

Calum McCarthy

Portfolio and Process Book

This will look at the process that i use to approach a design project in college (Phonics) and in work (Area22).



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Assistive Technology Design Project - Phonics

Phonics is an earpiece that helps autistic children suffering from auditory hypersensitivity. It reduces sound triggers by tuning out triggering noises of varying frequencies without interrupting their learning quality in the classroom or affecting low volume conversational noise, like the teachers voice.

Phonics was **Highly Commended in Design** in the Bolton Trust Awards and has since been shortlisted in the **top 50 in the Enterprise Ireland** Student enterprise competition, competing against 1000 applicants.

The Research Area...

Sensory Overloads

This research area was chosen as it is a topic that is overlooked in many ways:

- Many people see sensory outbursts as misbehaviour.
- It affects the educational quality for a large proportion of children.
- Children can feel ostracised or isolated

This decision came about due to a contact who works with children with special needs and had made us aware of the daily problems they face.

* This project was completed as part of a group of 4. (Calum McCarthy, **Tadhg Morrisroe, Sam Grogan and Salome Riva.**
All work that has not been completed by me will be represented with this red astrix *



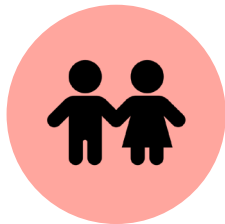
Secondary Research

Special Needs Assistance

Special Educational Needs (SEN) is defined as any “restriction in the capacity of a person to participate in or benefit from education.” Special needs assistance aims to help a child with special educational needs, this includes sensory rooms, ear muffers, and sensory equipment like weighted blankets and stress balls.



Across Ireland there are over 140 special needs schools.



1 in 4 children in Ireland have a form of special education need. This means approximately 250,000 are affected daily



Children are recommend to take movement breaks every hour and half to prevent sensory overload



Out of these 250,000, 71% attend mainstream schools meaning that they have access to less resources than attending a special school



In 2020 over one fifth of the government's education budget, which is a total of €1.9 billion, was spent on special education needs and this is only expected to increase

This means...

- Large sector with lots of space for innovation
- Sensory needs have been overlooked in mainstream schools
- Education in the classrooms has been affected - Teachers must tend to children experiencing sensory overload, and the child's involvement in class is hindered due to uncomfortable feelings of overload.
- Good possibility for investment

Sensory Disorders

A sensory overload occurs when there is an overstimulation of one or more of the body's five senses. This can affect anyone but it is very common in people with Autism Spectrum Disorder (ASD)

Daily experiences like going to school or offices can lead to a sensory overload

Different for everyone - some people may be more sensitive to sound, others may be more sensitive to noise.

Symptoms can include - the inability to ignore loud sounds, strong smells and other types of sensory inputs, a feeling of discomfort, anxiety and fear, extreme sensitivity to clothing or other textures, feeling overwhelmed or agitated, irritability, loss of focus, restlessness, and stress.

Children may cry, cover their face or ears, and close their eyes to show their discomfort

The symptoms can often be mistaken for "bad behaviour" because it can cause children to run away from situations, throw tantrums, or appear irritable and restless.

"Like I'm no longer in sync with what is happening around me. It feels like the rest of the world is moving at a pace I can't hold on to and have to let go. Then I feel like I want to escape to a safe and quiet place to calm down and relax a bit."

In order to help with this, it is important to help the child understand what is bothering them, this way they can prepare themselves and hopefully find a solution for when they experience these feelings again

Interviews



Paul - Parent

Pain Points

- Family misses out on experiences due to risk of triggers

Key Insight

Ear mufflers are not effective, as they are uncomfortable and ugly.

Movement can be an effective solution to sensory overloads.

Opportunity

A comfortable device that cuts out sound triggers while the child is engaged in activity.



Julia - SENO *
Special Education Needs Officer

Pain Points

- Students embarrassed using sensory equipment
- Minimal sensory funding

Key Insight

Students often block sound with music.
Each child has different sensory requirements.
Sometimes need to leave room

Opportunity

A way for students not to miss out on class time.
Discrete sensory equipment for children.



