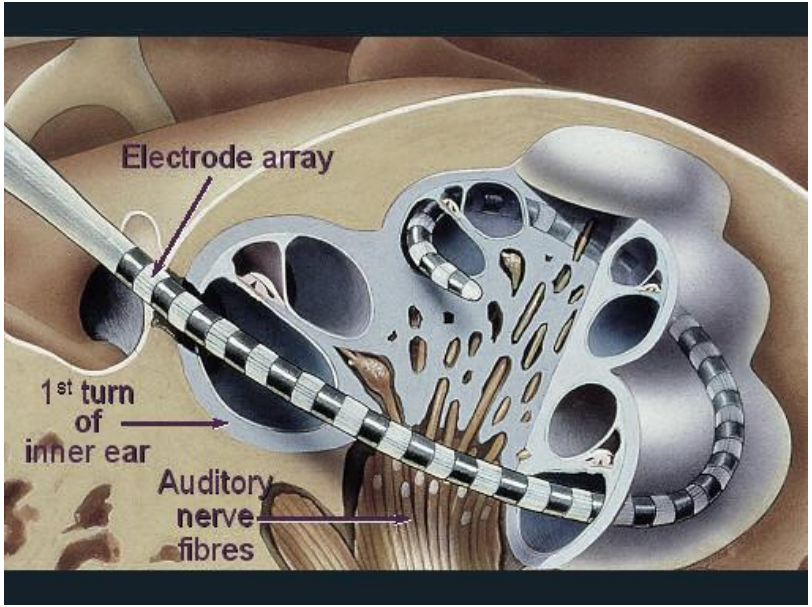




Source: http://medicaldevices.asmedigitalcollection.asme.org/data/Journals/JMDOA4/926071/035002_1_f2.jpeg

Pitch and timbre

Why should they perceive?

Auditory habilitation is an important part of the implant process to boost recipients' adaption for the devices post cochlear implantation.

Normal speech involves variations in pitch, volume, timbre etc., according to the expressions and so music habilitation helps in understanding these basic concepts based on which they are encouraged to develop their speech and music skills.

Pitch and timbre

Why should they perceive?

Musical habilitation can enhance recipients' self-esteem and increase their motivation for practicing more.

One of the main obstructions is lack of appropriate one-to-one teaching resources.

Source: Y. Zhou, K. C. Sim, P. Tan, and Y. Wang. Mogat:Mobile games with auditory training for children with cochlear implants. In ACM Multimedia '12, 2012.

Designing for Children with CI

Solving the puzzle

“Impaired??I Simply tell them that there is nothing "impaired" with me so please call me Deaf, thank you!”

- Comment on a Blog.

http://deafness.about.com/u/ua/hardofhearing/hearing_impairment.htm

Designing for Children with CI

Solving the puzzle

TOUCH
OR
VISION

+

RESIDUAL
HEARING

Concepts

Connecting the dots

Concept 1

Mapping images of animals to pitch values/ notes(inspired from studies in primary research with Indian musicians) and help children identify them easily in the early difficult stages. Scope for gamification.

VISION + RESIDUAL HEARING

Connecting the dots

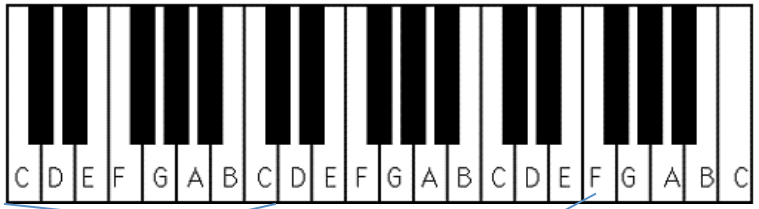
Concept 1

Inspiration from beliefs in Indian Music

Musical notes = (i.e., Sa, Re/Ri, Ga, Ma, Pa, Dha/Da, and Ni) is traditionally held to have originated in the sound of a different animal, and some have additional meanings of their own.

Swara	Sanskrit Expansion	Meaning	Animal	Chakra	God
Sa	Shadja (षड्ज)	six-born	peacock	*mūlādhāra* मूलाधार (base of spine)	Ganapati
Re	Rishabha (ऋषभ)	bull	skylark	*svādhisthāna* स्वाधष्ठिान (genitals)	Agni
Ga	Gandhara (गान्धार)	sky	goat	*manipūra* मणपिूर (solar plexus and navel)	Rudra (Shiva)
Ma	Madhyama (मध्यम)	middle	dove/heron	*anāhata* अनाहत (heart)	Vishnu
Pa	Panchama (पञ्चम)	fifth	cuckoo/nightingale	*viśuddha* वशिुद्ध (throat)	Naarada
Dha	Dhaivata (धैवत)	earth	horse	*ājñā* आज्ञा (third eye)	Sadasiva (Shiva as the unmanifest, precursor to creation)
Ni	Nishadam (नषिाद)	hunter	elephant	*sahasrāra* सहस्रार (crown of the head)	Surya (Sun)

http://en.wikipedia.org/wiki/Swara

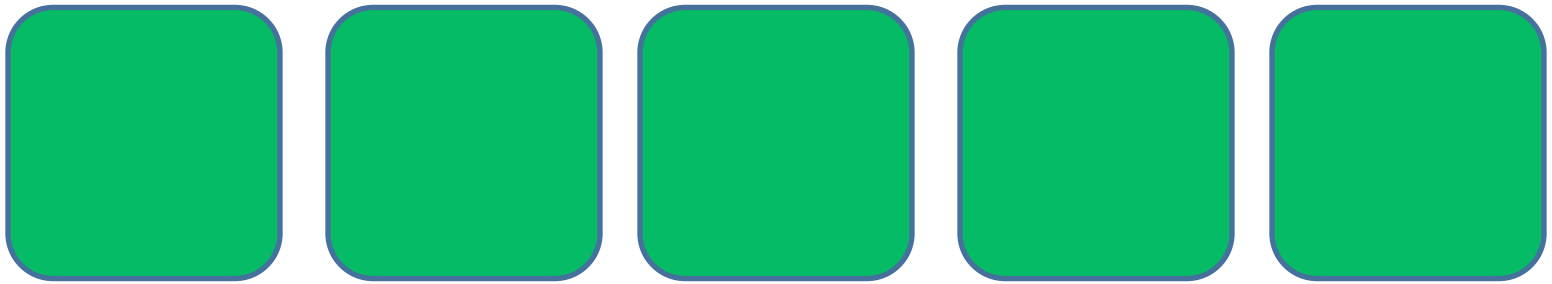


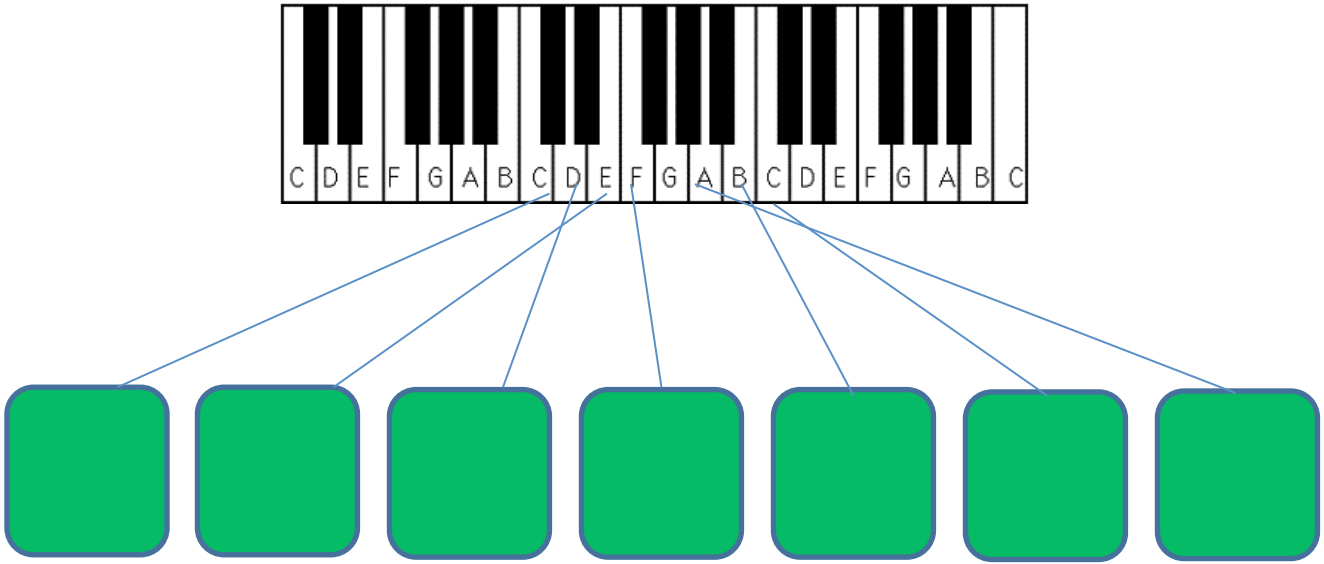
http://www.photos.com/clipart-vectors/bee



Correct Answer : DO

http://www.photos.com/clipart-vectors/bee




C D E F G A B C D E F G A B C D E F G A B C

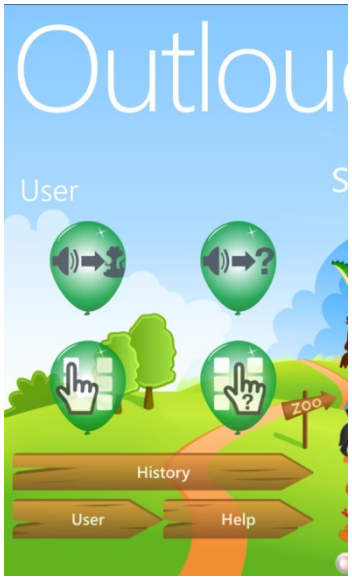
Why it wont work?

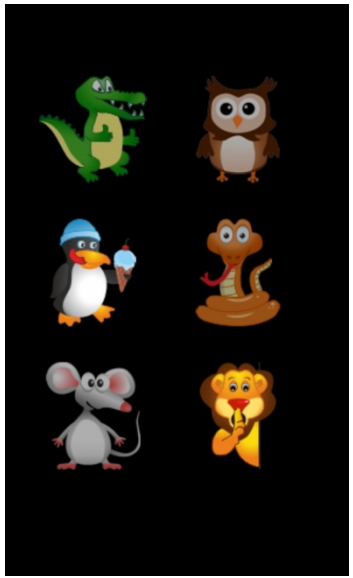
Disadvantages

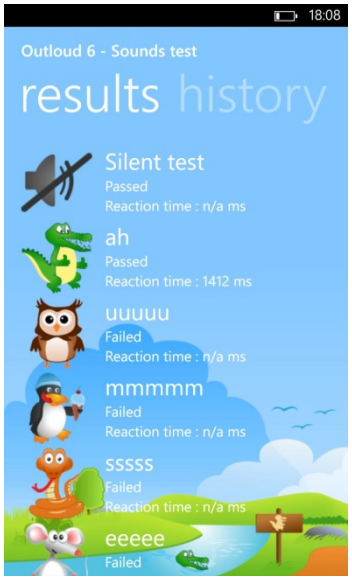
The mapping of pitches to animals might make children misunderstand the relationship between the way animals make sound and pitches of the musical notes.

Also, there are mobile applications that already exist teaching them to pronounce sounds of diifferent animals like “bow bow” for a dog and “meow” for a cat.
(OUTLOUD 6 – Sounds Test for Windows)

SCREENSHOTS (OUTLOUD 6)







Connecting the dots

Concept 2

Making use of tactile Sound – vibrations from the device – tablet/phone (like the bowing of a cello), participatory listening cum pitch production involving an Interactive mean.

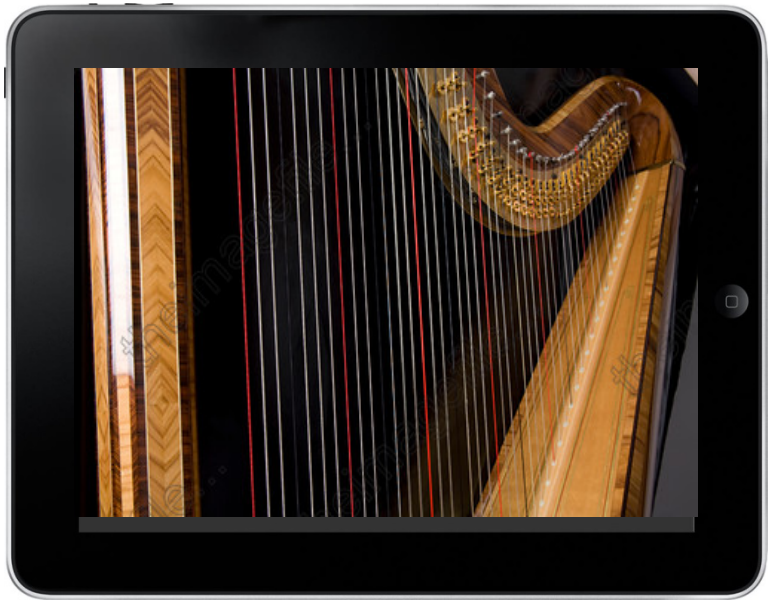
TOUCH
+
VISION

\+

RESIDUAL
HEARING

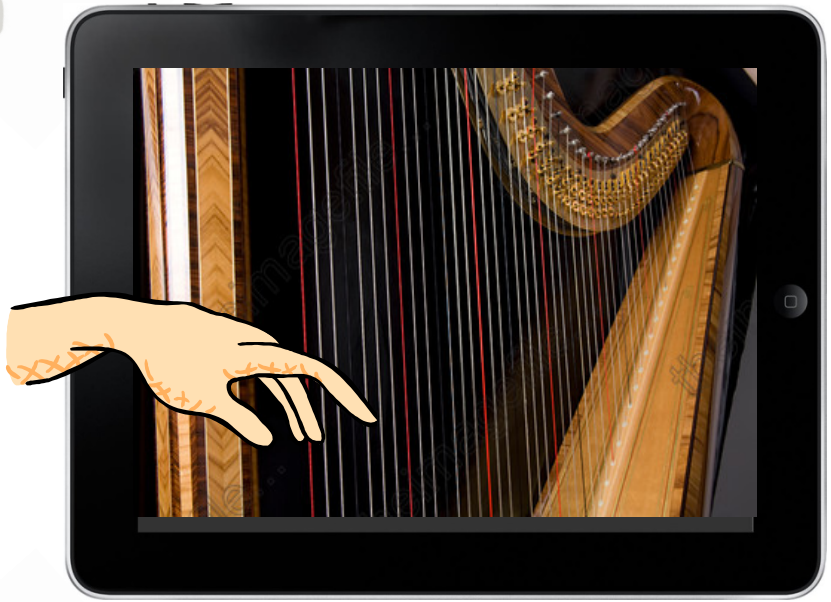
Tactile Sound + Residual Hearing

Concept 2



Feeble vibrations

Stronger
Vibrations



Why it wont work?

Disadvantages

The vibration frequency range in today's phone/tablet doesn't allow the difference between semitones to be clearly communicated to the user by vibrating appropriately*
(vibration range of phones~150 Hz).

*The Mobile Phone's Optimal Vibration Frequency in Mobile Environments Jinho Yim, Rohae Myung, Byongjun Lee

Connecting the dots

Concept 3

Mapping pitches to facial gestures like the bebot app in iphone that helps children to understand not only pitch, timbre in music but also its role in speech modulation and intonation and people's facial gestures while producing it.

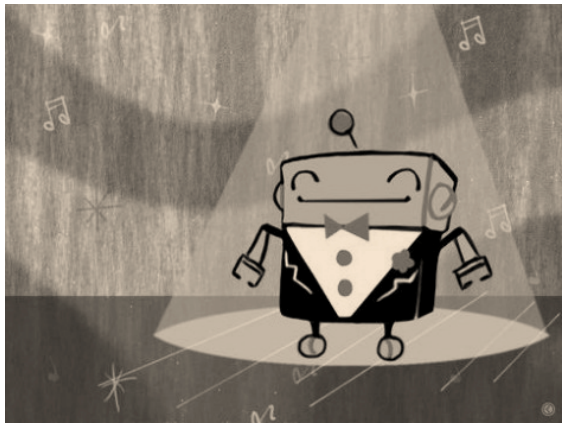
VISION + RESIDUAL HEARING

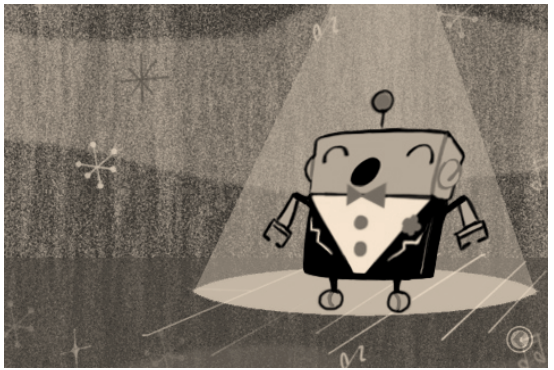
Connecting the dots

Concept 3

Connecting the dots

Concept 3





Why it wont work?

Disadvantages

Following a cartoon character for learning/imitating movements, gestures and lip movements is not better than imitating a human, because the details in gestures that a real human would do, are lost in the cartoon which is often made very abstract and minimal.

Musical Habilitation??
Study on Aphasia Patients

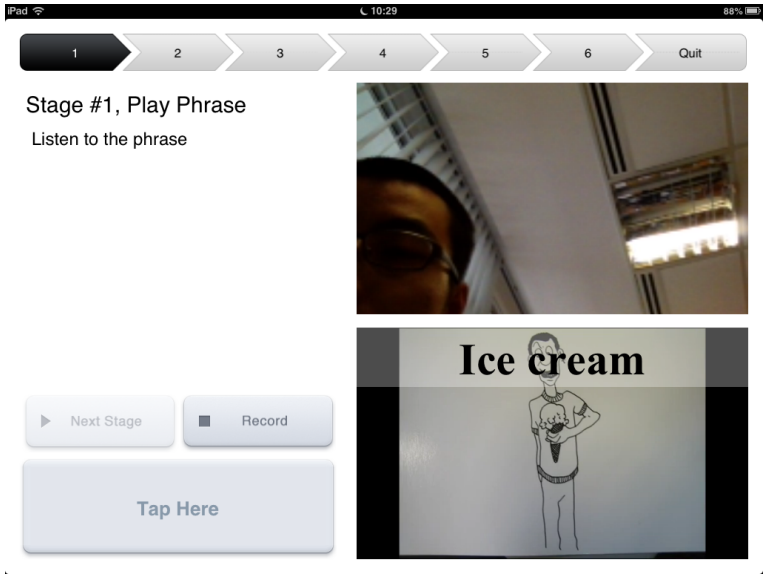
The Users?

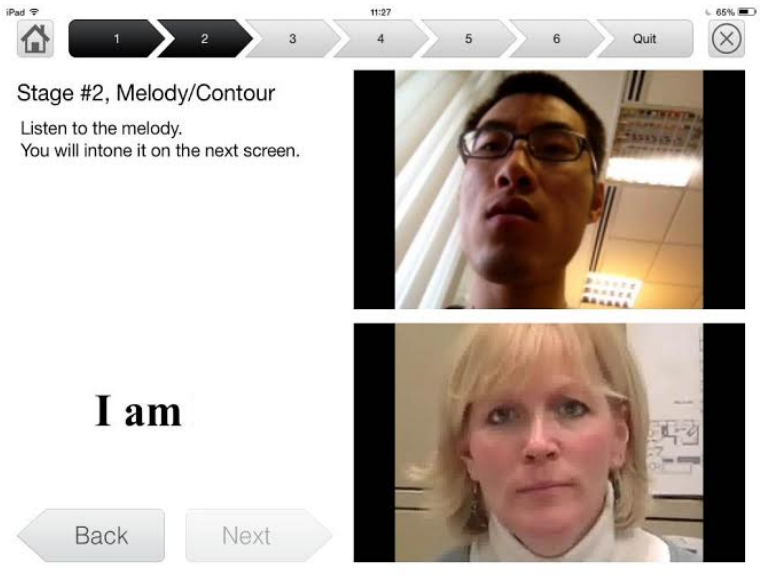
Aphasia / Post-Stroke Effects …

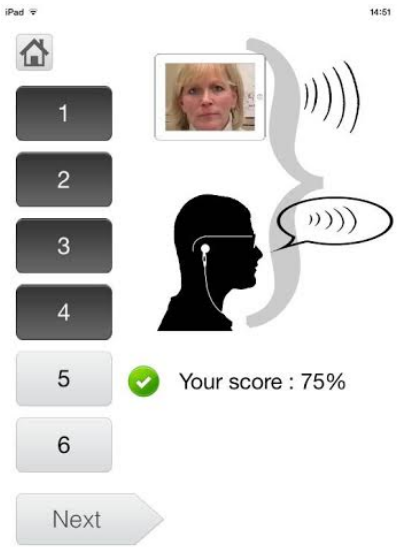
This user group was the exact opposite of cochlear implants in the following ways..

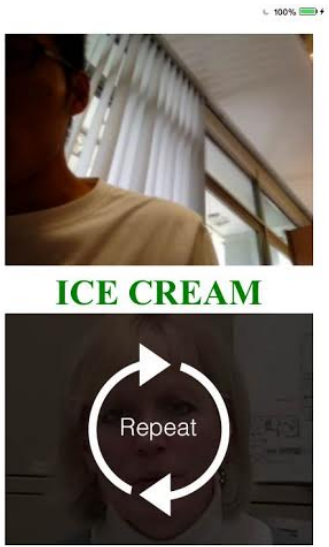
Post-Stroke patients are usually aged above 40.

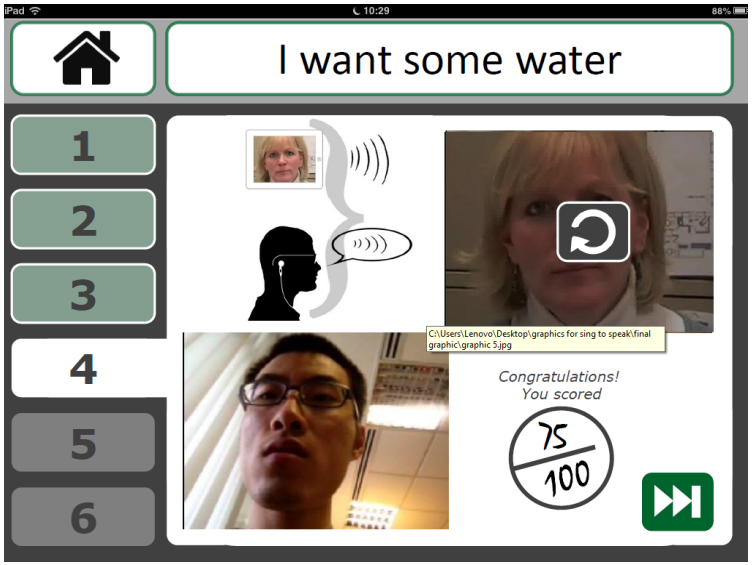
- *Can listen to music and and sing.*
- *Cannot talk normally due to lack of blood supply to parts of brain.*
- *Right hand and Left leg normally paralysed after attack.*
- *Can sing and talk together after getting trained in Melodic Intonation therapy.*


iPad
10:29
88%
1
2
3
4
5
6
Quit
Stage #1, Play Phrase
Listen to the phrase
Ice cream
Next Stage
Record
Tap Here


iPad
11:27
65%
1
2
3
4
5
6
Quit
Stage #2, Melody/Contour
Listen to the melody.
You will intone it on the next screen.
I am
Back
Next


iPad
14:51
1
2
3
4
5
6
Your score : 75%
Next


100%
ICE CREAM
Repeat


Pad
10:29
88%
I want some water
1
2
3
4
5
6
C:\Users\Lenovo\Desktop\graphics for sing to speak\final graphic\graphic 5.jpg
Congratulations!
You scored
75
100

Gamification

Final Concept?