Mary - Teacher *

Pain Points

- Sound is common trigger
- Hard to communicate during overload.

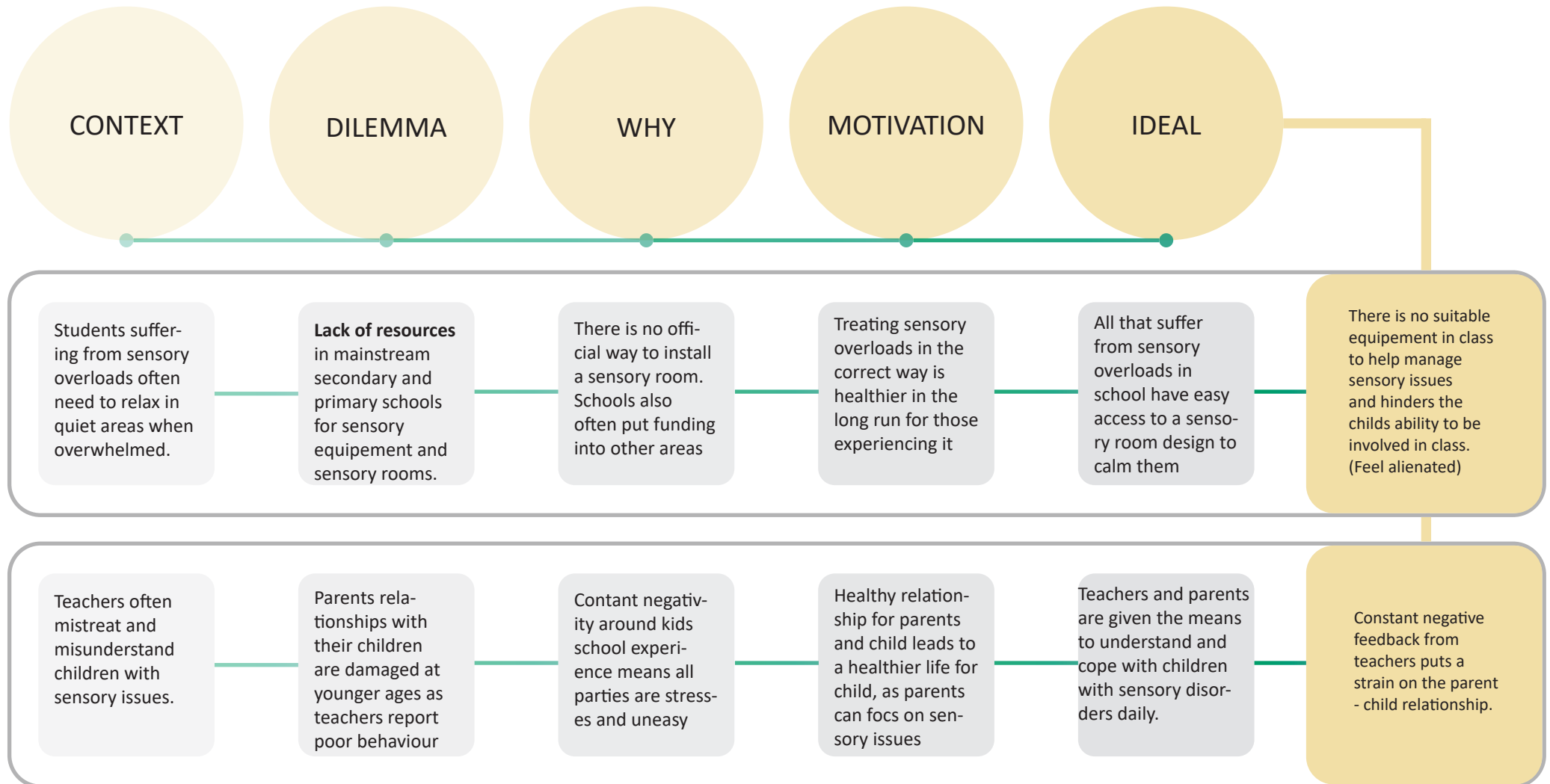
Key Insight

Avoids ear mufflers as she notices kids cannot hear anything and therefore struggle with their school experience.

Opportunity

Ear mufflers that don't hinder the child's educational experience

Insight Statements



Who am I?

Simon is a 10-year-old boy in 4th class in a mainstream primary school in south Dublin. Simon suffers from ASD and sensory disorders he finds school difficult as it is an alien environment for him, he finds school stressful and overloading. He is often singled out because of issues he can't control. His parents love and support him but are disheartened by the school's continual complaints about his behaviour when he acts fine at home.



Simon
Primary school student

Task Goals

Ensure good quality of education by ensuring Simon can participate in class
Improve the student teacher relationship preventing the teacher feeling the need to make complaints to Simons parents



Pain Points

Loud unpredictable noises in the school environment can cause Simon to feel overloaded and unable to calmly participate in class
Some current solutions single Simon out and make him stand out this, this alienates Simon from the class



Experience Goals

Ensuring Simon can seamlessly participate in class and feel more comfortable and relaxed in school

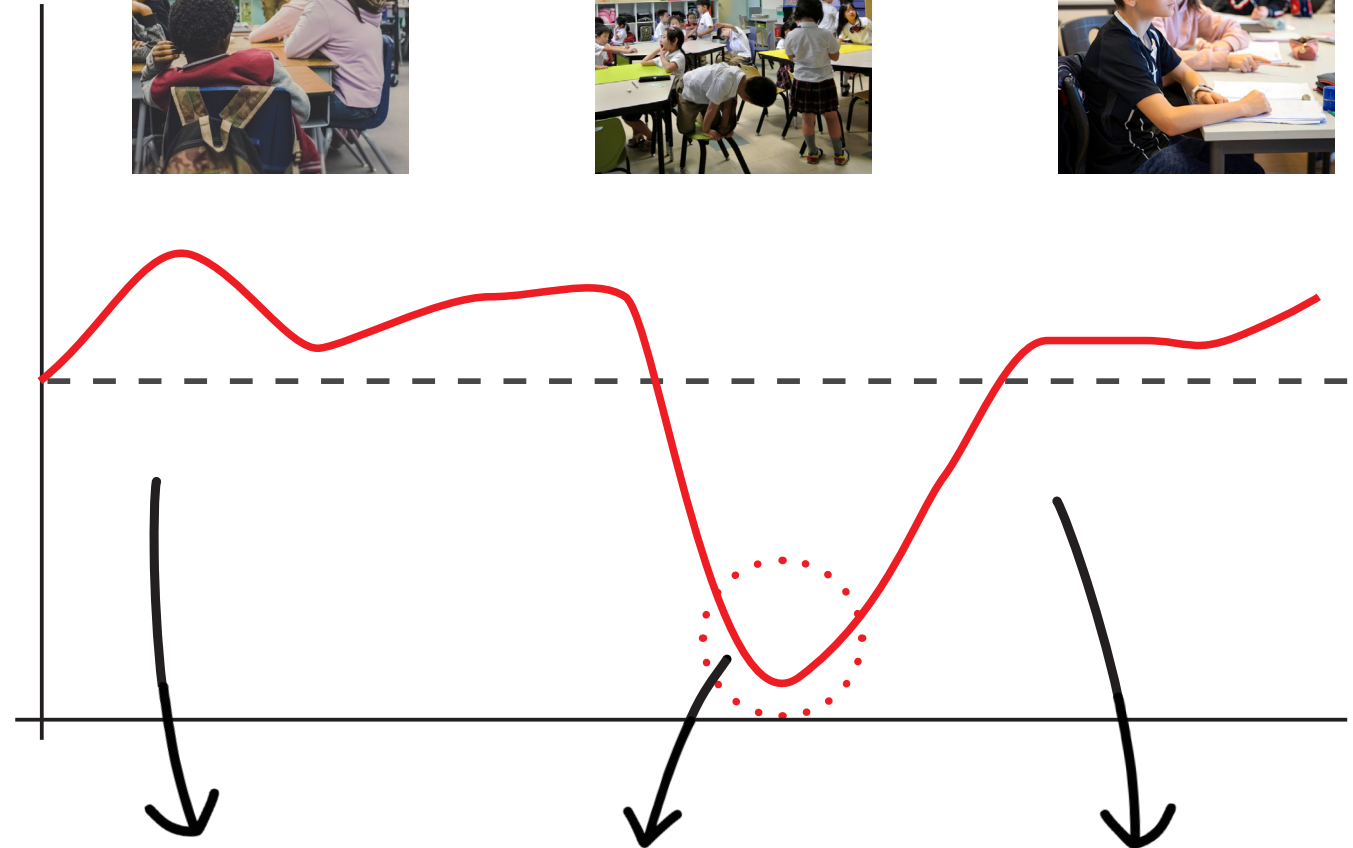


Key Behaviours

Loud unpredictable noises can cause Simon to feel overwhelmed and shut down. Stopping communication and not wanting to participate in the class
Some of Simons coping mechanism for preventing a sensory overload seem strange to the teacher and class and make him stand out



Journey map over a two hour period.