Connecting the Dots …

The idea is to connect all the ideas into one platform and to gamify the entire musical auditory habilitation programme.

Why Gamification?

- *Engagement*
- *Progression*
- *Social*
- *Habit*

Visualizing Pitch

Colour and Music Notes

There have been many Hypotheses from scientists like Newton and Pythagoras about the relationship between colours and individual music notes in an octave.

*If we take note A = 440 Hz and keep doubling until you get into the range of light we will find ROYGBIV = F, G, A, Bb, B, C, D, E, F.**

Note	Freq (Hz)	+40 oct. (THz)	Wavelength (nm)	R	G	B	Color	HTML name
F♯$_4$	370	407	737	174	0	0		dark red
G$_4$	392	431	696	255	0	0		red
G♯$_4$	415	457	657	255	0	0		red
A$_4$	440	484	620	255	102	0		orange-red
B♭$_4$	466	513	585	255	239	0		yellow
B$_4$	494	543	552	153	255	0		chartreuse
C$_5$	523	575	521	40	255	0		lime
C♯$_5$	554	610	492	0	255	242		aqua
D$_5$	587	646	464	0	122	255		sky blue
D♯$_5$	622	684	438	5	0	255		blue
E$_5$	659	725	414	71	0	237		blue
F$_5$	698	768	390	99	0	178		indigo

Concept Inspiration

Neil Harbisson

Neil Harbisson is a contemporary artist, musician, and cyborg activist best known for his self-extended ability to hear colours and to perceive colours outside the ability of human vision.

He uses the musical note his device produces when exposed to a colour, to recognize that particular colour.

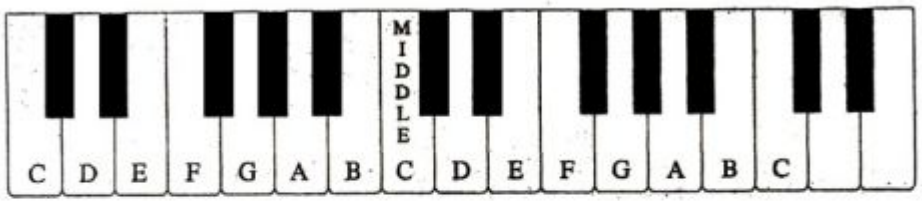

I listen to
COLOUR!!

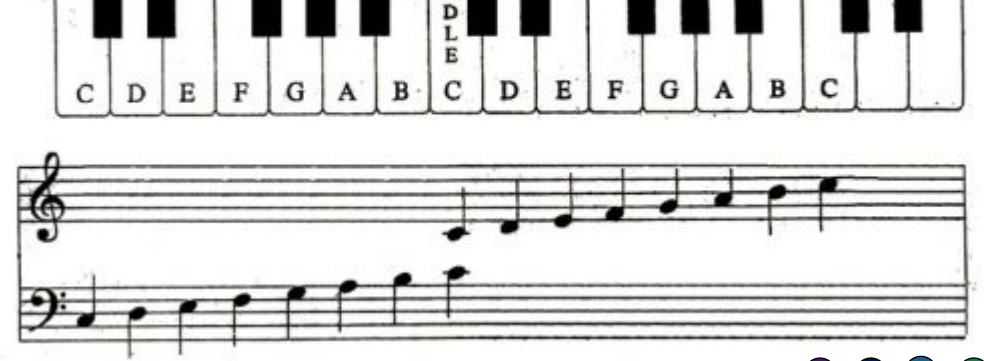
Mapping Colours to Notes

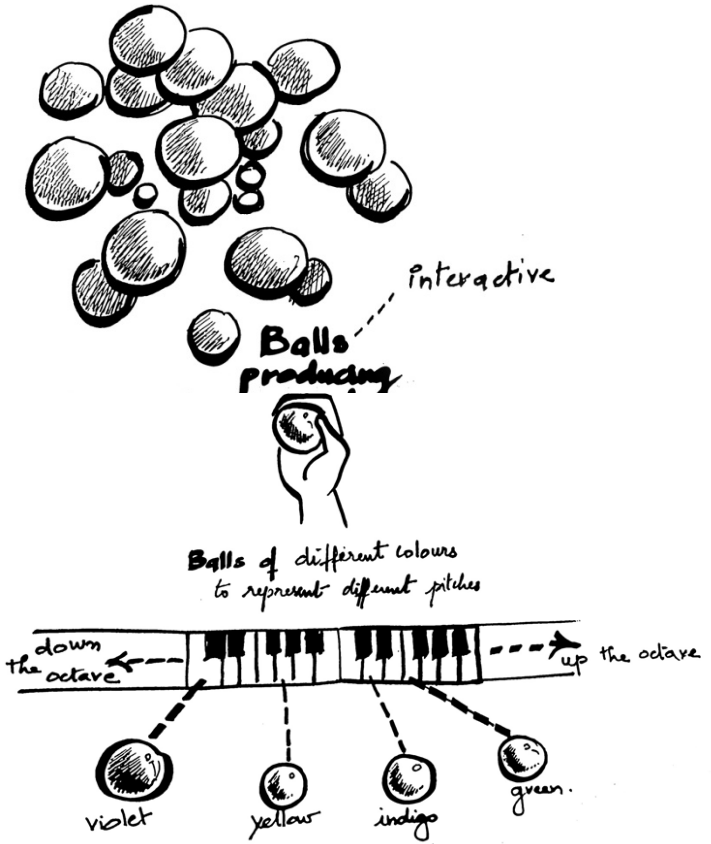
Musical spheres

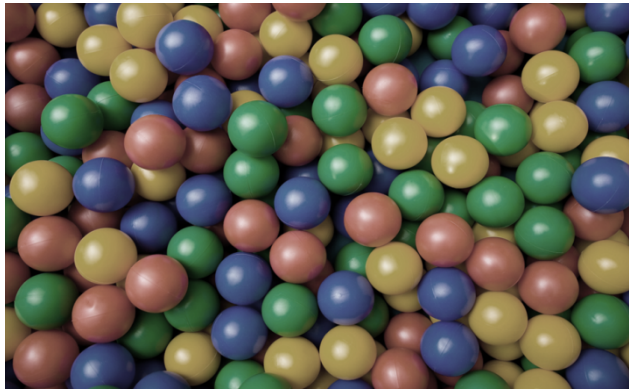
For convenience Sake, the mapping is done from violet to red (the same order as in a Rainbow), along the ascending music scale.

The tonic in the diagram shown below is taken as C, where the colours from Violet to Red are assigned along the scale. The Luminance(brightness) of the colour shows the octave the ball belongs to.


MIDDLE
C D E F G A B C D E F G A B C




interactive
Balls producing
Balls of different colours
to represent different pitches
down the octave
up the octave
violet
yellow
indigo
green.

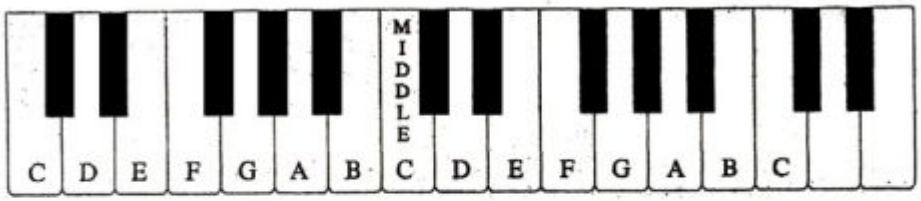


Fitting it all in a display

Mobile game?

The idea is to have a solution that is cost-effective and portable so that it can be used at anywhere, anytime by the users.

The solution should ideally be a cross-over of the different ideas discussed prior. It should be a holistic, all-in-one solution to all the problems in one platform addressing them one by one in increasing order of difficulty.


MIDDLE
C D E F G A B C D E F G A B C

国　　乐

1 = C $\frac{2}{4}$

2 3 2 | 2 1 6 5 | 5 6 1 1 2 | 3 2 3 1 1 6 | 5 1 3 2 |
巩　　金　　瓯，　　承　天　　帱，民　物

3 2 2 1 6 5 6 | 1 6 2 1 6 | 5 5 3 5 3 2 | 1 6 5 | 3 5 1 2 1 6 |
欣　　鬼　　藻。　　喜　同　　袍，清　时　幸

5 6 1 1 6 | 3 2 3 1 1 6 | 5 1 3 2 | 3 2 2 1 6 5 6 | 1 6 2 1 6 |
遭，　　真　熙　　皞，帝　国　苍　　穹　　保，

5 5 6 5 3 5 | 5 6 2 1 6 | 5 5 6 5 3 2 | 1 - ‖
天　高　　高，海　　滔　　滔。

(tsk#1)

D,DD, ,,,,, D,D,P G,,,,

,,,,, ,,,,, D,Ṡ,D P,,,,

D,D,P G,,,, P,G,R

(violin)

D,Ṡ,D P,,,, P,D,P G,,,,

G,P,G R,,,, R,G,R S,R,S

Ḍ,S,Ḍ S,R,S Ḍ,S,R

(tsk#2)

G,G,G P,D,P GPD,P GRG,,

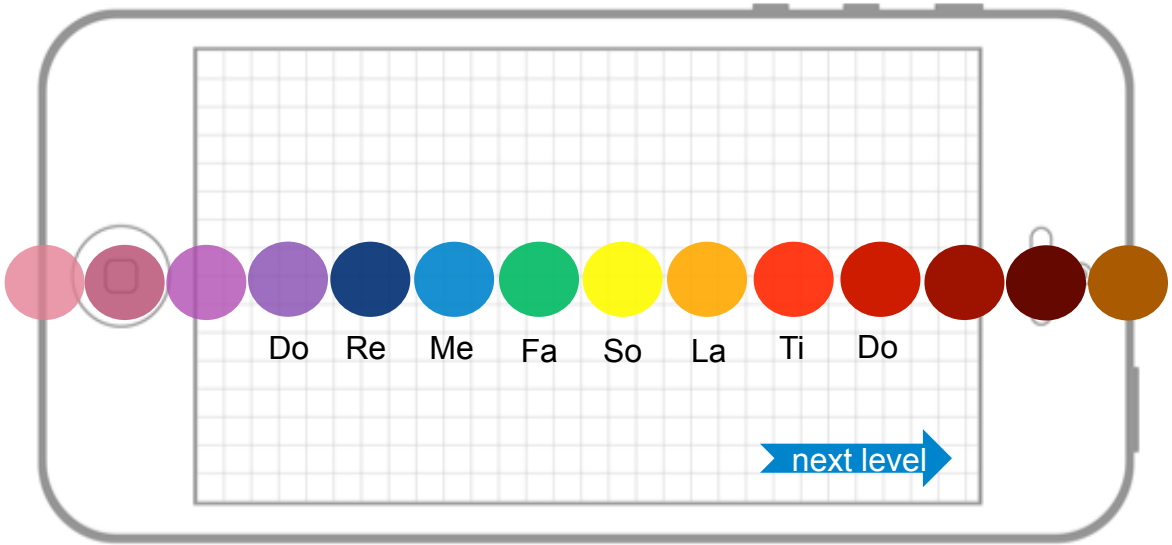
P,P,P D,Ṡ,D PDṠ,D PGP,,

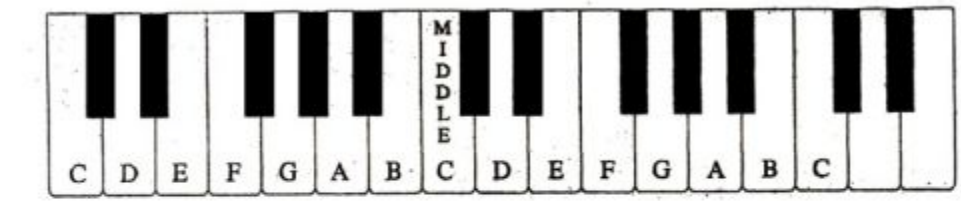
Ḍ,Ṙ,Ṡ DPD,, D,Ṡ,D PGP,,

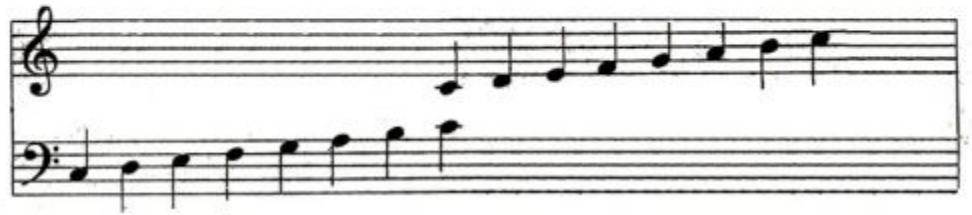
G,D,P

Pre-Pitch perception

Level 0

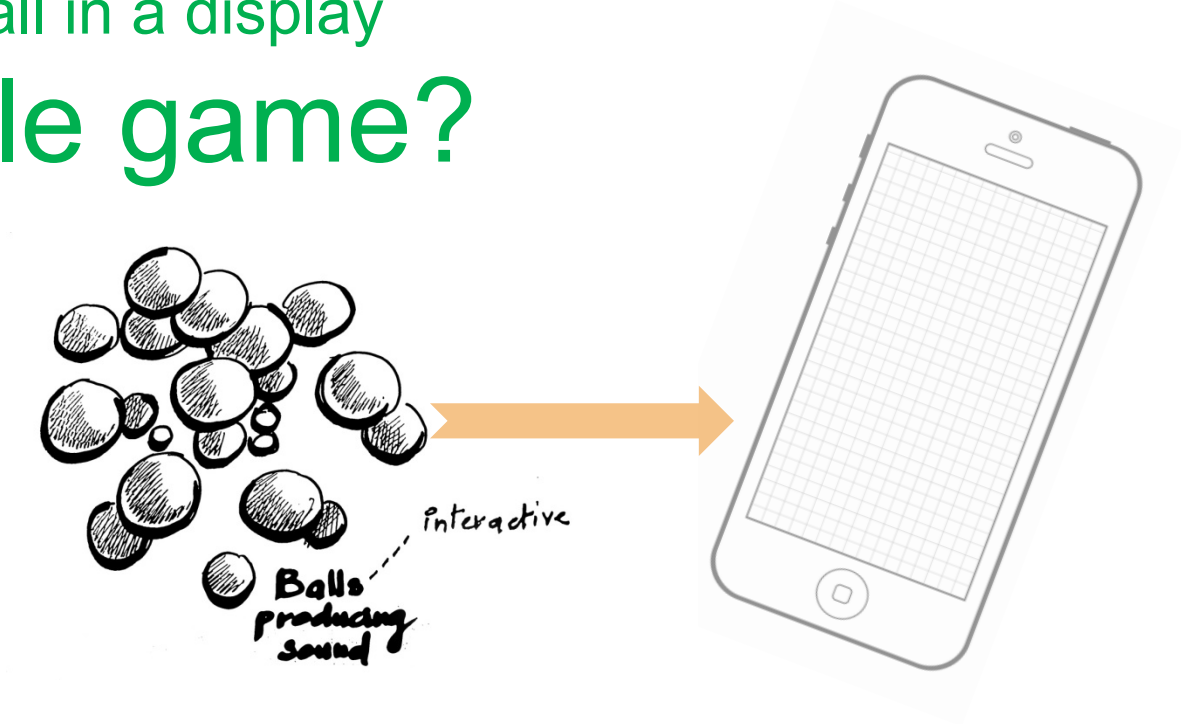



MIDDLE
C D E F G A B C D E F G A B C



Fitting it all in a display

Mobile game?



Overall Scheme

Levels of the Game

The following is the order of objectives, which the user has to ideally go through in the game levels.

Pitch Perception,
Timbre perception
Single Pitch production and
Melody production with lyrics.

Overall Scheme

Levels of the Game

In simple terms, the user kid has

- *to learn to listen to the differences in pitches and the differences in timbre.*
- *to learn to sing in one particular pitch and then sing a melody.*

Learning to Listen…

Listening to Pitch and Timbre

Pre-Pitch perception

Level 0

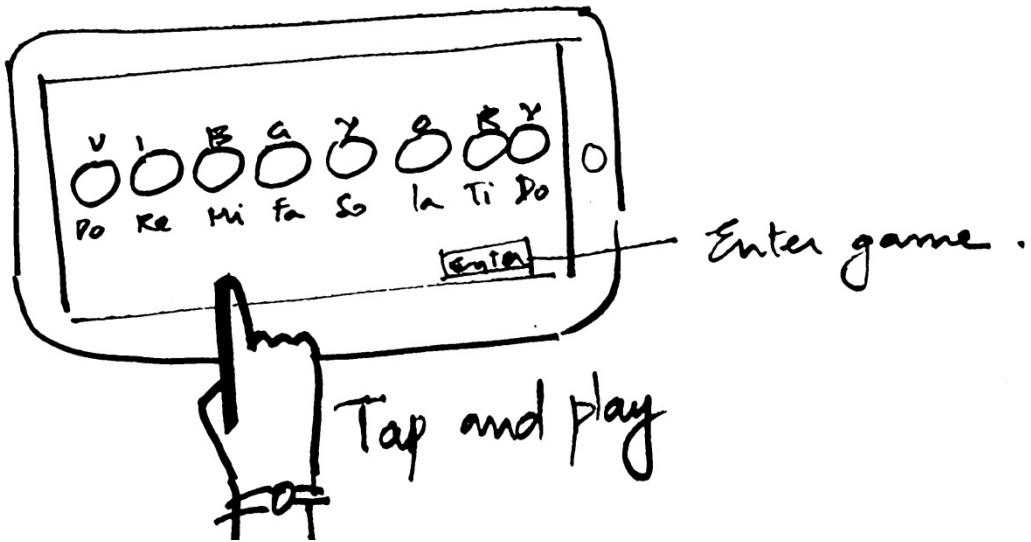
Prior to learning Pitch Perception, the user has to get a hold of colours being mapped to every musical note. So, as an introduction, the user is given a xylophone interface with colourful spheres which sound when the display is touched.

The mapping of notes will be from violet to red with the 7 coloured spheres forming the notes of the major scale.

During the first time play, the user cannot go to the next step unless the user spends at least
30 seconds playing the xylophone to get an idea of the various pitches.

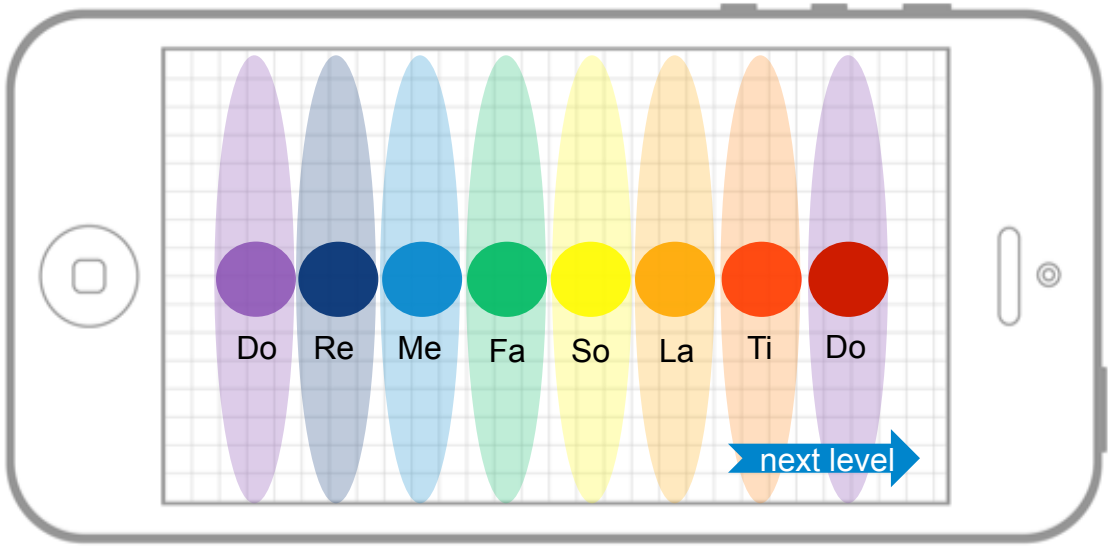
Introduction to Pitch.

① Giving them a sample of xylophone with coloured spheres to play and learn.



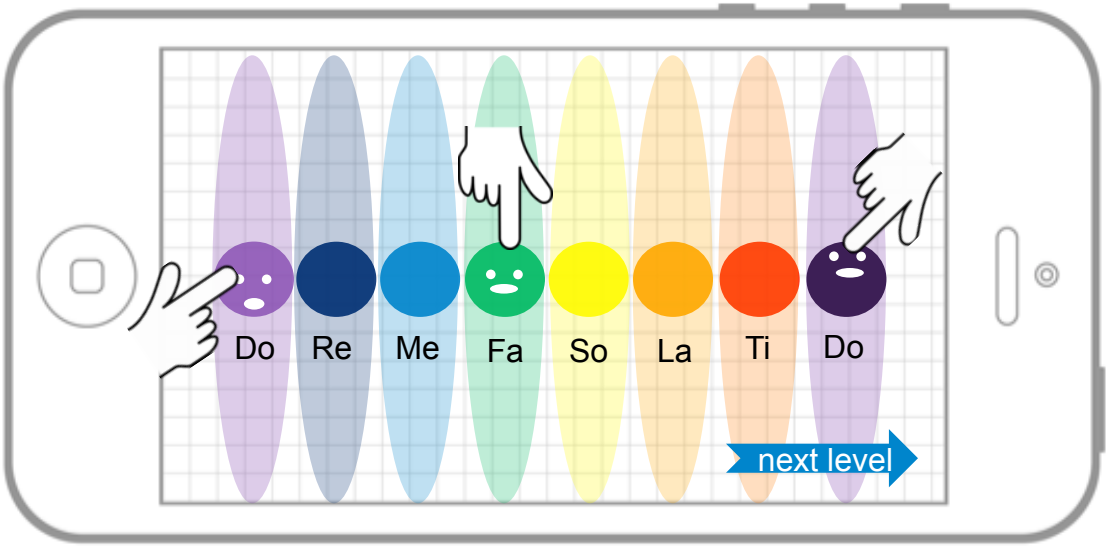
Pre-Pitch perception

Level 0



Pre-Pitch perception

Level 0



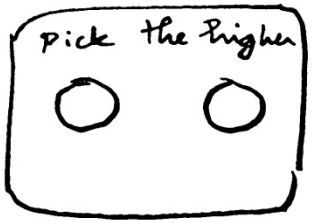
Pitch Perception

Level 1

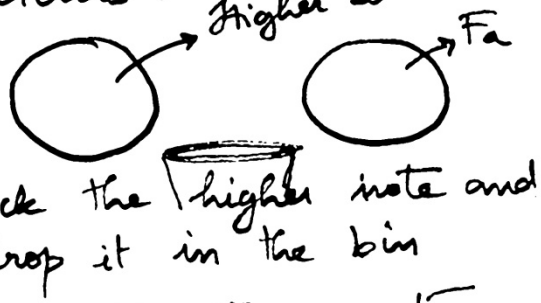
For Pitch Perception, the user is given two of the musical coloured spheres and asked to choose the one with the higher note.