During this period the class are working quietly at their own work, Simon is in a calm environment and is getting the most out of this educational experience.

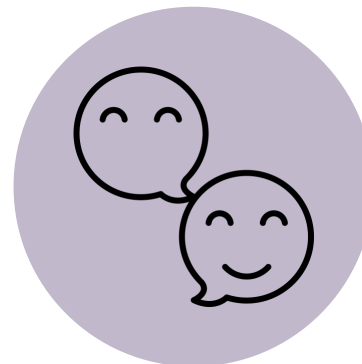
As the class moves to a new lesson some children begin to stand move about, a chair is pulled out from a desk and scraps the floor

During this period the class are working quietly at their own work, Simon is in a calm environment and is getting the most out of this educational experience.

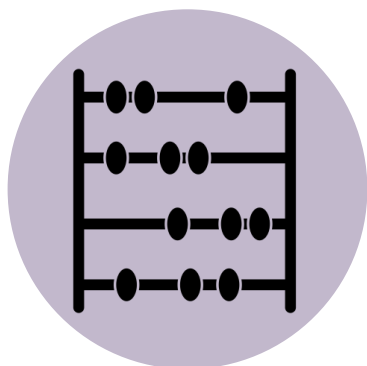
User Needs



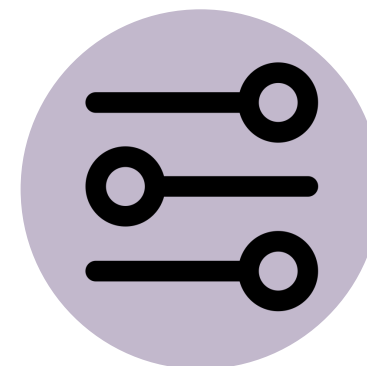
**Sensory equipment that
doesn't alienate them
from their peers**



**A way to communicate
what is bothering them**



**More sensory equipment in
school**



**Control sensory
overloads**

Refined User Needs

Simon feels

- Earplugs are more comfortable than over-ear ear mufflers due to the pressure and sweat the ear mufflers cause - they just don't do as good a job at noise cancellation.
- Ear mufflers block out all sound, it can be quite hard to hear when engaging in conversations or listening to the teacher
- Active noise cancelling devices put added pressure on his head and they trigger other sensory issues
- Current earplugs are too big and fall out of his ear
- Over-ear devices make him feel anxious and claustrophobic



Simon would like

- A product he could still use when with other people, and he doesn't have to take out when engaging in a conversation.
- A product he could wear comfortably for a longer period of time.
- A more effective, discreet earplug
- A lightweight product that didn't trigger other sensory issues