The difference in semitone range is first given as really high for easy differentiation between high and low pitches and then gradually decreased in subsequent try's so that the user identifies finer differences in pitches.

As the user slowly starts finding the pitches the colours are made grey so that the user doesn't depend on the colours to identify and starts listening to the pitch keenly.

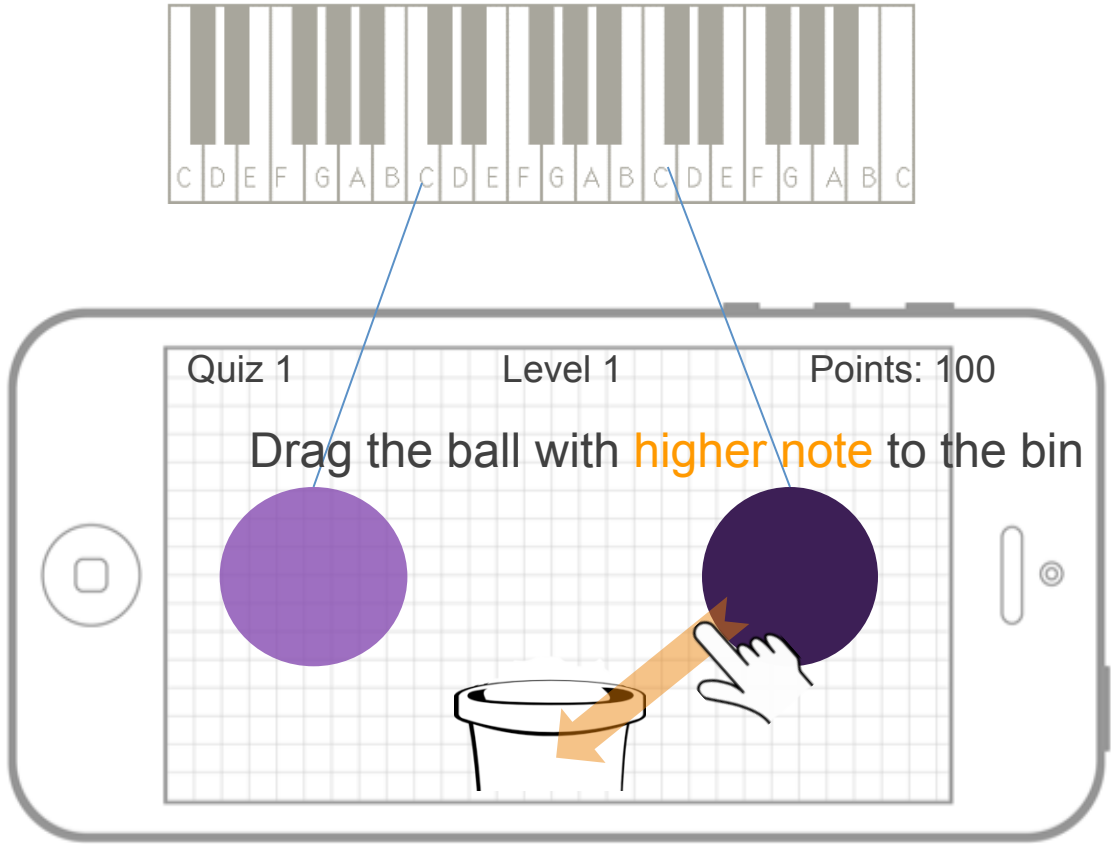


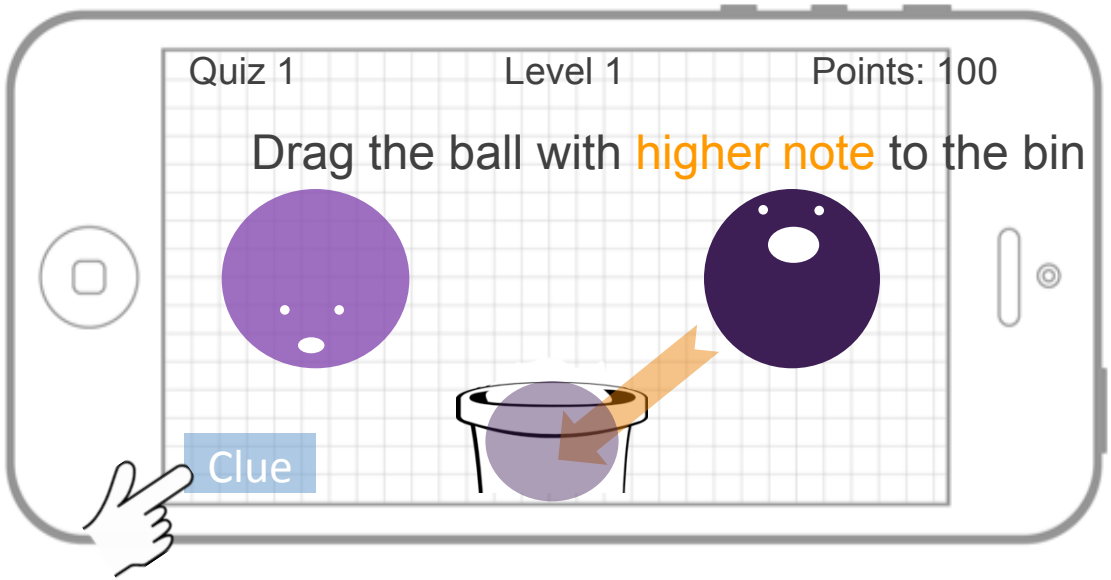
① Give them two of the colours.

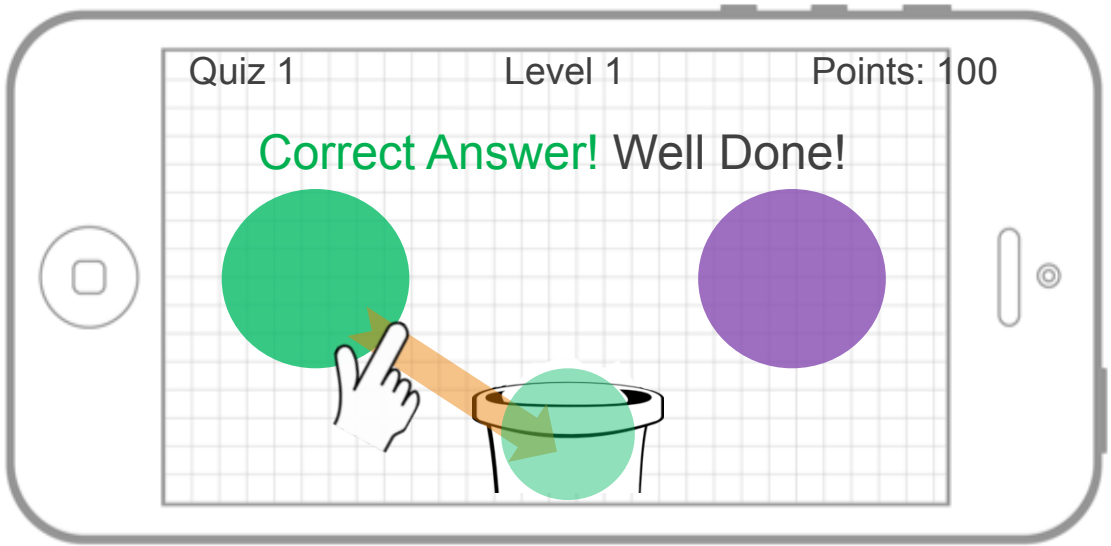


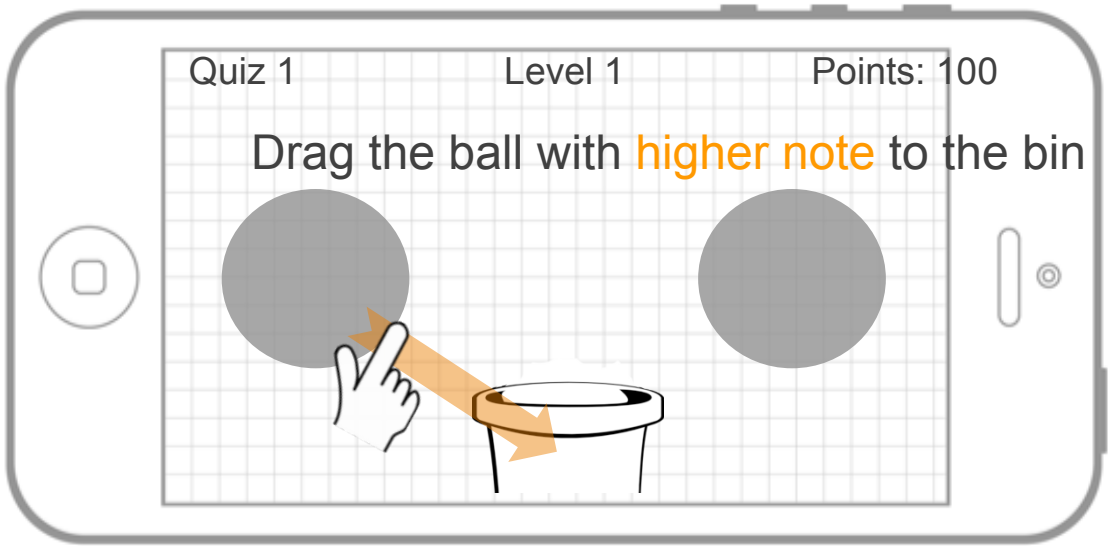
The Range between the two notes shall slowly be decreased as the user progresses.

Colours may be faded to grayscale after enough tries with colours.


C D E F G A B C D E F G A B C D E F G A B C
Quiz 1
Level 1
Points: 100
Drag the ball with higher note to the bin


Quiz 1
Level 1
Points: 100
Drag the ball with higher note to the bin
Clue

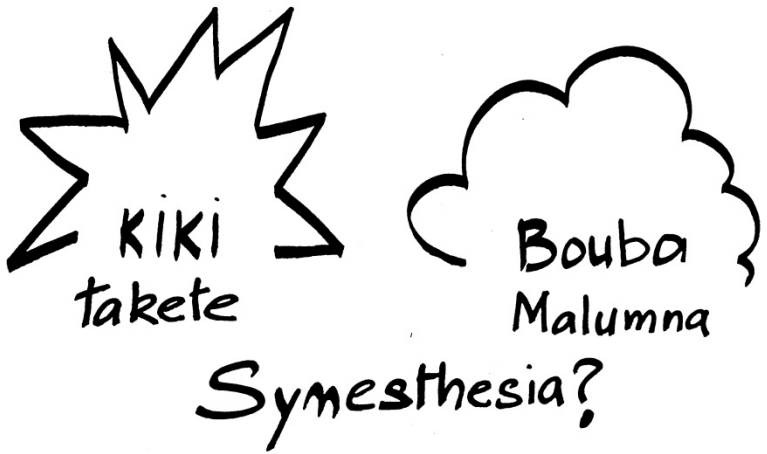

Quiz 1
Level 1
Points: 100
Correct Answer! Well Done!


Quiz 1
Level 1
Points: 100
Drag the ball with higher note to the bin

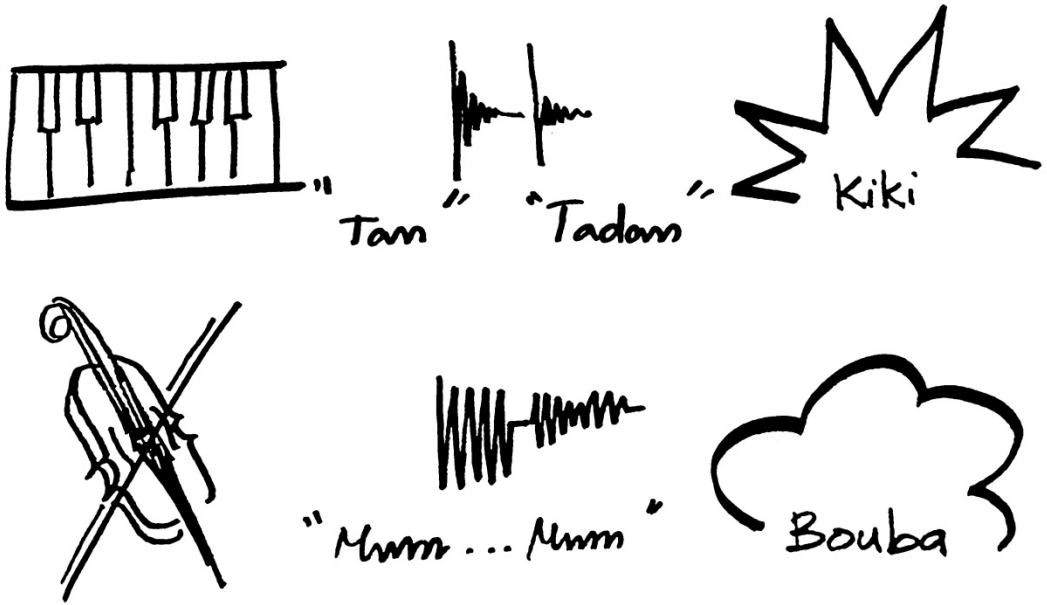
Visualising Timbre

Kiki-Bouba effect

More than 95 percent of Americans and Indians tested identified the “spiky” shape to be “Kiki” and globular shape to be “bouba”(experiments by Scientist Viliyanur Ramachandran).



Visualising Timbre



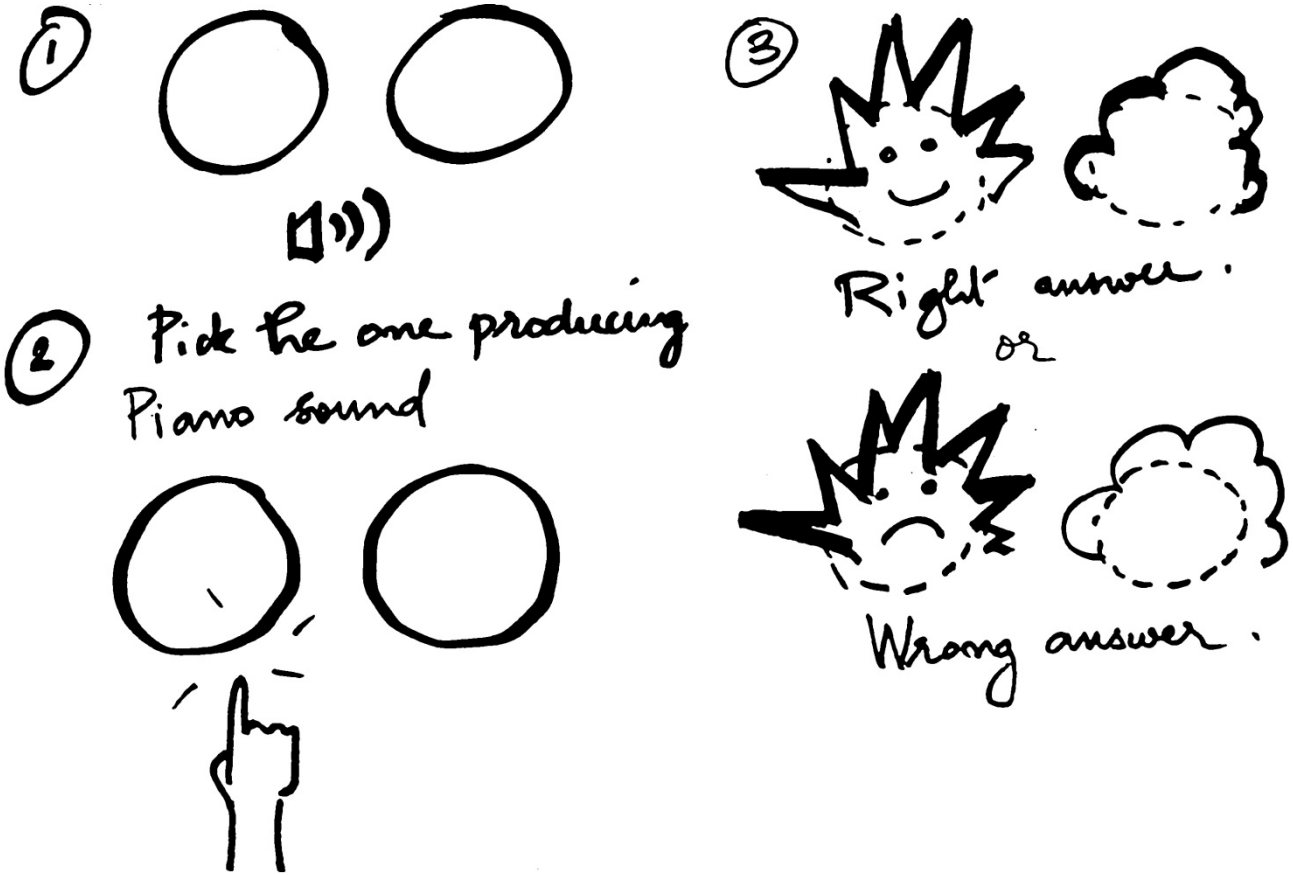
Timbre Perception

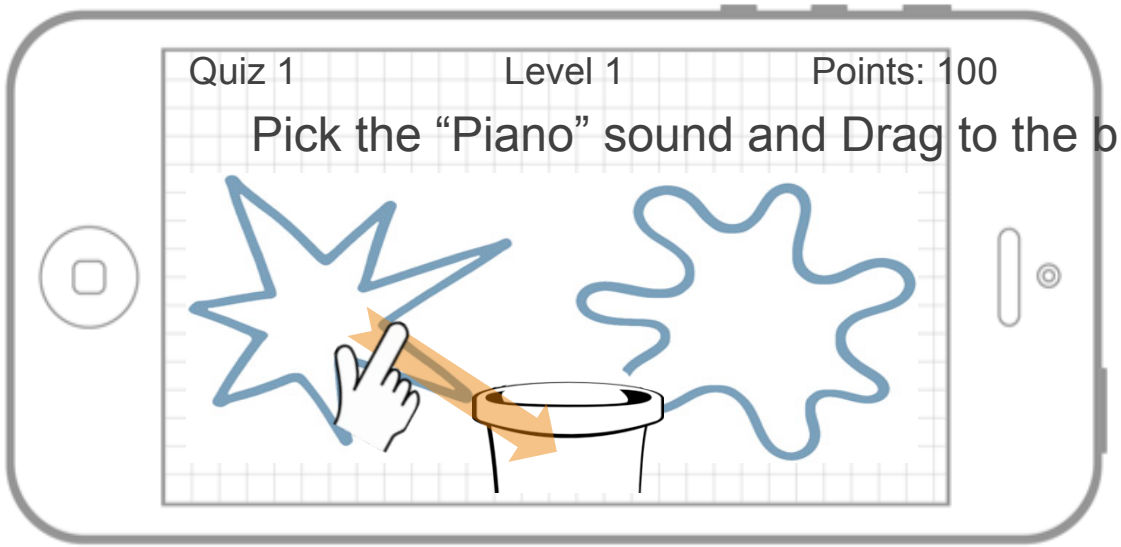
Level 2

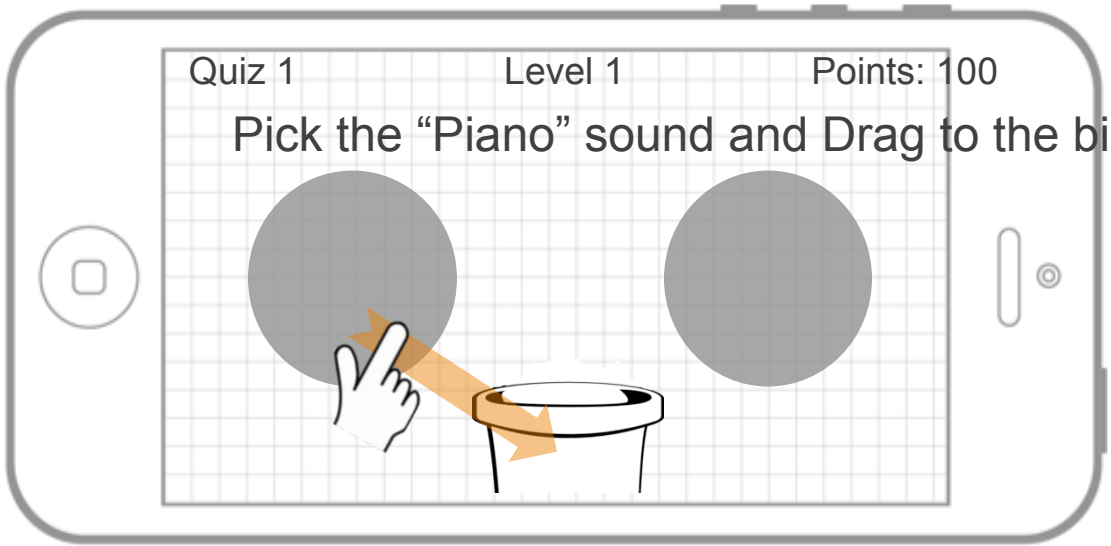
For Timbre Perception, the users are needed to differentiate between two different music instruments.

The two shapes (inspired from Kiki-Bouba concept) are displayed and once touched, they produce each of the assigned music instruments' sounds.

The user has to choose one of them as the instructions require and drop them to the basket below. As the difficulty levels increase, the user has to just listen to the sound and choose from the two similar spheres. This makes them more keen on the sound than the visuals.


1
2
Pick the one producing
Piano sound
3
Right answer.
or
Wrong answer.


Quiz 1
Level 1
Points: 100
Pick the “Piano” sound and Drag to the bin


Quiz 1
Level 1
Points: 100
Pick the “Piano” sound and Drag to the bin

Learning to Sing…

Learning to sing 1 note

Learning to sing a melody…

Pitch Production

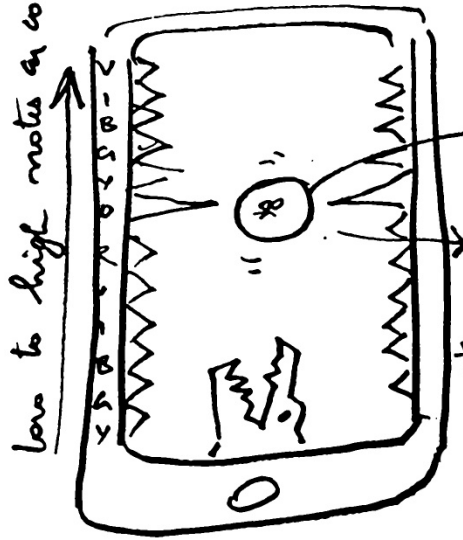
Level 3

For Pitch Production, the users are needed to sing one particular note and prolong it.