Redefined Brief

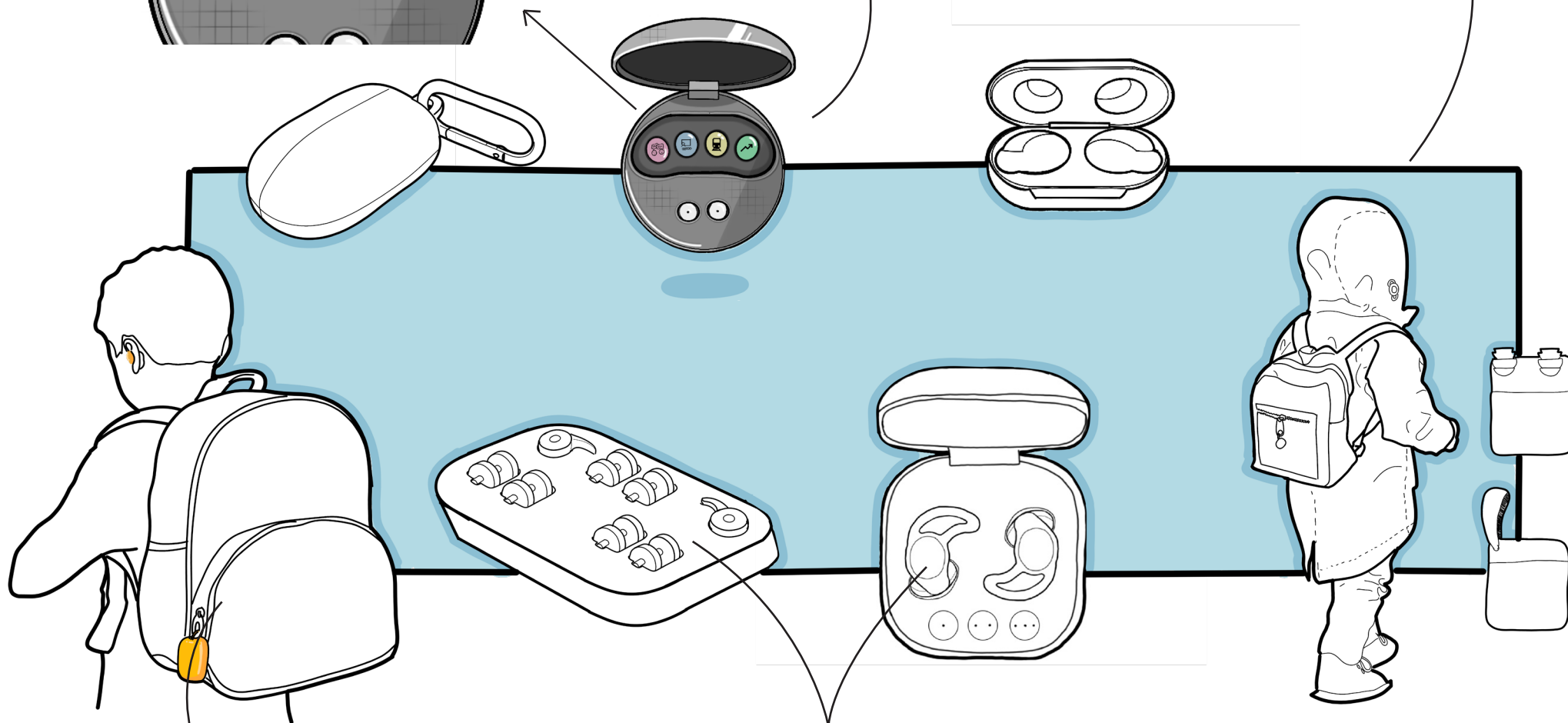
Design a discreet in-ear device which attenuates triggering sounds for children with auditory hypersensitivity.

Noise filters that can be changed into the earbud, attenuating different sounds, according to their environment



This is one of our more interesting concepts that looks to use icons to help the user know which ear tips to use in order to not suffer a sensory overload.

This concept further develops how the case could be used to help destigmatise the use of our product. Maybe it could be a stylish accessory *

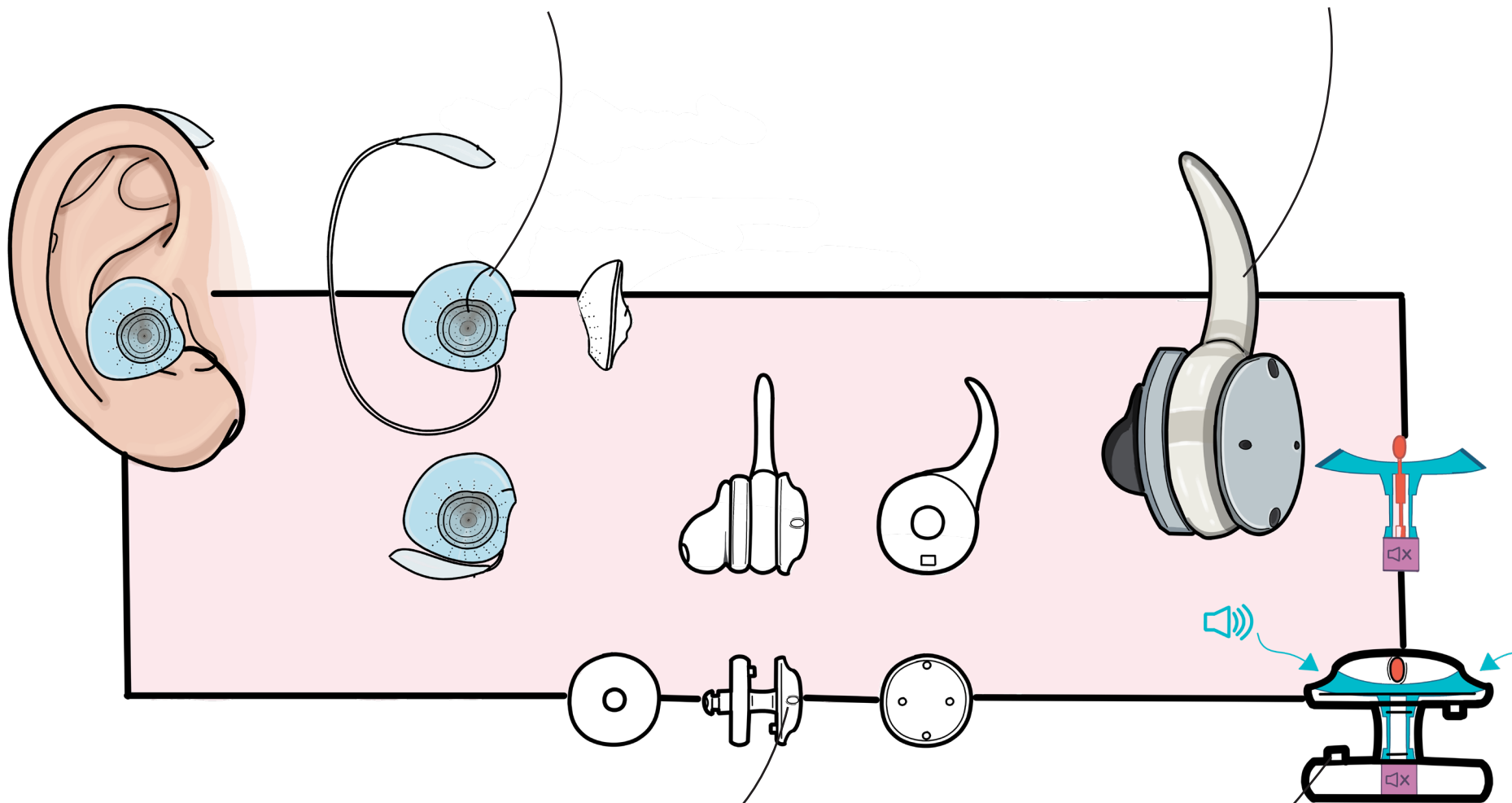


An idea that we have for the case is to ensure that it cannot be lost by the user. This clip allows the user to attach it to their school bag.