The reference pitch/note is played from the pre-recorded files in the game and the corresponding colour in the interface is highlighted. The user is prompted to sing along.

As the user sings and prolongs the note, the bubble in the centre gets bloated with the note's colour and bursts by awarding points to the user. If the user doesn't sing the note, then the bubble remains small and wavers according to the wrong notes sung.

Single pitch production.



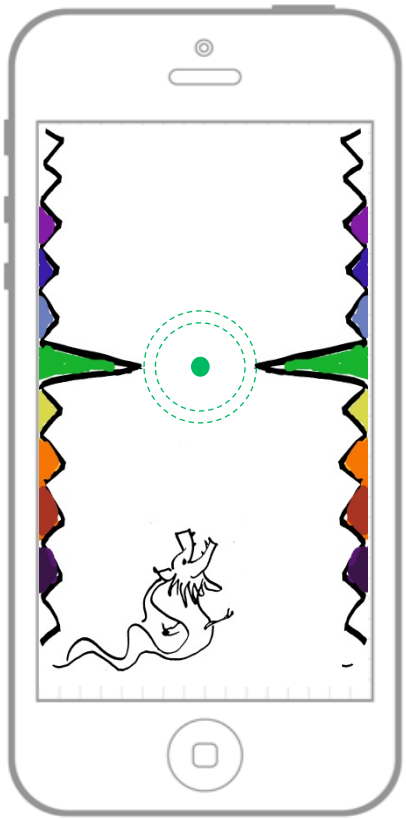
orange fills as one sings and bubble becomes big and gets pricked by orange pin.

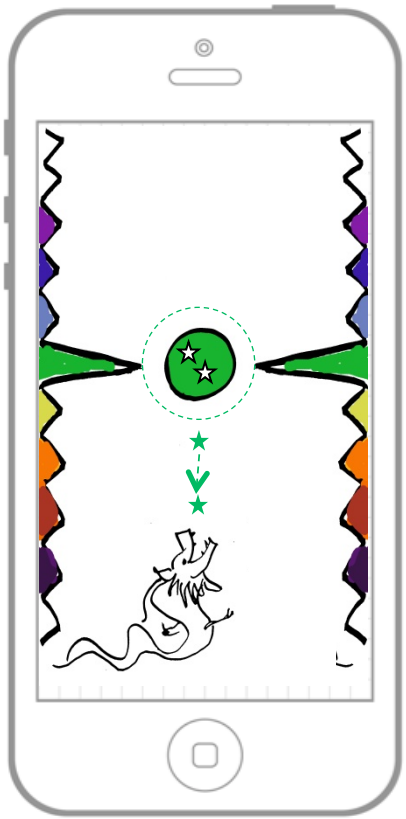
increasing bubble size as one sings the single note.

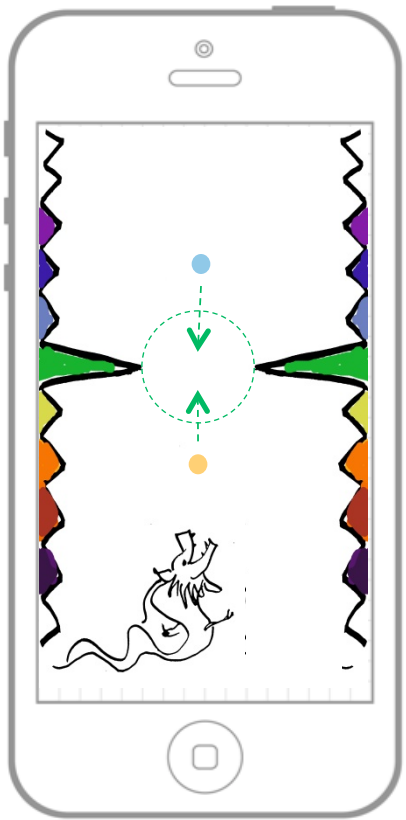
The user sings higher (towards top) for higher notes and vice versa.

The picks are also coloured acc to the note.

Do
Ti
La
So
Fa
Me
Re
Do







Melody Production

Level 4

For Melody Production, the users are needed to sing a melody along with the melody played back by the device.

This melody is also expected to be sung along with lyrics. Since these melodies are designed for children, most of these are simple songs and rhymes(in english).

The interface is designed so that the user gets awarded with points only if he/she sings the exact pitches in the melody. The same is also visualised in terms of percentage of perfection in the tuning.

From pitch to melody

Time and Tune

Musical notes make a tune when they are arranged in an interesting way with respect to time.

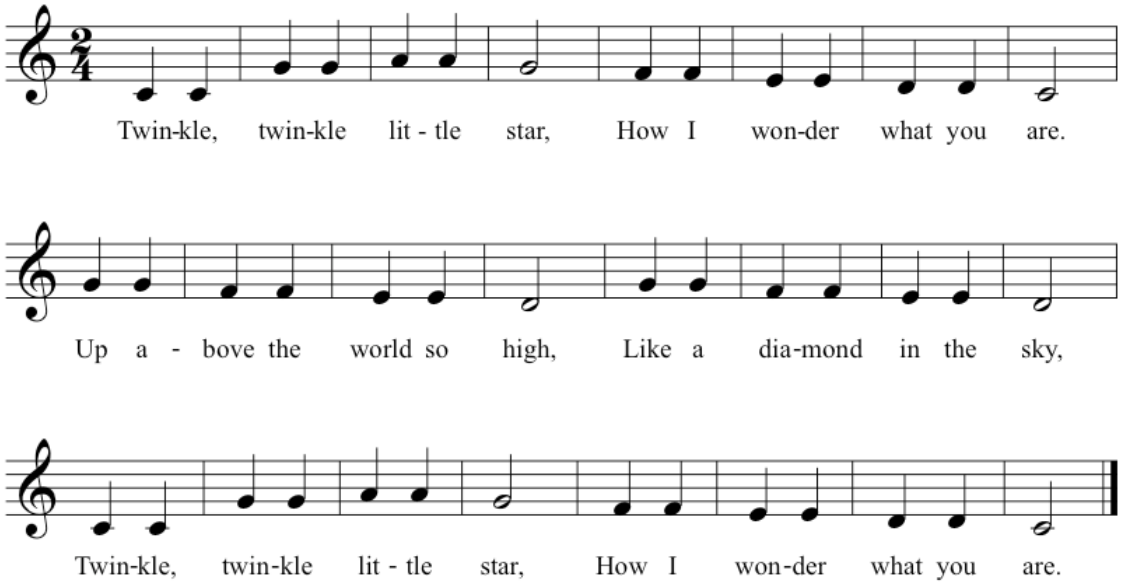
That way every musical note starts having beat values according to the way it is composed. Today, midi composers work with the Midi grid mapped against the keyboard layout.

English names for notes and rest values

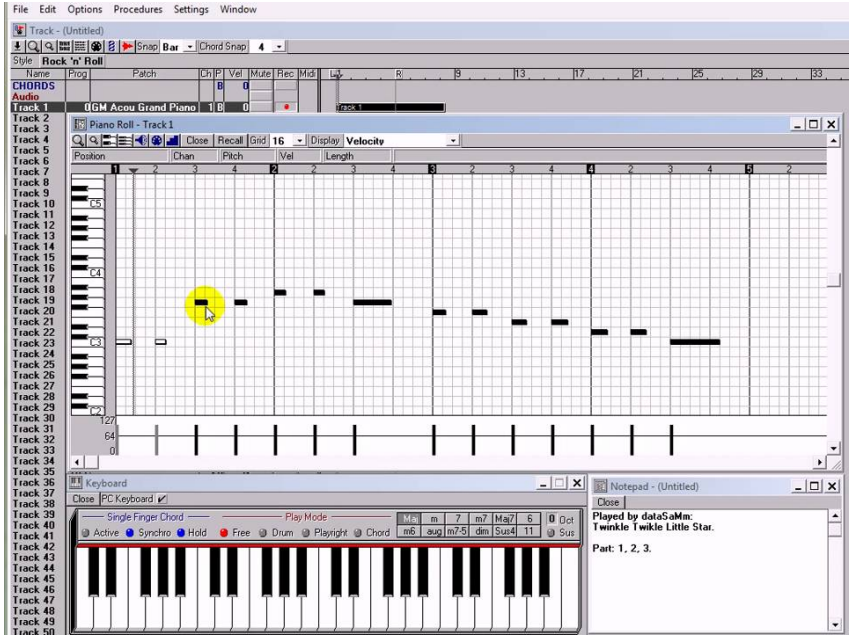
Sign	Name	Relative Length	In 4/4 Time	Rest
	Semibreve	Whole note	4 beats	
	Minim	Half note	2 beats	
	Crotchet	Quarter note	1 beat	
	Quaver	Eighth note	½ beat	
	Semiquaver	Sixteenth note	¼ beat	

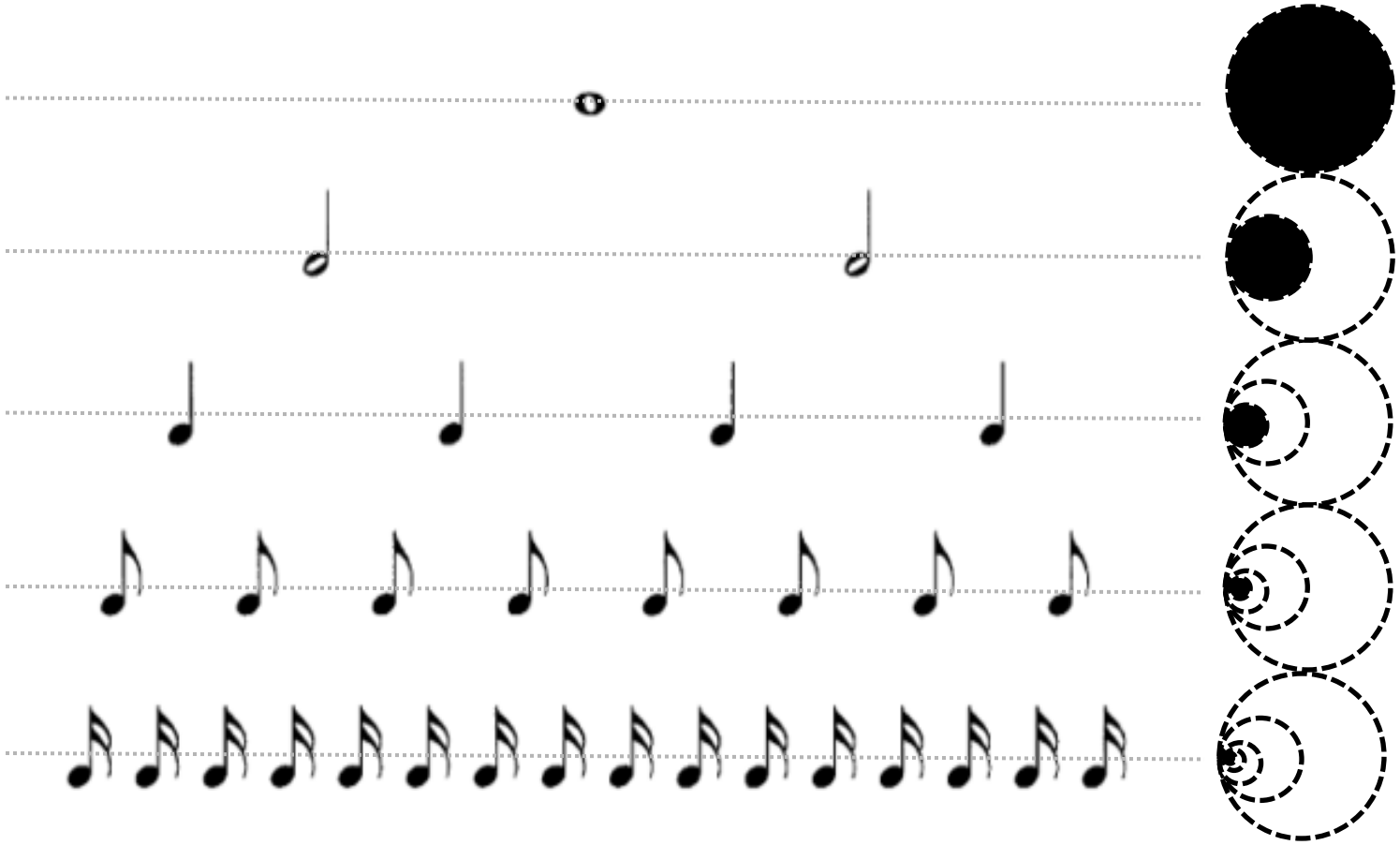
http://www.musicandmeaning.net/articles/JMM10/JeffreyNHowardJMM10.pdf

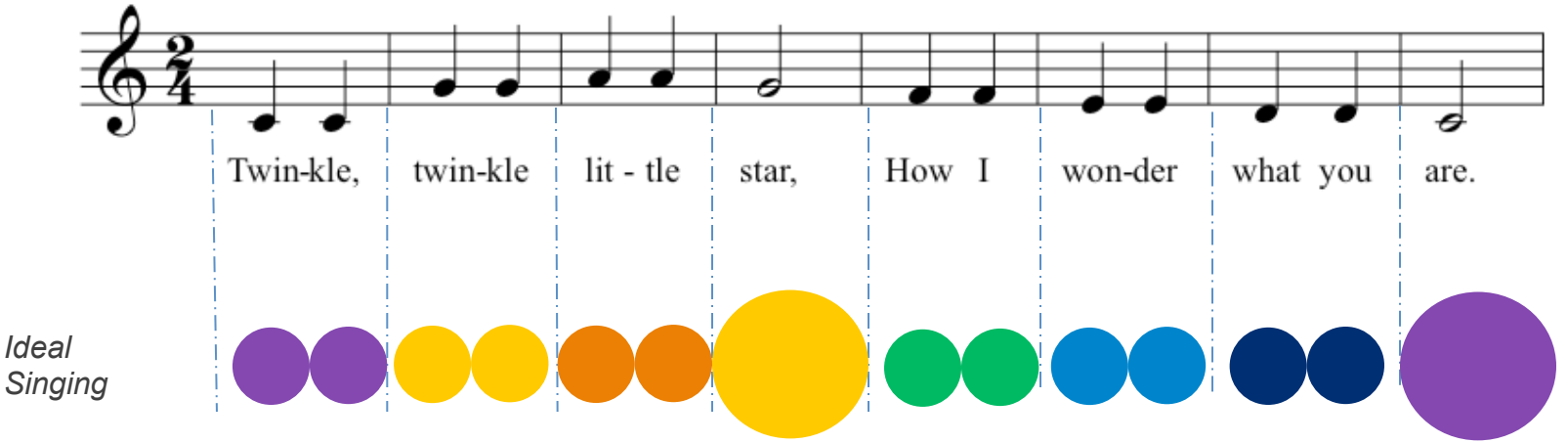
Staff Notation of the famous “Twinkle.. Twinkle..” Rhyme.



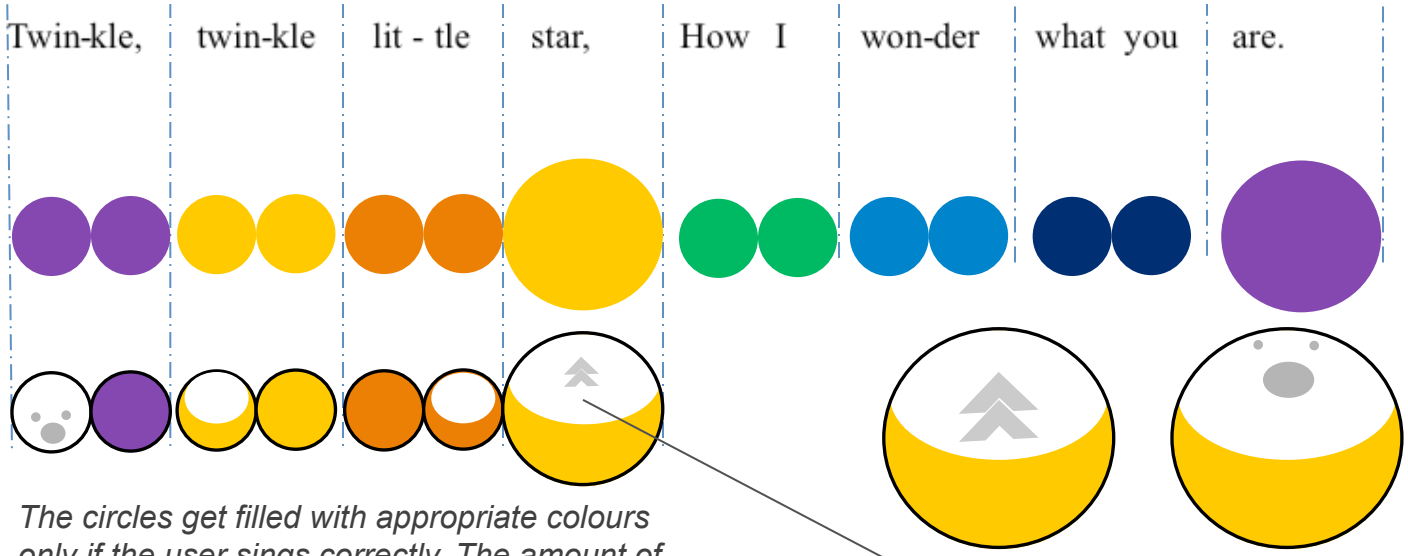
MIDI mapping of the famous “Twinkle.. Twinkle..” Rhyme.






Twin-kle, twin-kle lit - tle star, How I won-der what you are.
Ideal Singing

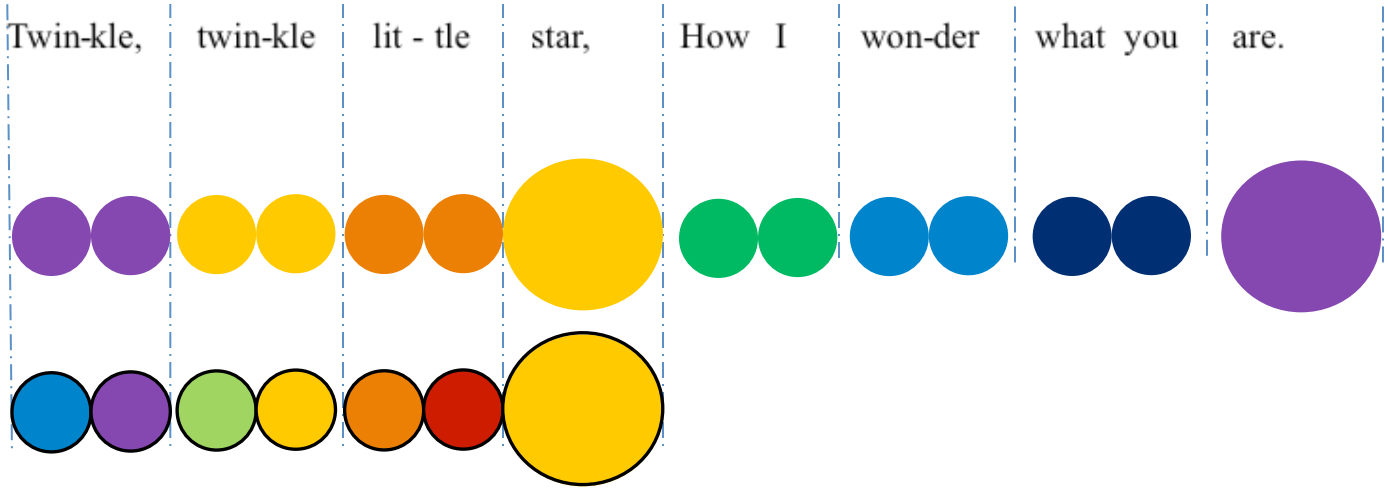
Design OPTION 1



The circles get filled with appropriate colours only if the user sings correctly. The amount of colour filled in corresponds to the correctness of the note he/she has sung.

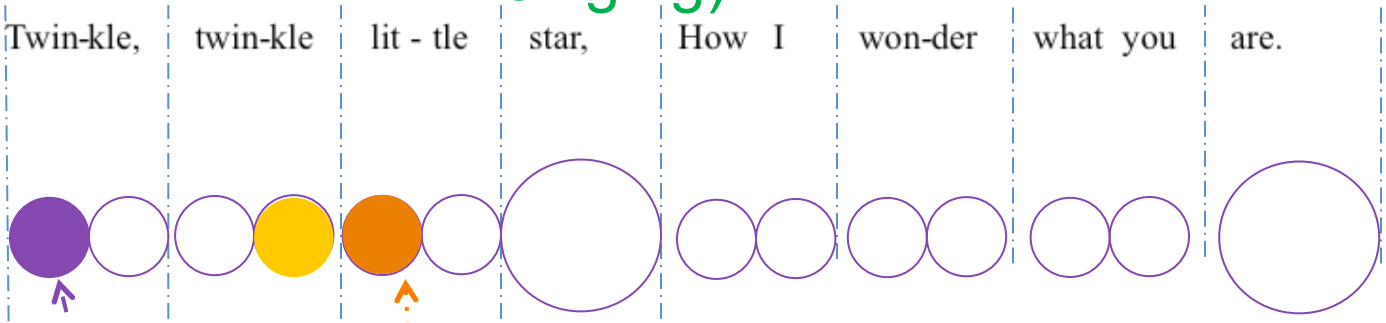
Options for prompts to sing above/below the current pitch for perfection.

Design OPTION 2

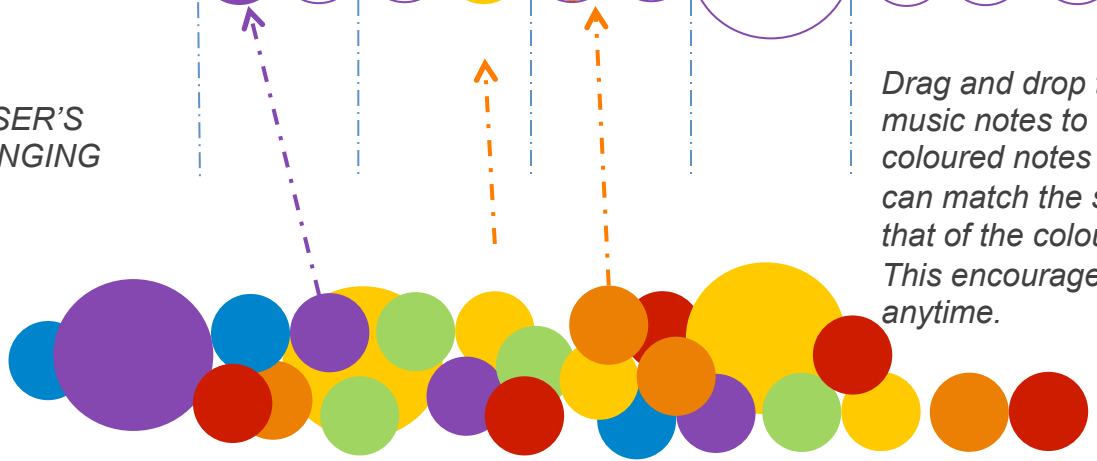


The circles get filled with wrong colours for Wrongly sung notes. The user can know which note he/she has sung than the needed one.

For SILENT GAME MODE (Learning melody without singing)

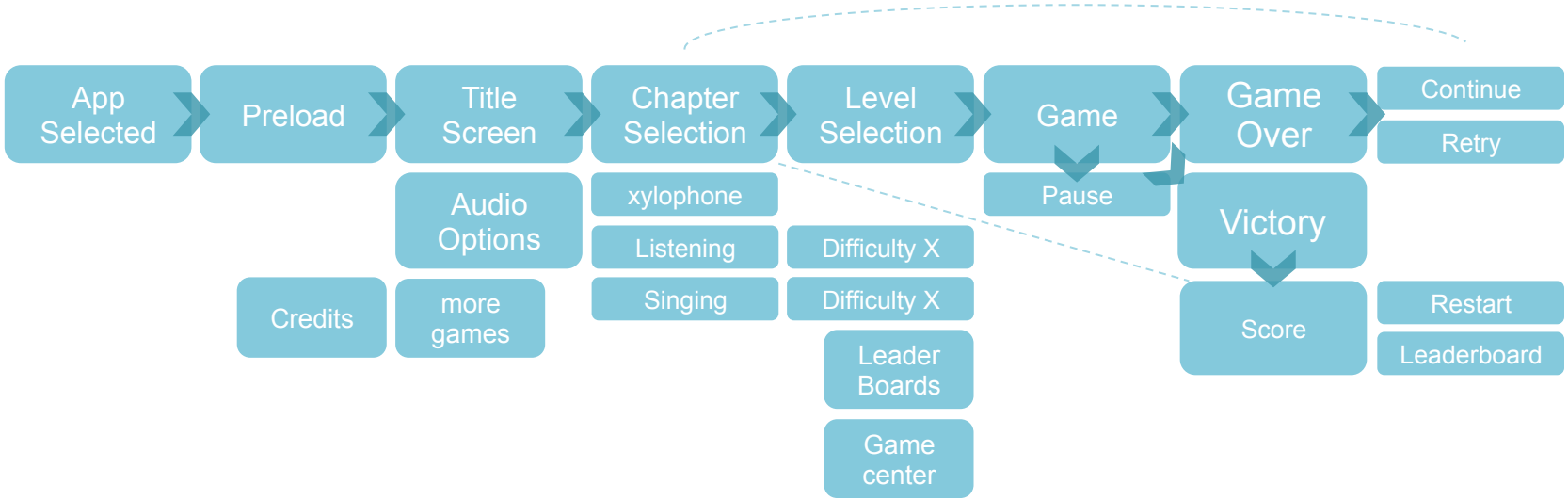


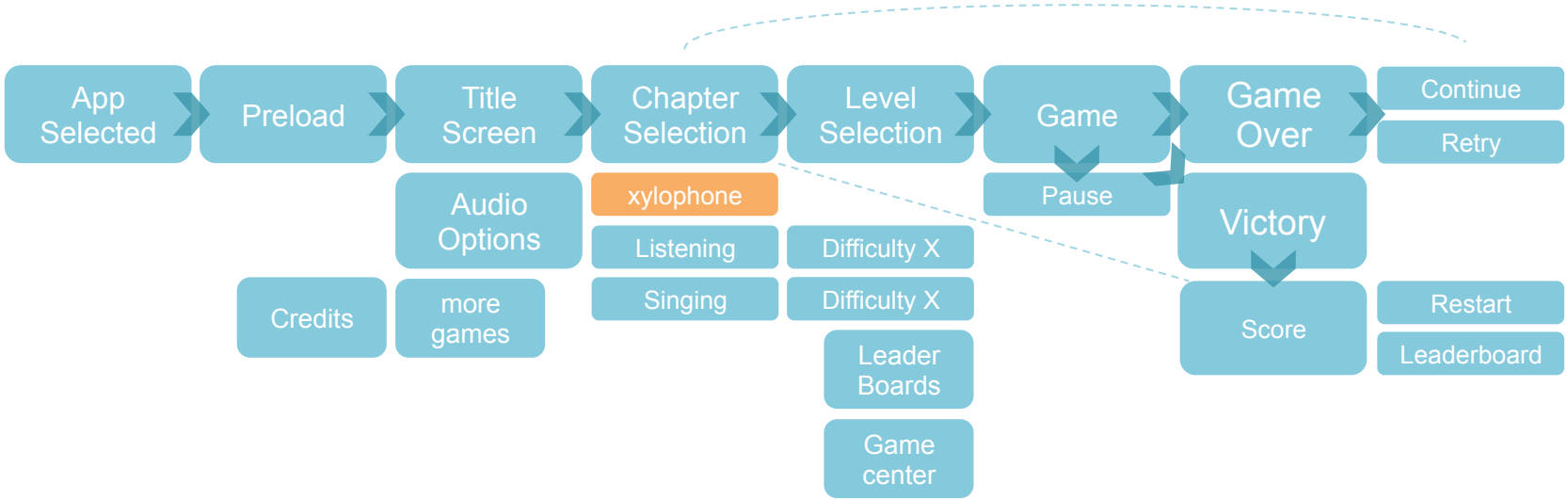
USER'S SINGING

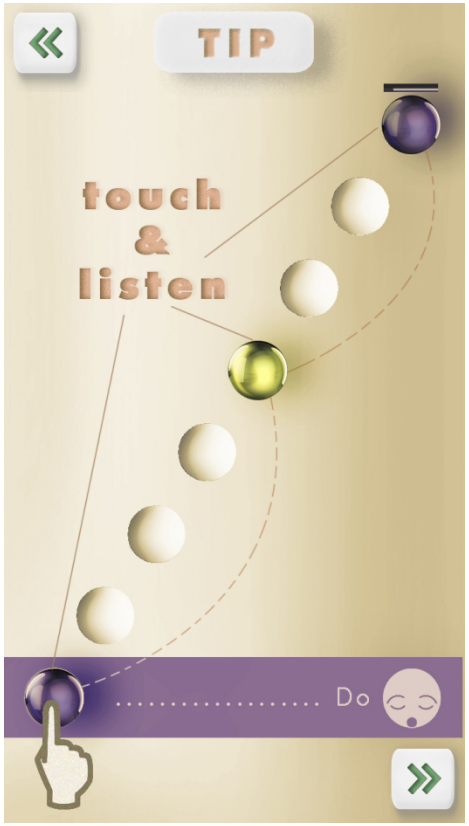


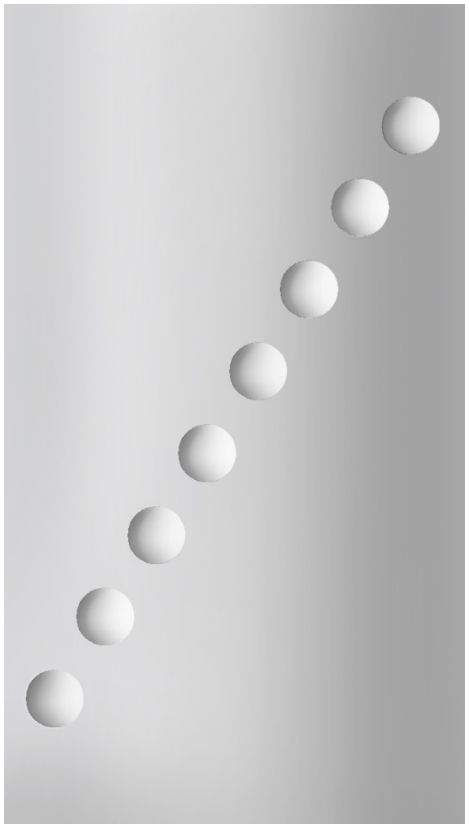
Drag and drop the right Coloured sphere-music notes to fill in the empty circles. The coloured notes sound when tapped. The user can match the sound of the empty circle with that of the coloured one to match and drop. This encourages silent learning, anywhere, anytime.

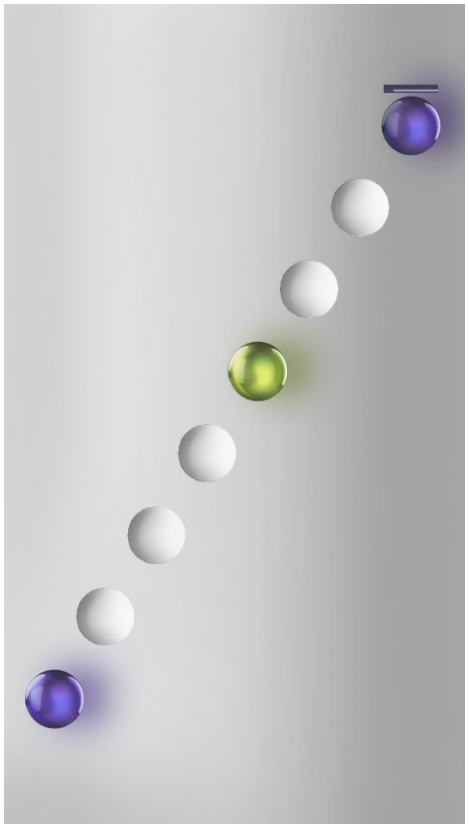
Final Design

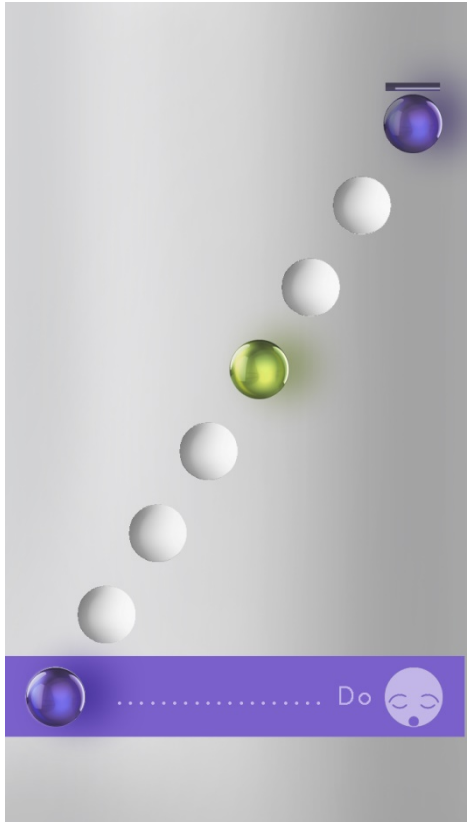

App Selected
Preload
Title Screen
Chapter Selection
Level Selection
Game
Game Over
Continue
Retry
Audio Options
xylophone
Pause
Victory
Listening
Difficulty X
Credits
more games
Singing
Difficulty X
Score
Restart
Leaderboard
Leader Boards
Game center

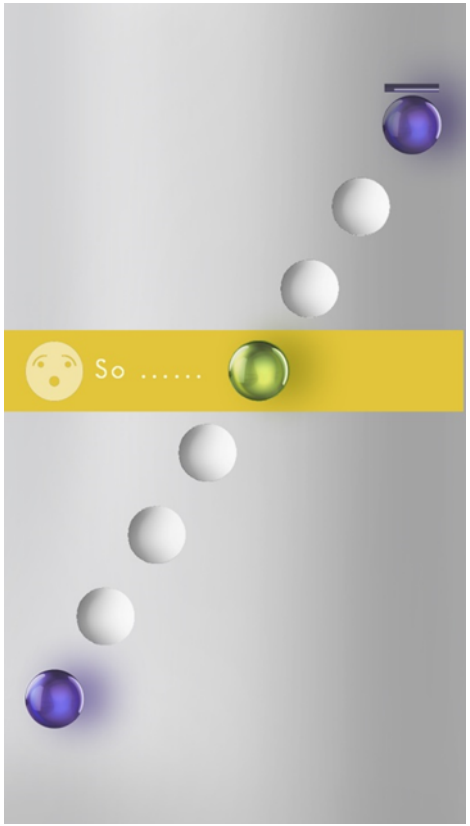

App Selected
Preload
Title Screen
Chapter Selection
Level Selection
Game
Game Over
Continue
Retry
Audio Options
xylophone
Pause
Victory
Listening
Difficulty X
Credits
more games
Singing
Difficulty X
Score
Restart
Leader Boards
Leaderboard
Game center

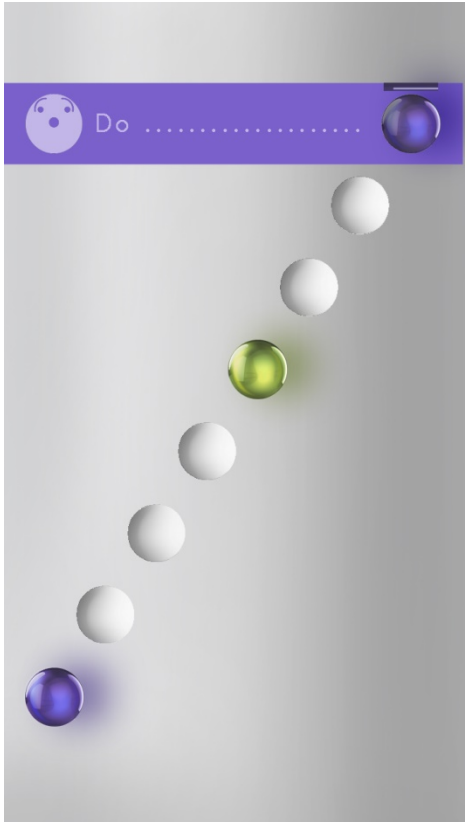

TIP
touch
&
listen
Do

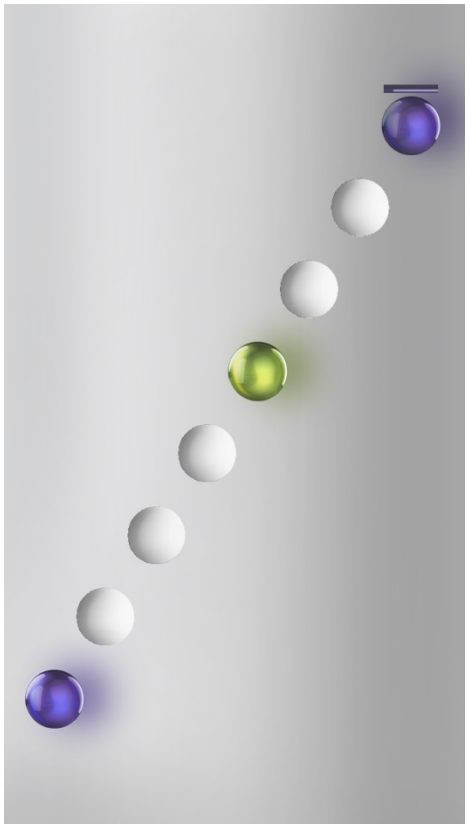


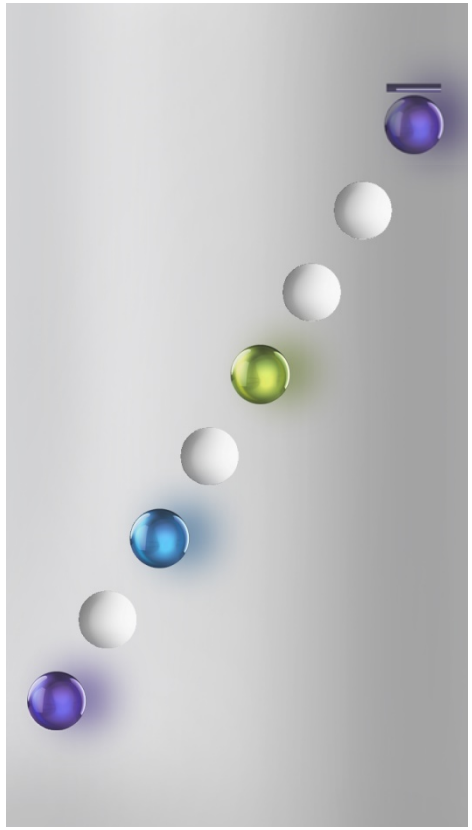


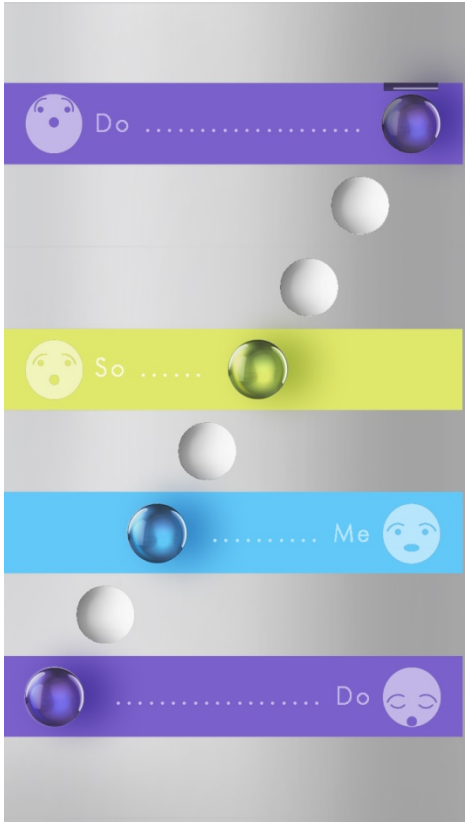

Do

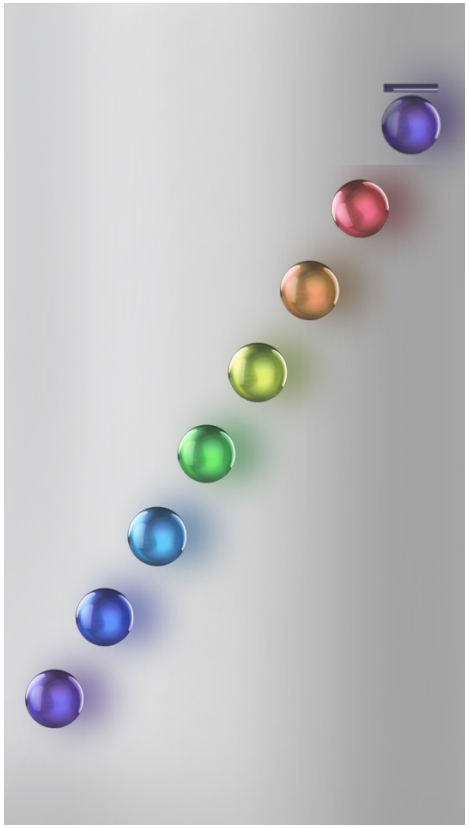

So .....

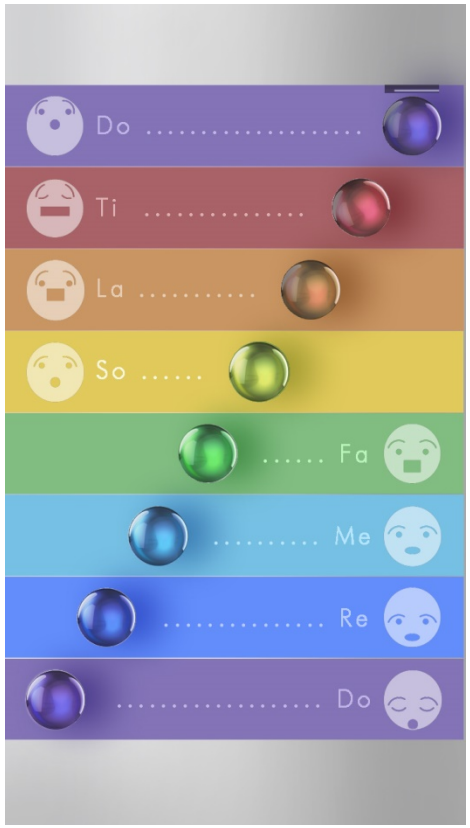

Do

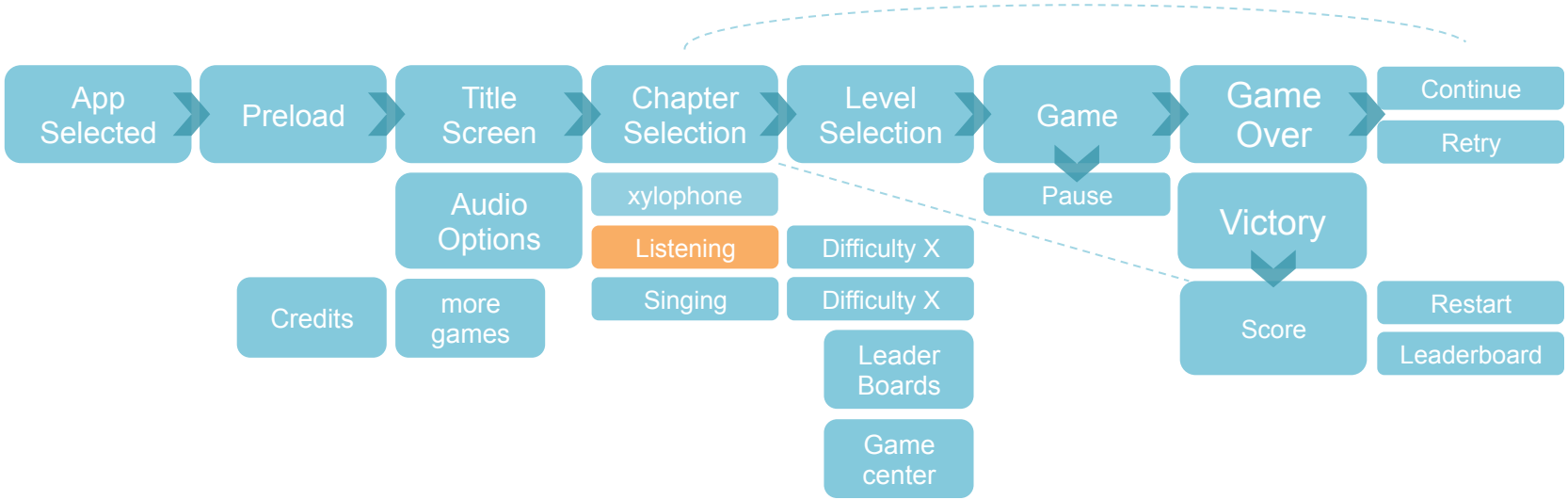


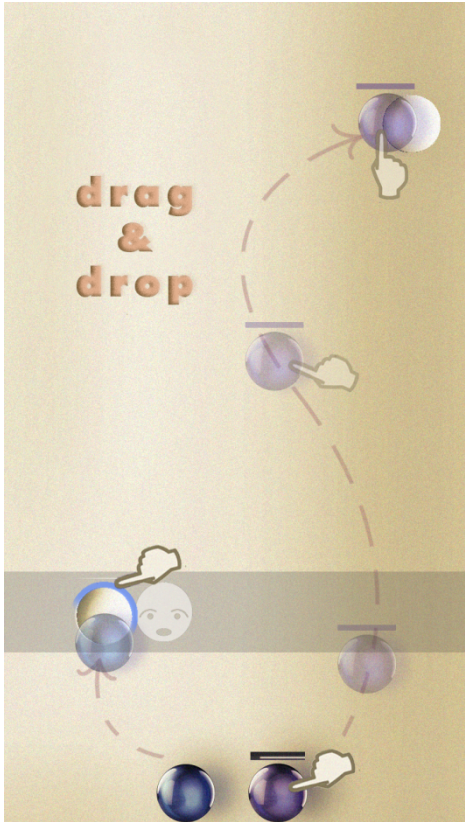


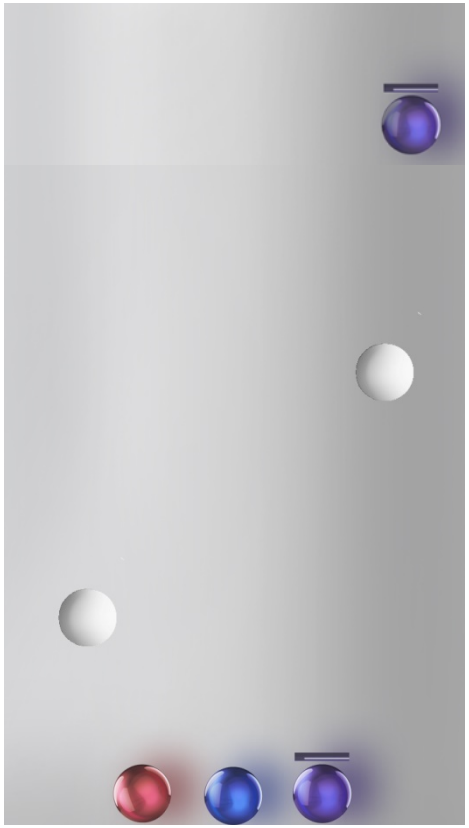
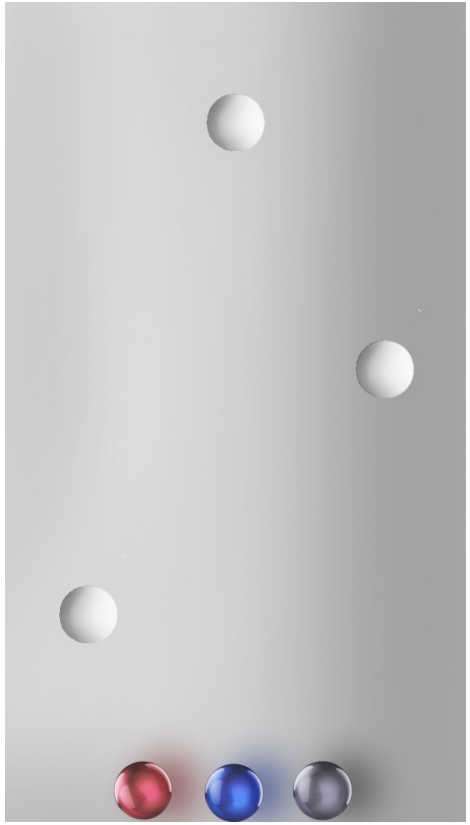
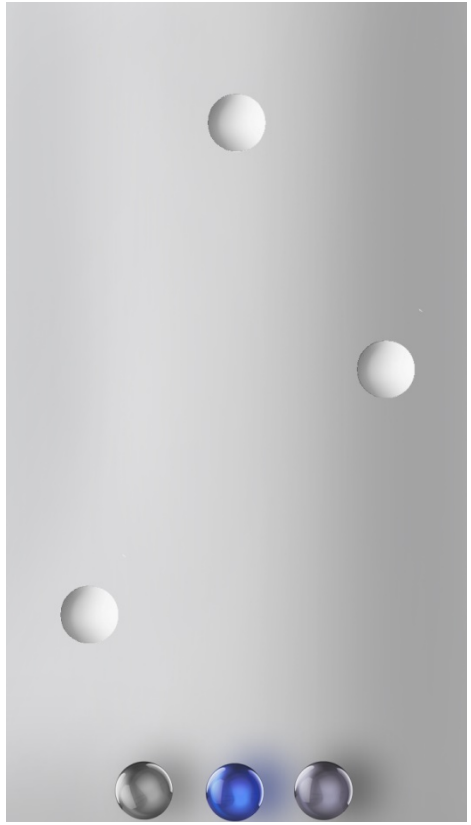

Do .....
So .....
..... Me
..... Do

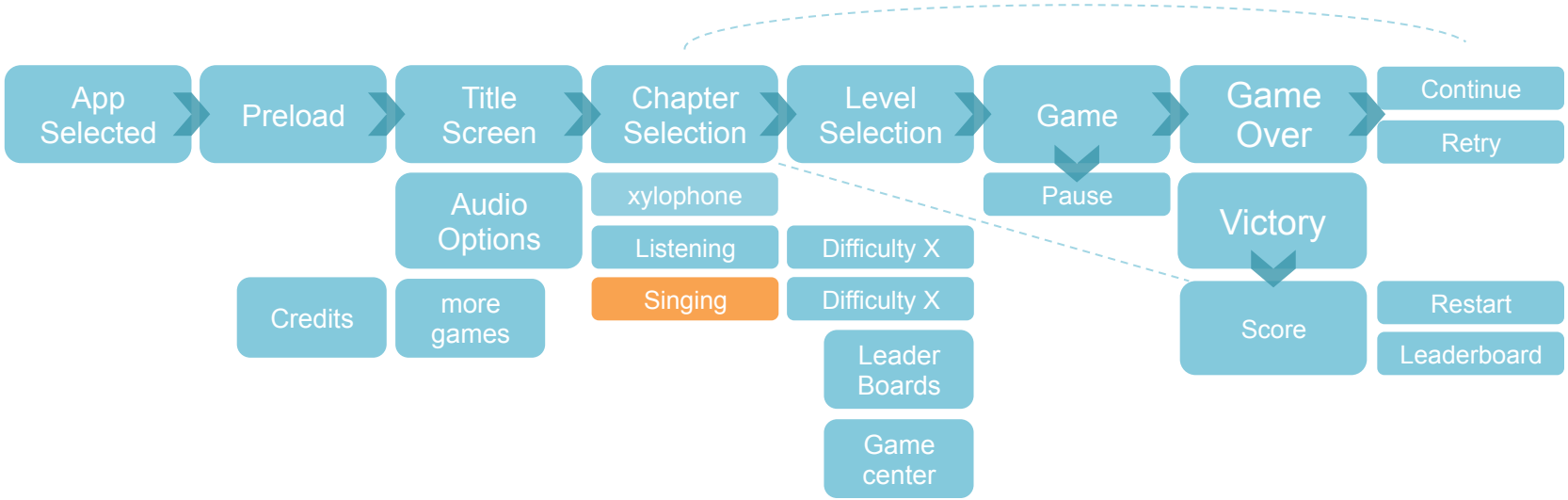



Do
Ti
La
So
Fa
Me
Re
Do


App Selected
Preload
Title Screen
Chapter Selection
Level Selection
Game
Game Over
Continue
Retry
Audio Options
xylophone
Pause
Victory
Listening
Difficulty X
Credits
more games
Singing
Difficulty X
Score
Restart
Leader Boards
Leaderboard
Game center


drag
&
drop


App Selected
Preload
Title Screen
Chapter Selection
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Game Over
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Retry
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xylophone
Pause
Victory
Listening
Difficulty X
Credits
more games
Singing
Difficulty X
Score
Restart
Leaderboard
Leader Boards
Game center

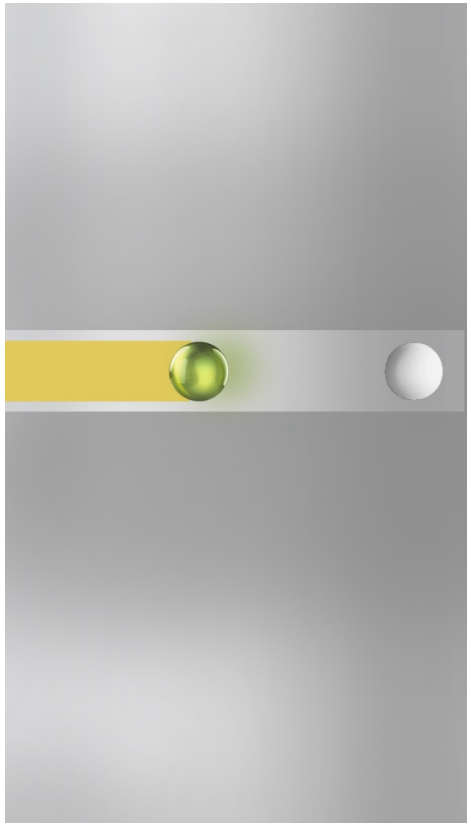
Pitch Production

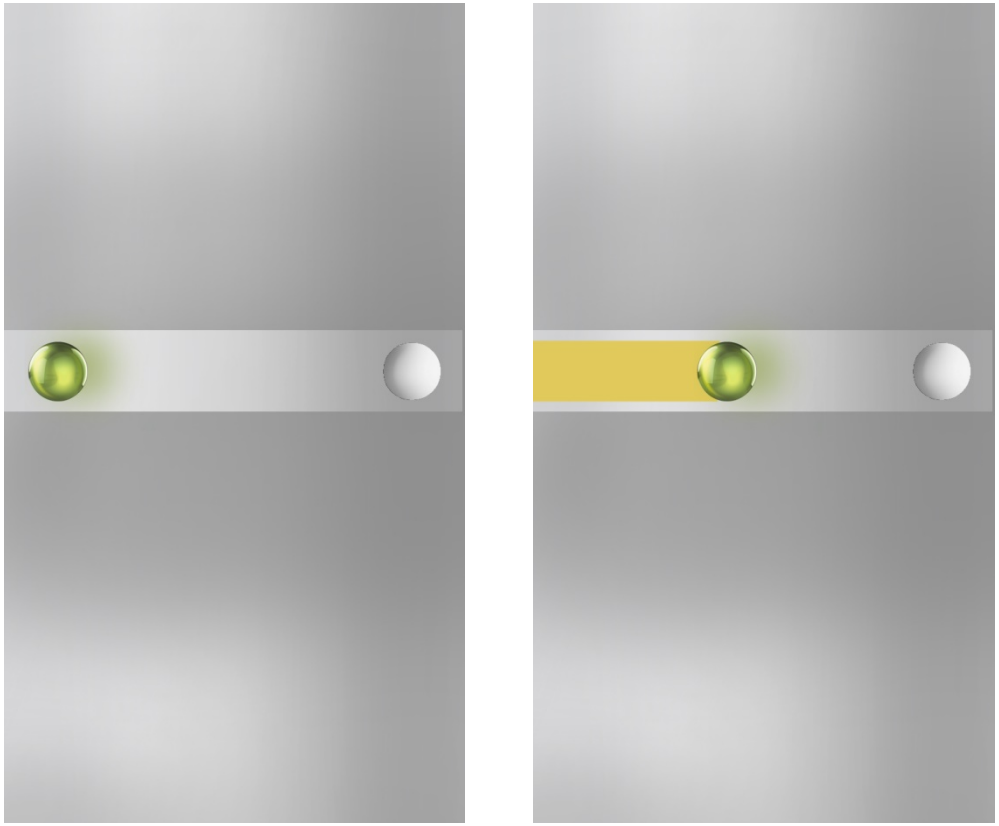
Level 3

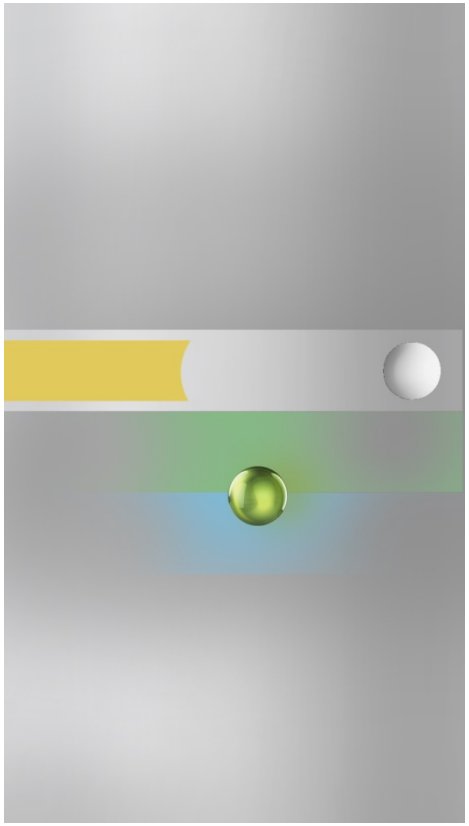
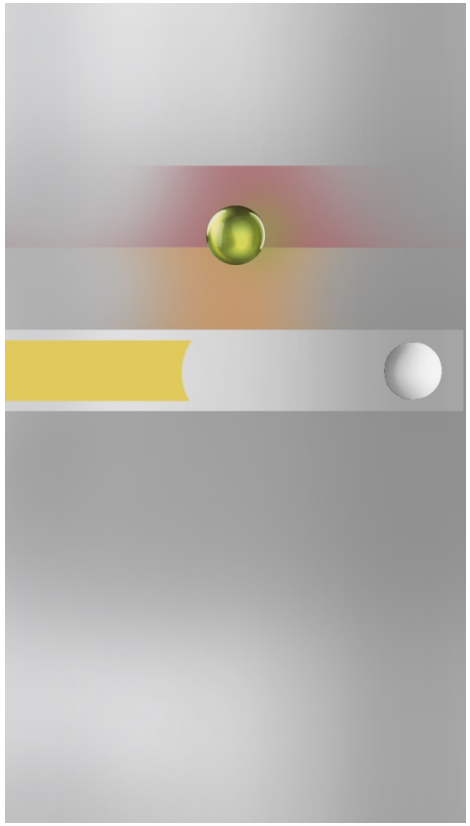
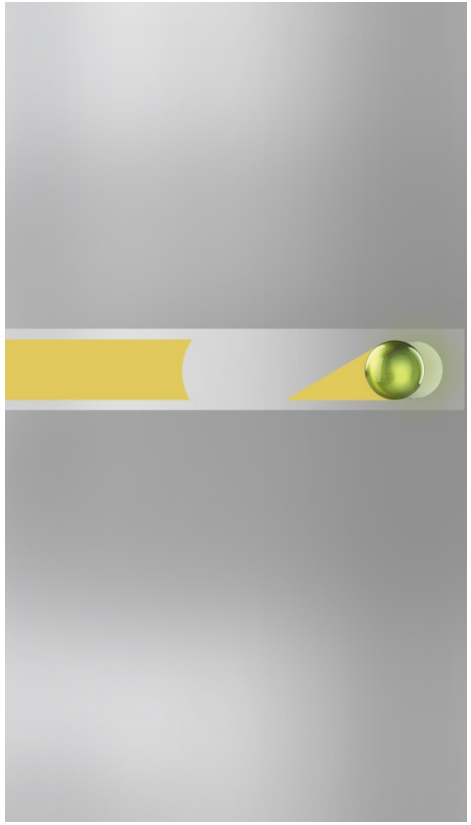
For Pitch Production, the users need to sing one particular note and prolong it.

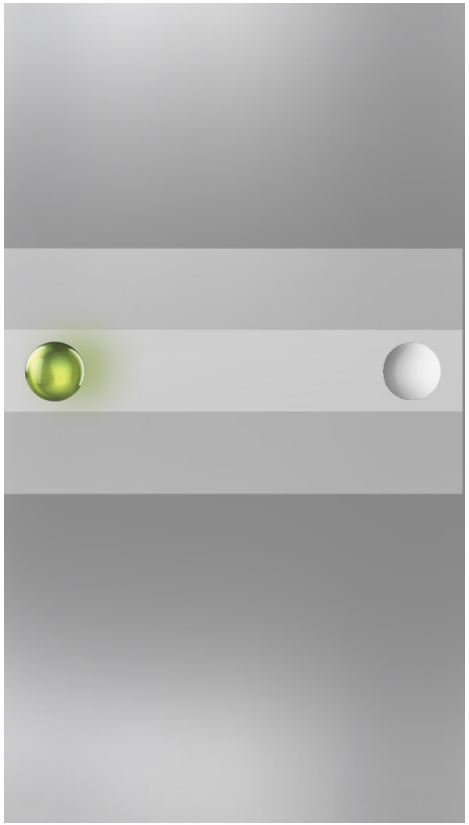
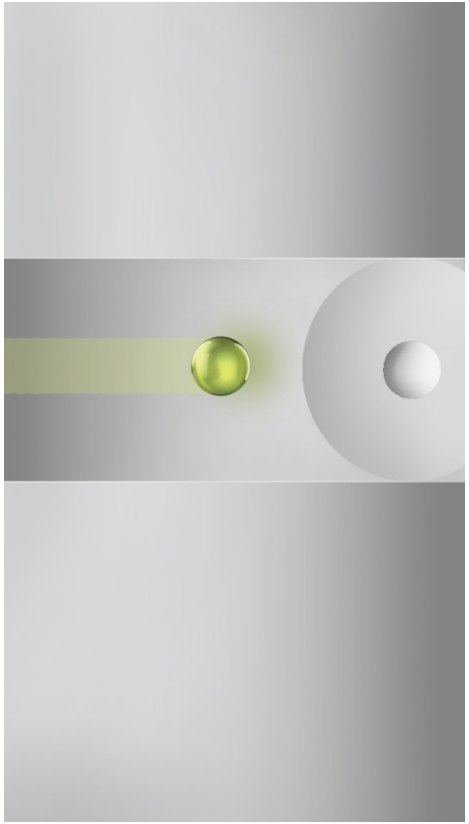
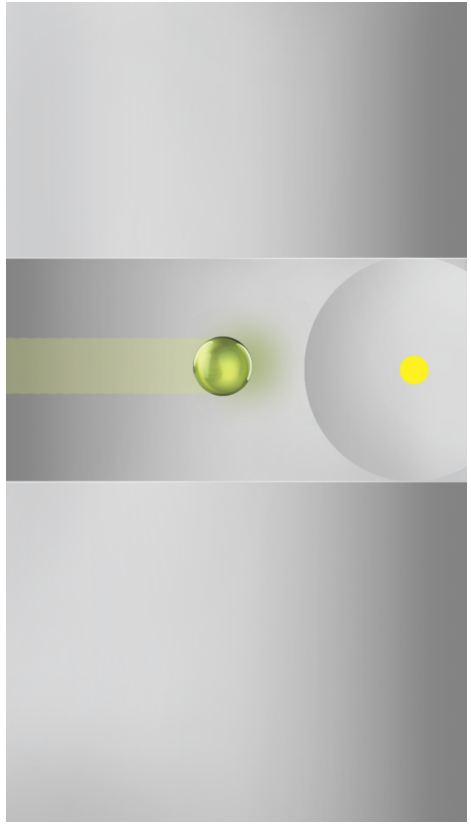
The reference pitch/note is played from the pre-recorded files in the game and the corresponding colour in the interface is highlighted. The user is prompted to sing along.

As the user sings and prolongs the note, the marble reaches the recess. If the user doesn't sing the note, then the marble wavers along the slope according to the wrong notes sung, up or down.

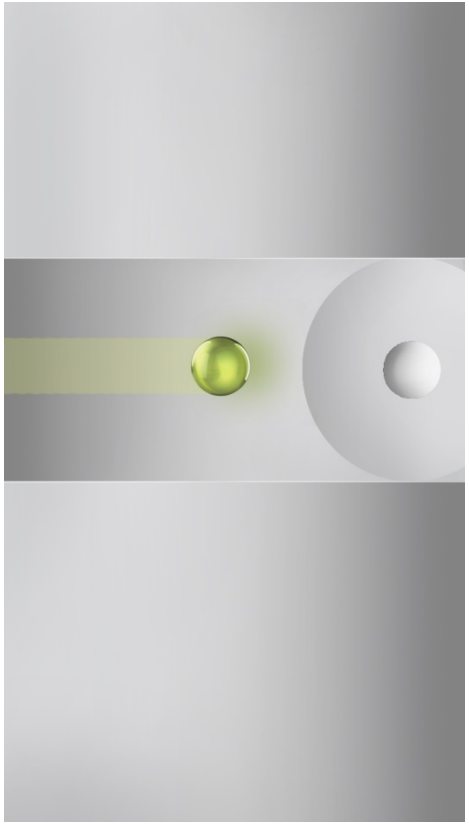





1
touch
to
listen
2
sing
to
roll



Usability Study

Usability Evaluation

Goals

1. *Evaluate the ease of use of "Singing Lions" android game for mobile devices. Identify interaction design and interface design flaws in the app.*

2. *Evaluate the User's Satisfaction while using the game/app.*

Users- Children with Cochlear Implants (Ages 5-7)

Questionnaire for Child

Pre-Session

Participant No : _____ (to be filled by evaluators)
Observer will ask these questions to the child
and complete the form.
Name:_____
Tick in the appropriate blank
How often do you use the smartphone?
___ Every day
___ Once a week
___ Once a month
___ Only when I need something
Where do you use the smartphone the most?
___ School
___ Library
___ Home
___ Others _____
Who usually uses the smartphone with you?
___ Parent
___ Only me
___ Sitter
___ Teacher
___ Others _____
What language does your smartphone work in?
___ English
___ Mandarin
___ Malay
___ Tamil
___ Others _____

Questionnaire for Child
Post-Session

Child - User Satisfaction Survey

Participant No : _____(to be filled by evaluators)
Please fill out the following questions about the game (tick the appropriate box)

	Yes, totally	Yes	Neutral	No	Not at all
I understood the instructions.					
The game was fun					
The game was easy to play					
I want to play this game again					
I would like to play this game at home					

Rate the games in Singing Lions on 5.

1. Introduction – Xylophone _____/ 5
2. Higher Lower :_____/ 5
3. Sing N Roll : _____/ 5


Gg Hh Ii
Pp Qq Rr
Zz

Task 1

Xylophone/introductory level

The users were given the “Xylophone” exercise where they had to understand that musical notes are being mapped to the colours in rainbow. The coloured marbles on the interface would sound the corresponding notes when touched.

Task 1

Key question

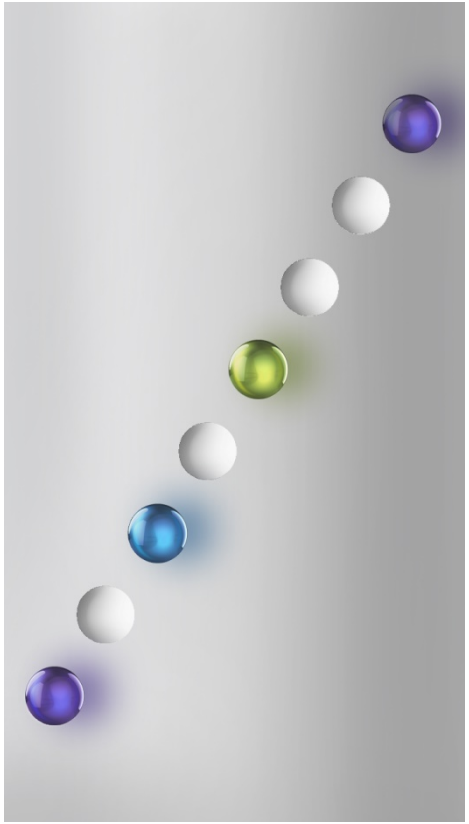
Is the user able to learn that musical notes are mapped to the respective colours of the marbles in the layout?

User Feedback 1

The users understood that the music notes are arranged in an ascending scale but did not seem to understand the visual arrangement in the order of the rainbow colours which was intended in the game.

Insight 1

Making the entire layout with horizontal coloured bars (along with the marble) and making them light up more(or become white) when the user touches one of them would be a better idea. This would give them more sense of the rainbow colours.



User Feedback 2

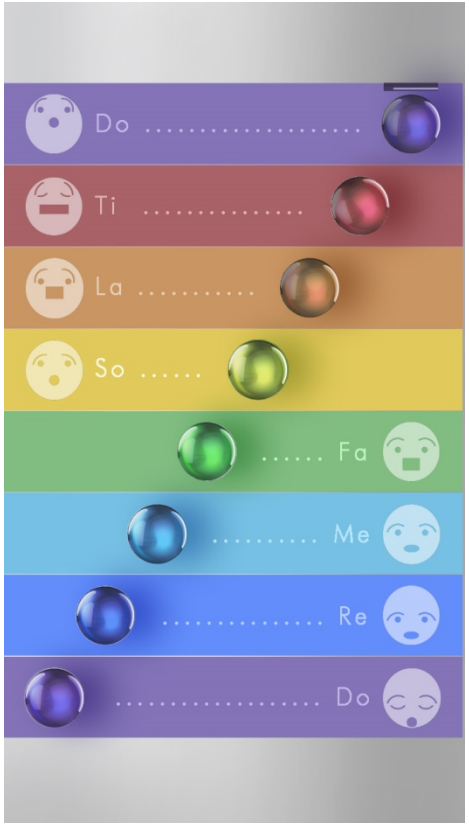
The users kept playing the xylophone's sub-levels endlessly. Only when prompted, they understood that they should press the next button to proceed.

Insight 2

Since the next button was not understood it can probably be changed to a button with the lion's face to go back to home page/menu.

Insight 3

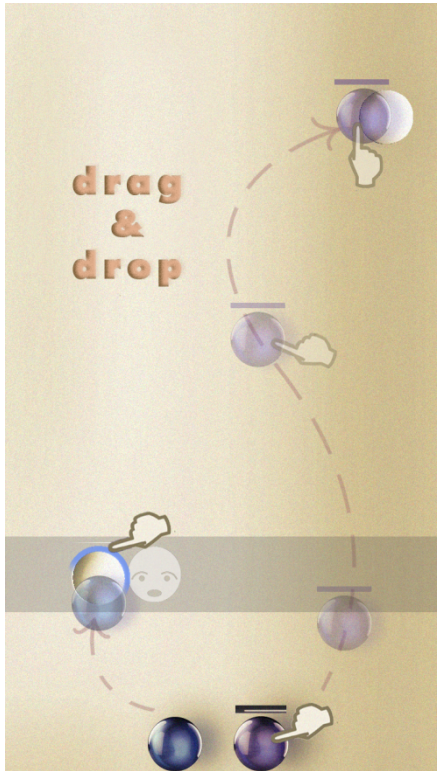
Newer marbles can appear automatically after the user touches all of the notes given in a sub-level (instead of making the user hit the "next" button).



Task 2

High Low Game

The users were given the “High Low” game where they had to drag and drop the marbles in respective recesses.


drag
&
drop

Task 2

Key Question

Is the user able to learn that the marbles of different musical pitches/notes belong to their respective recesses on the layout when playing this game?

User Feedback 1

To listen and match the music notes, users did not try to tap the recesses with rings unless prompted.

Insight 1

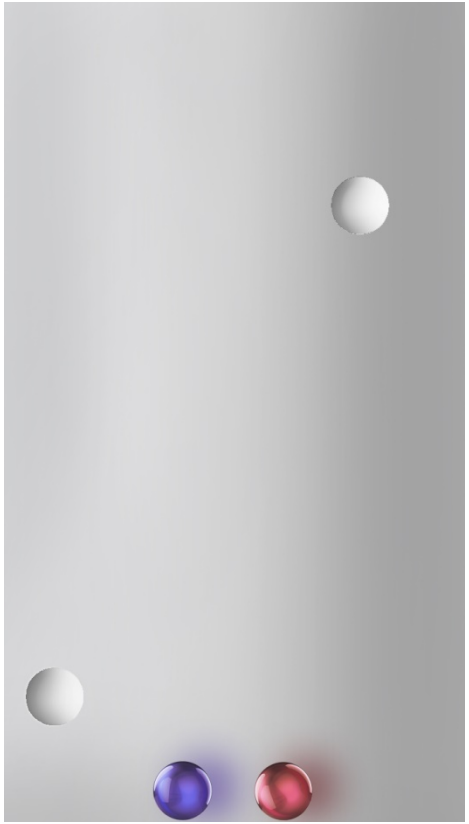
A design idea?
A prompt -“crotchet” appearing for 1 second next to the recess + ring, if left untouched for more than 5 seconds.

User Feedback 2

When the user goes wrong, he/she is given the same game to retry again and so user tries to guess the answer by trying a different combination.

Insight 2

Can the combinations in the sub-levels be randomized and scores be given at the end?



Task 3

Sing n Roll

The users were given the “Sing n Roll” game where they had to sing and roll the marble to make it reach the recess.


1
touch
to
listen
2
sing
to
roll

Task 3

Key Question

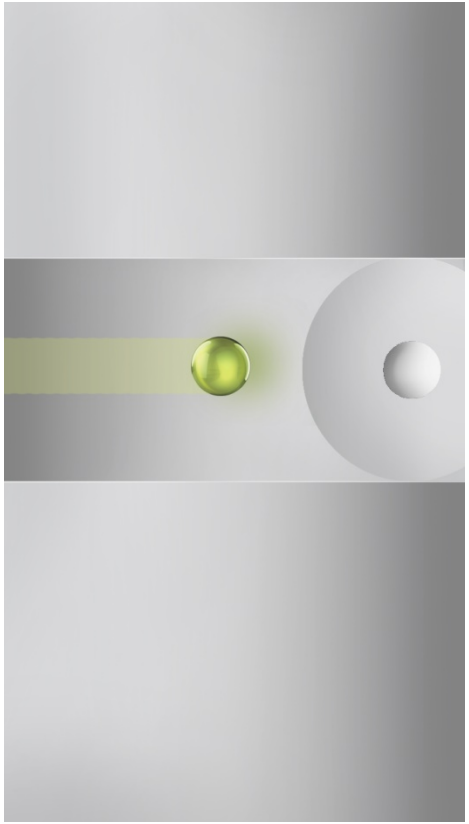
Is the user able to relate to the movements of the marble in the interface with respect to his/her singing?

User Feedback 1

Though most of the users got the idea of moving the marble as one sings or hums, it took a little prompting in the beginning. The users kept touching the marble expecting to drag along as in the previous levels.

Insight 1

A design idea?
a better prompt to make sure the user understands that he has to “sing”..



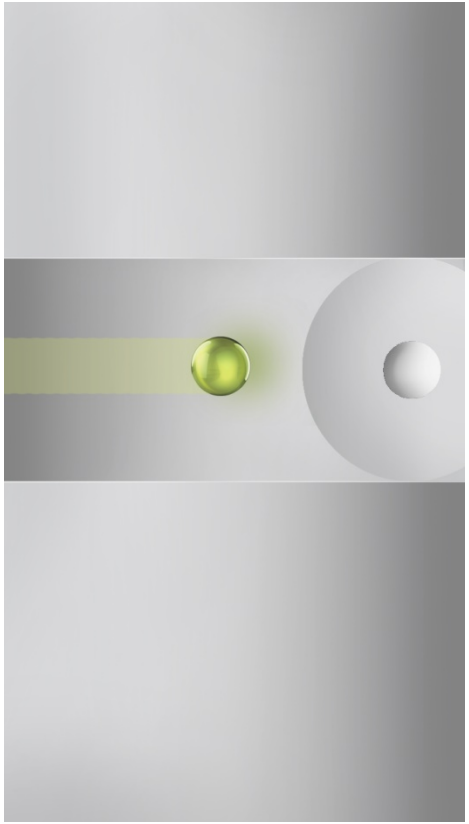
User Feedback 2

As the users were young children (5-7), they could not sustain the note beyond a level. They found it very difficult to make the marble reach the recess in such a slow speed, as they prolonged a note.
Also, they had problems in singing a note perfectly.

Insight 2

Making the ball's speed to reach the recess faster than it takes currently.

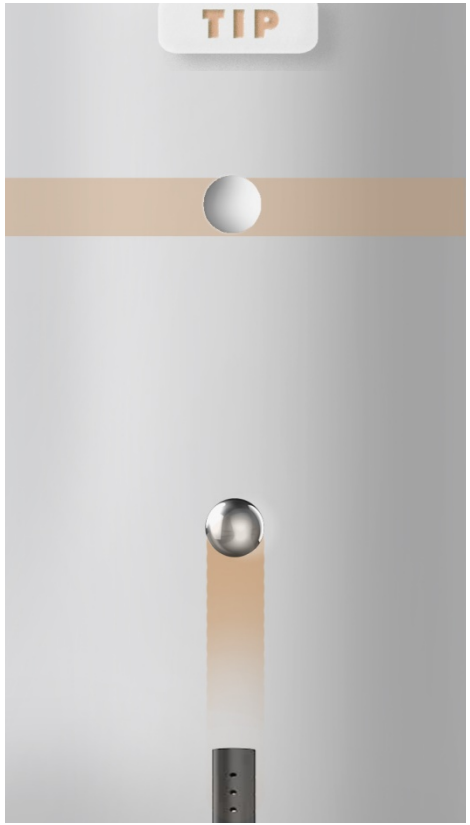
This would reduce the breath problems faced by the kids while singing.



Iteration

Since the users were tempted to
touch the marble rather than singing, a rifle that would shoot
out the marble as one sings is the new idea.

The user has to sing and hit the right note for making the marble land on the recess.



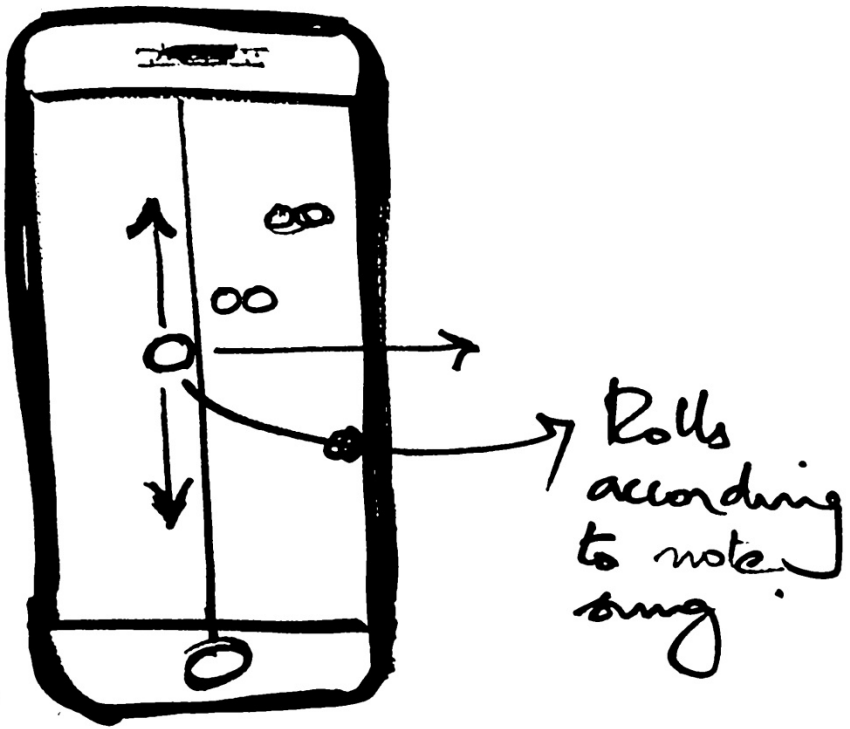
Questionnaire for Child

Post-Session

Child - User Satisfaction Survey

	Yes, totally	Yes	Neutral	No	Not at all
I understood the instructions.			5/5		
The game was fun	2/5	3/5			
The game was easy to play		4/5	1/5		
I want to play this game again	5/5				
I would like to play this game at home	5/5				

Other Explorations

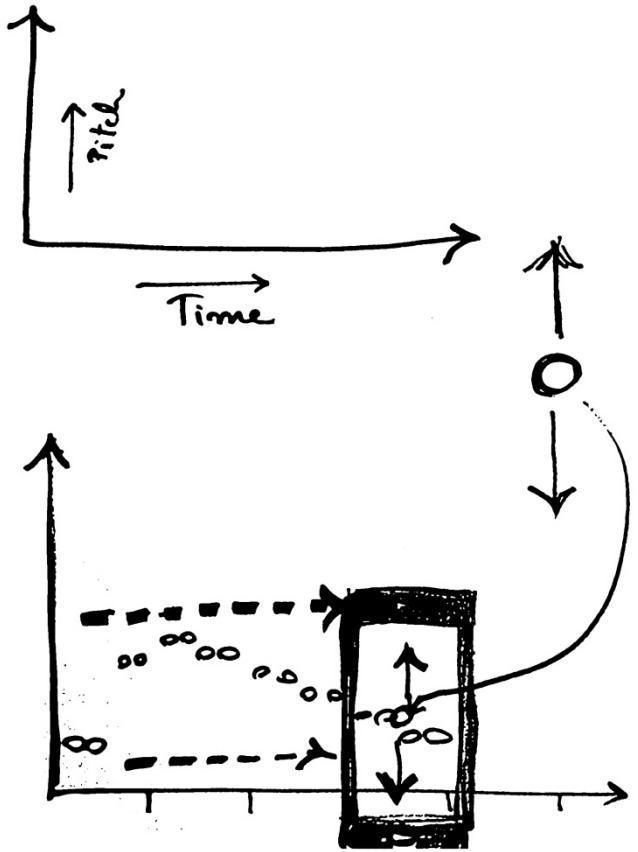

Rolls according to note sung

Future game extensions

Melody Singing

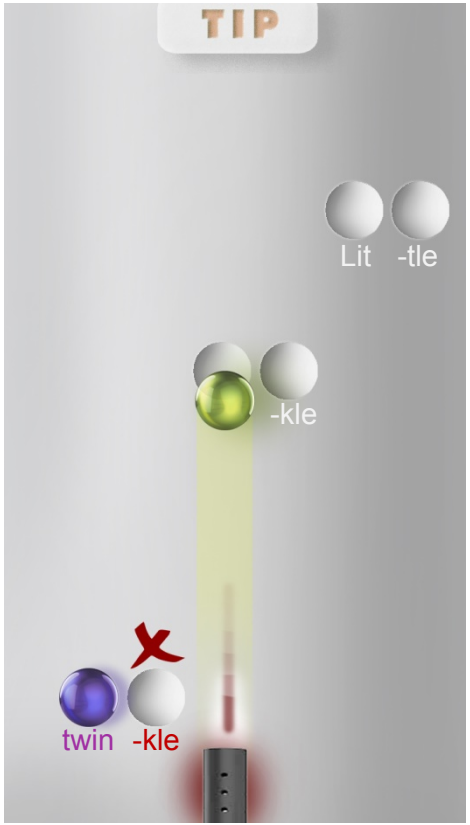
The melody singing game would include X-axis as the time element and recesses would be plotted.

The user has to sing correctly to Marbles land on the right recess.




TIP
Lit
twin -kle
twin


TIP
Lit -tle
twin -kle
twin -kle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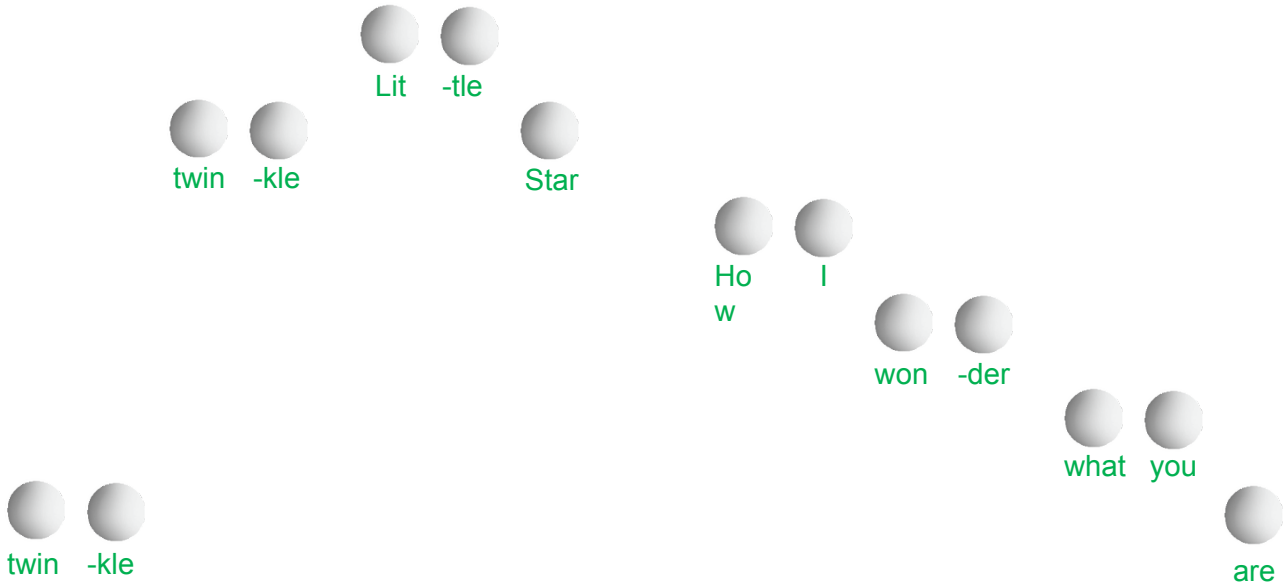
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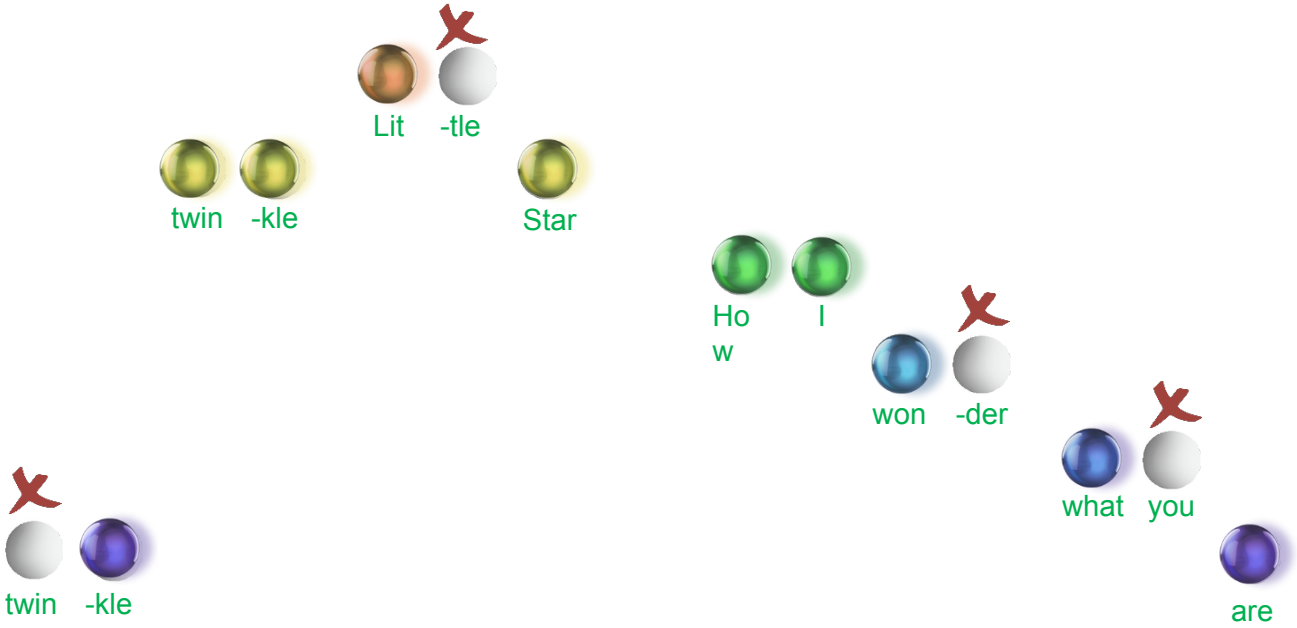
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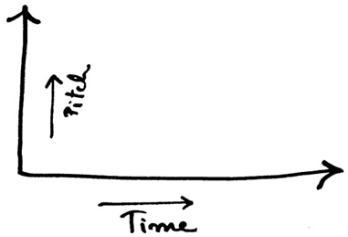
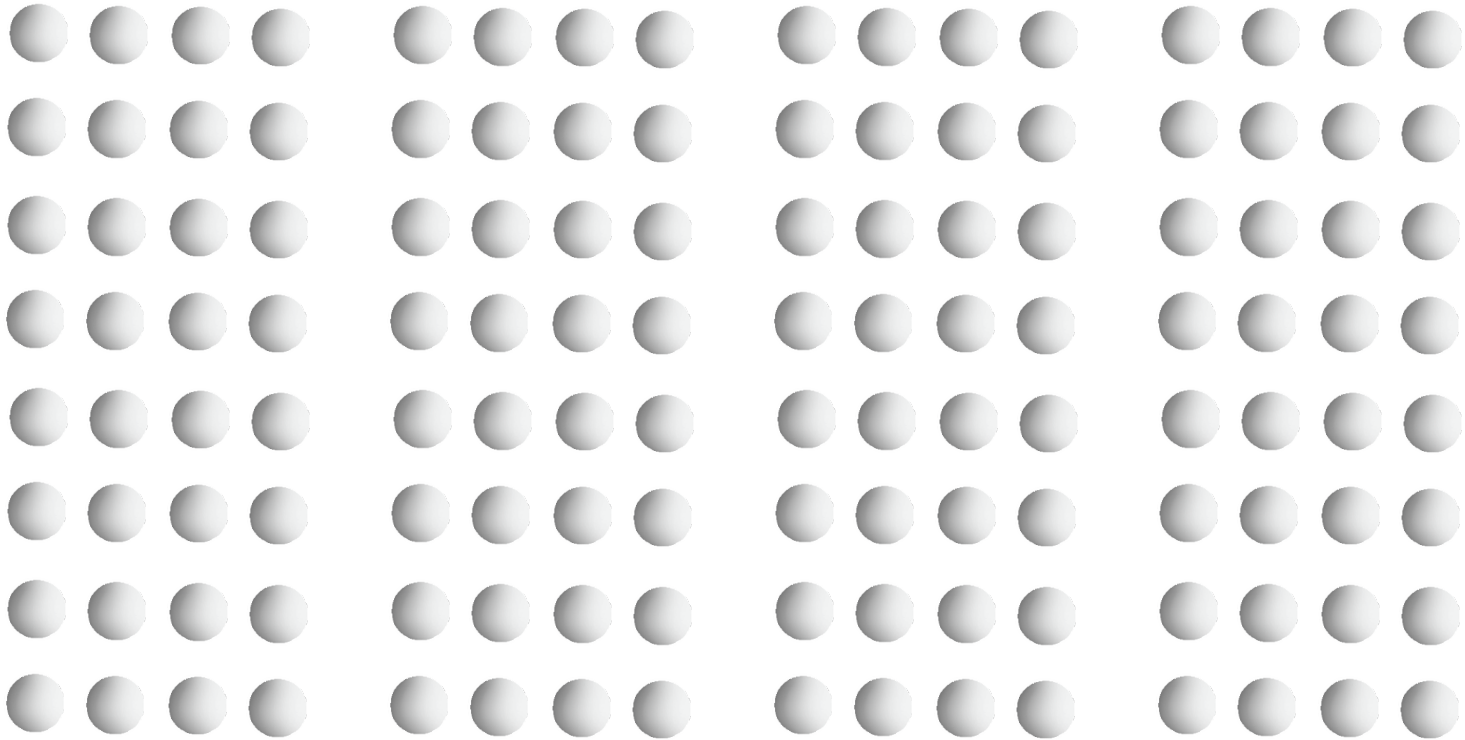
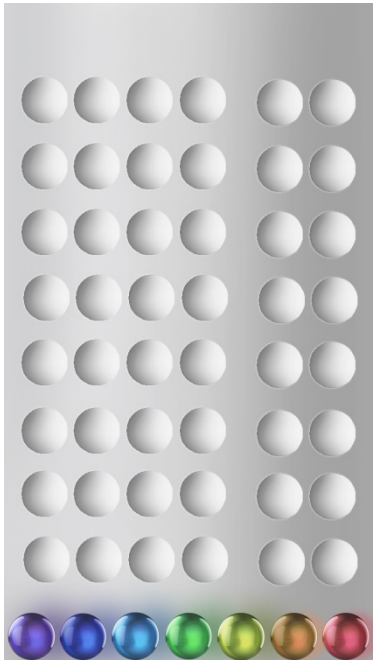
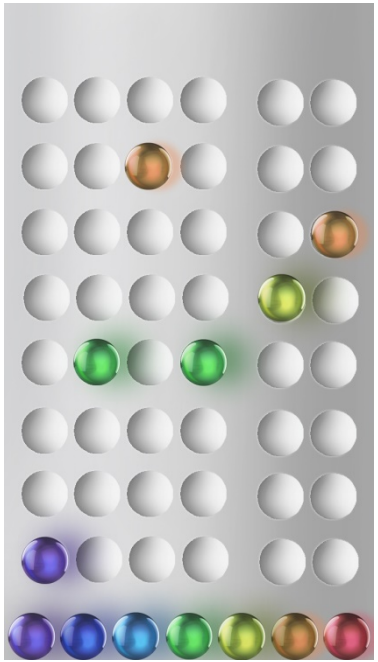
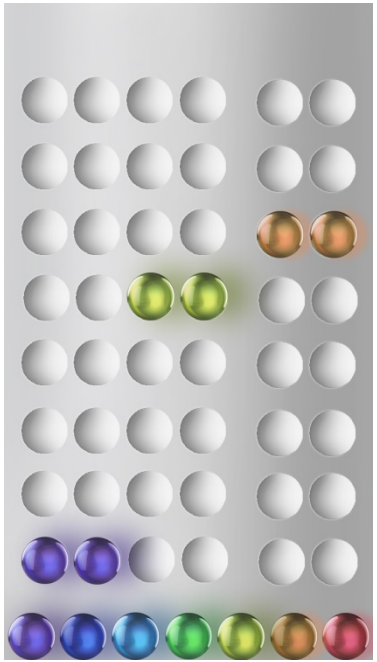
Future game extensions

Melody Construction



Since the users are reluctant to sing, melody construction exercises can not only make them learn melody in a silent way but also unleash the composers hidden in some of them.



Future game extensions

Timbre Perception

What Makes Up Timbre?

spectra: the aggregate of simpler waveforms (usually sine waves) that make up what we recognize as a particular sound.

envelope: the attack, sustain, and decay portions of a sound (often referred to as transients).

Future game extensions

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Future game extensions

Timbre Perception

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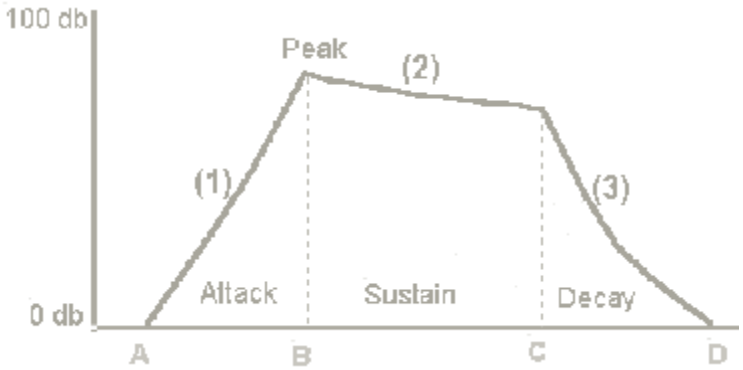
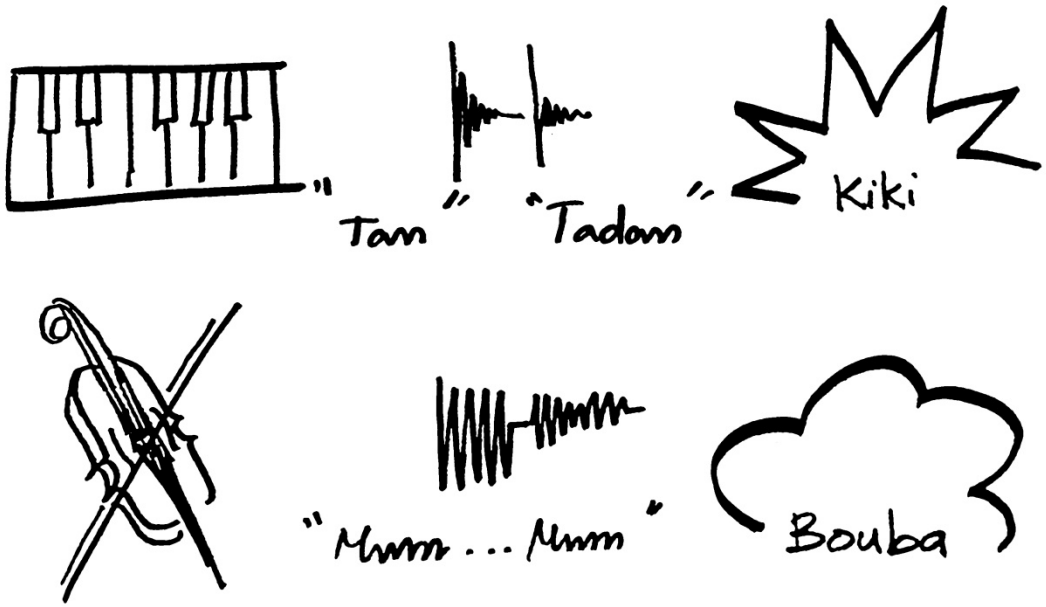
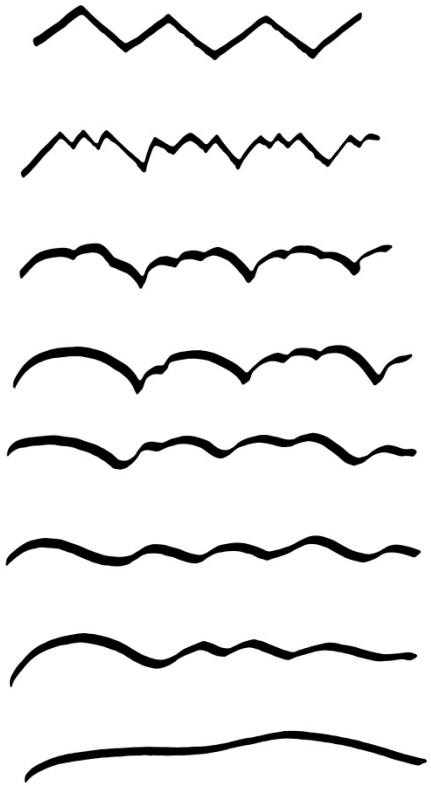
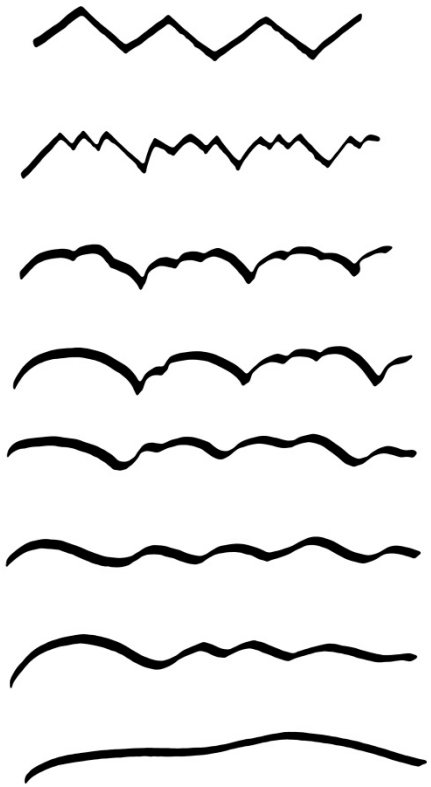


Visualising Timbre





There are a range of musical instruments
and it would be difficult even for a normal user to differentiate between all of the instruments.



4 completely different instruments were chosen for the visualization check (since designing for children with cochlear implants)

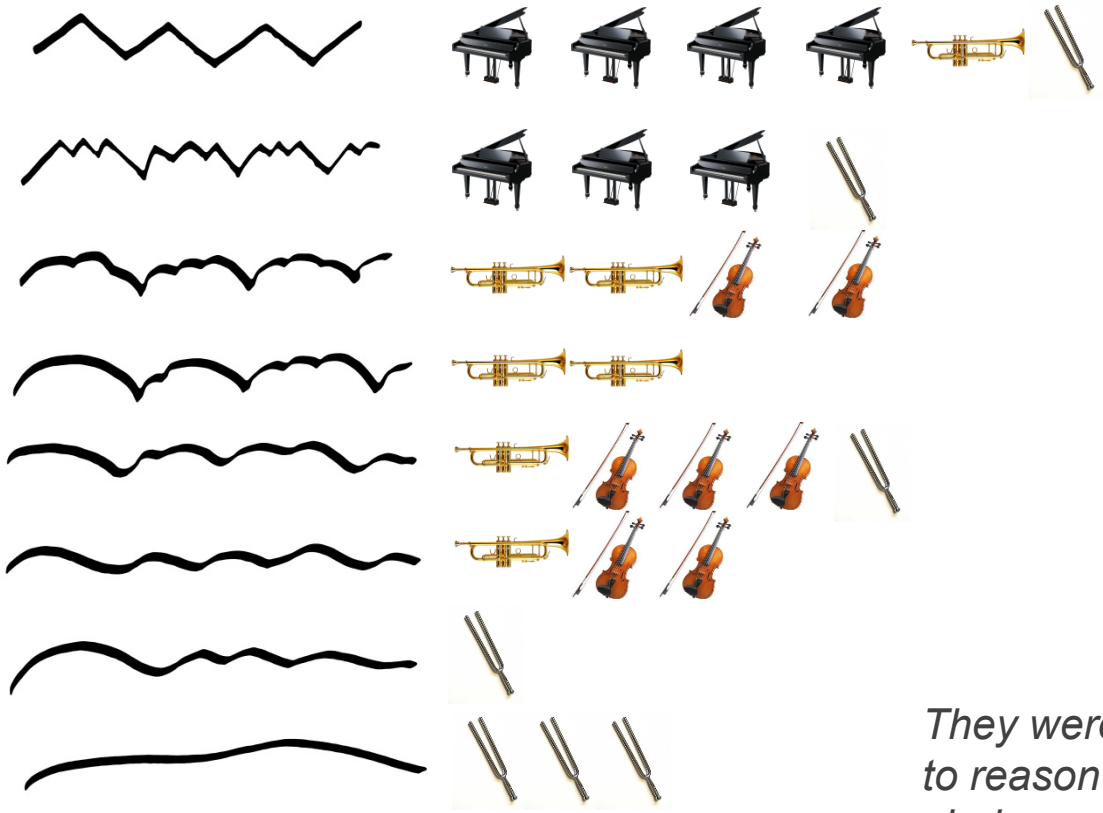
Future game extensions

Matching visuals to sound

Which music instrument?

Around 7 individuals were called and they were asked to match the 4 music instruments chosen with the many forms shown(similar to the KIKI BOUBA Experiment)..

The affinities were noted as shown.



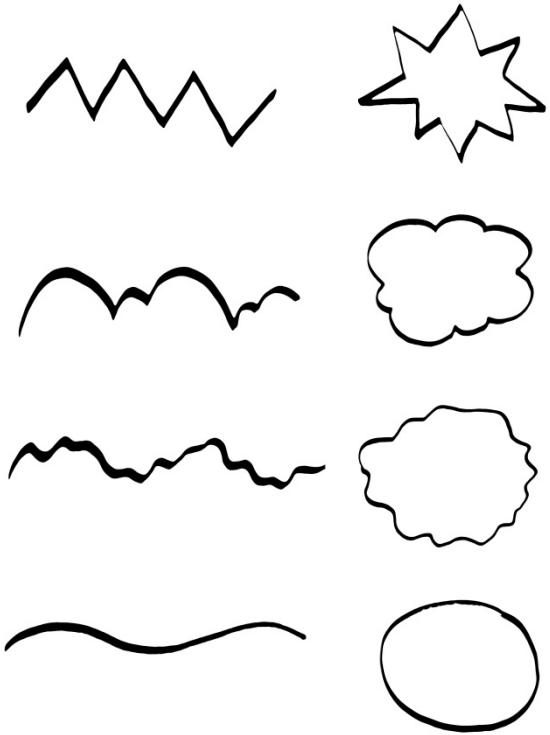
They were also asked to reason out their choices..

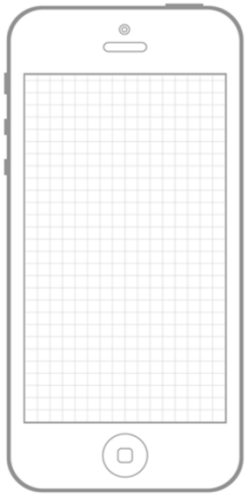
"Piano..", "abrupt", "discrete", "breaks", "sharp"…
were the words used

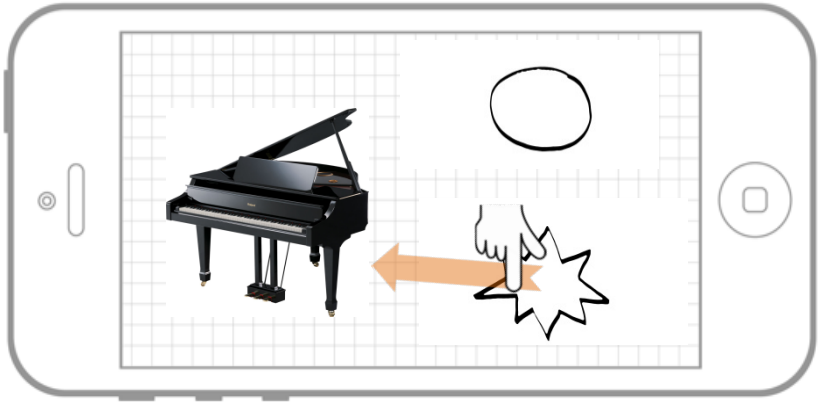
"pom pom!", "windy", "cloudy", "blowing", "bending notes"…
were the words used

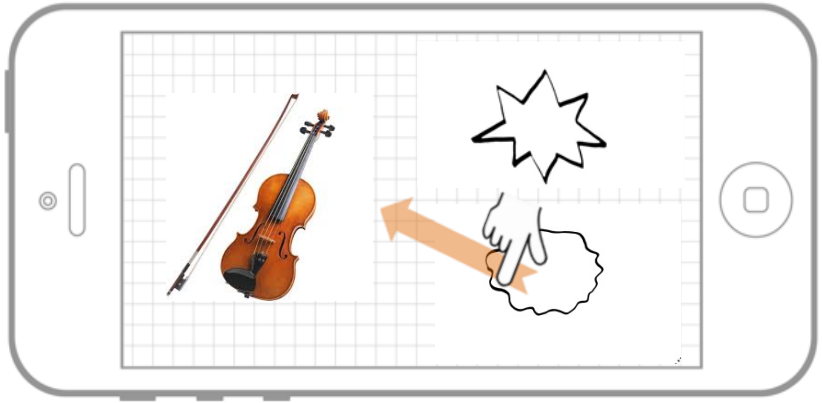
"Wavy", "flowy", "vibrating", "soft"…
were the words used

"plain", "flat", "simple" …
were the words used



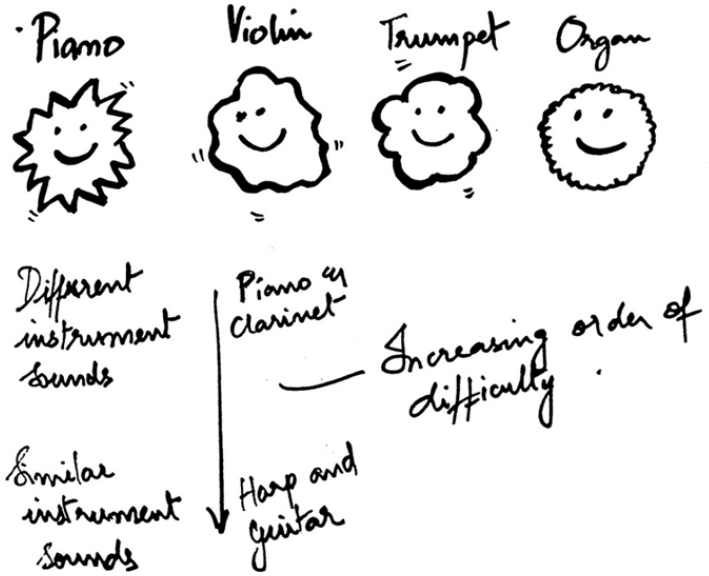


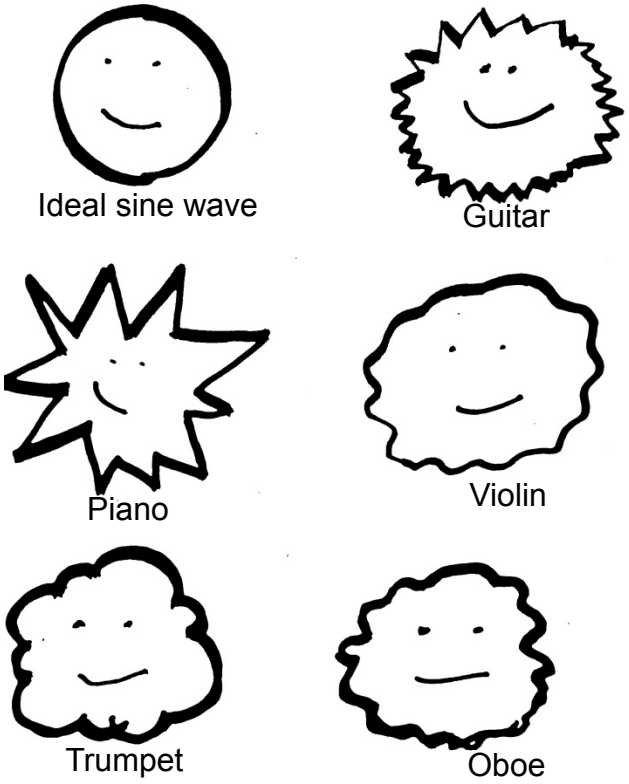




This shall give scope to designing many type of quizzes/ games etc. (Match the sound, drawing shapes etc)

Visualising Timbre



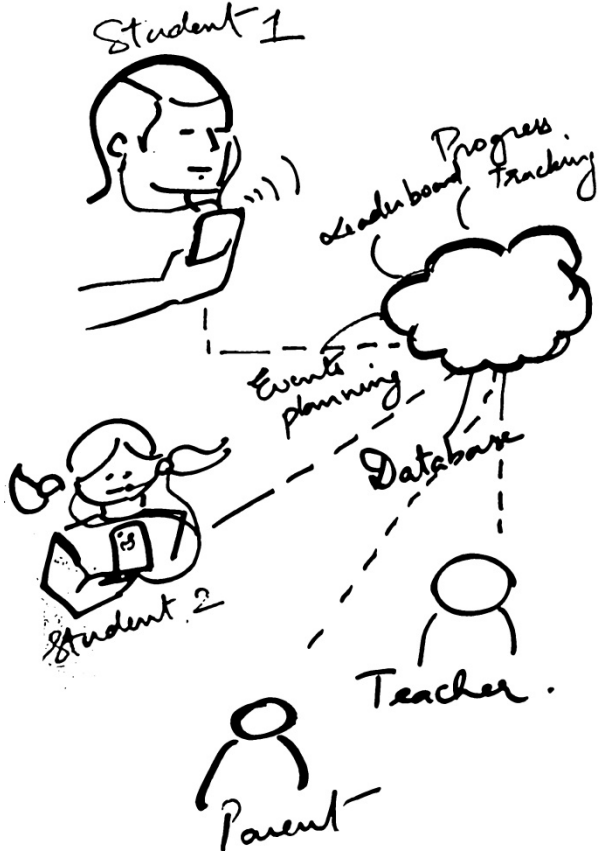


Future extensions

Scope

The virtual habilitation programme can become social by connecting other children with similar problems, parents, teachers and audio therapists.

A record of the child's progress can be maintained in the cloud and the app can be updated and personalized accordingly.



Future extensions

Other Users

Researchers have found that 1 in 20 people truly has amusia, the technical term for tone deafness. Tests have shown that some people with bad singing voices hear music just fine.

Amusics are a group of people who can’t pick out differences in pitch or follow the simplest tunes.

Though the game is intended to serve users with Cochlear ear implants, it can also benefit other users like users with Amusia/tone-deafness, music learners etc.

Thank you !

Vanakkam! ;)

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