These designs look at how the user can carry their different frequency prevention inserts.

This design took heavy inspiration from a hearing aid. The main aim was to find an alternative method to hold it to the ear.

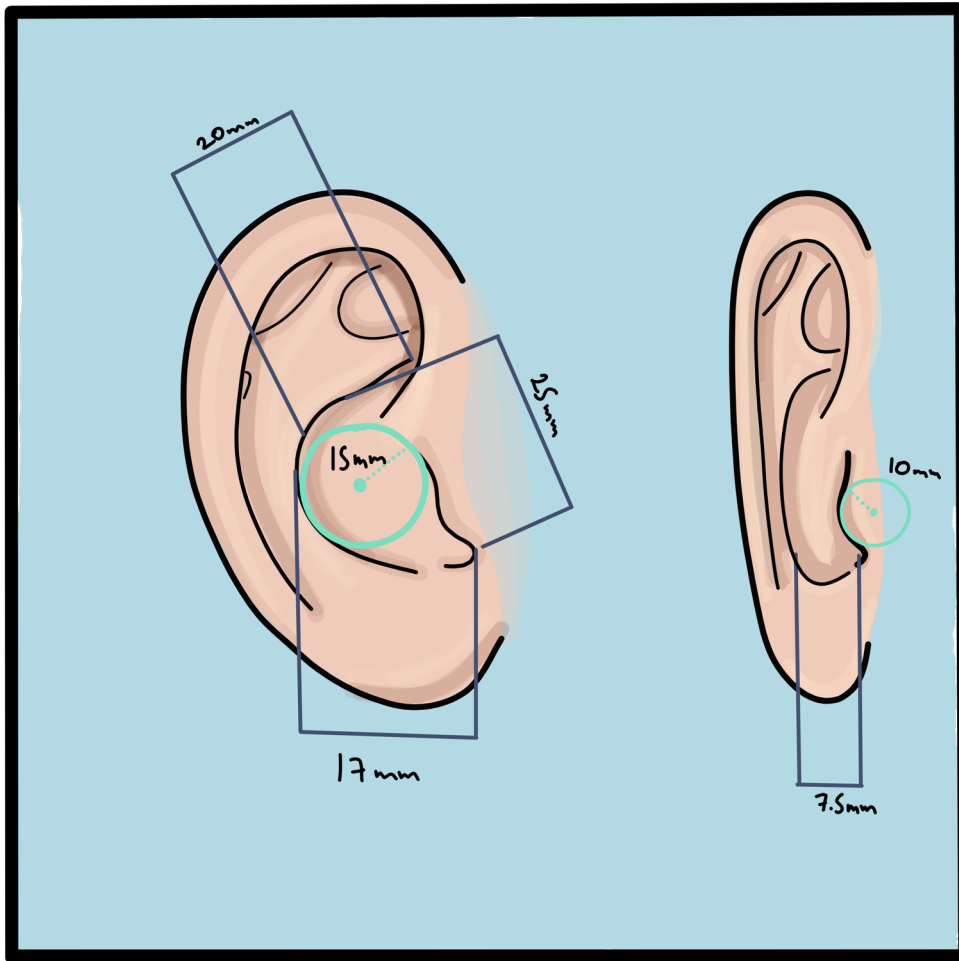
Similarly to the other design this focuses on keeping the product in your ear however it allows



This design was eloded and conceptualised further.

This design focuses on directing the sound to the ear through the use of various resonators

Human Factors and ergonomics



We measured two 8 year olds' ear dimensions along with two 14 year olds ear dimensions. We then took the average dimensions from these to try and gain a rough estimate of the sizing of our final design.

We aim to have these sizes to be fluid through different ear tips etc. To the right is a sketch which was used in order to scale the product in the ear. This helped us to visualise how the design may look before the prototyping phase.



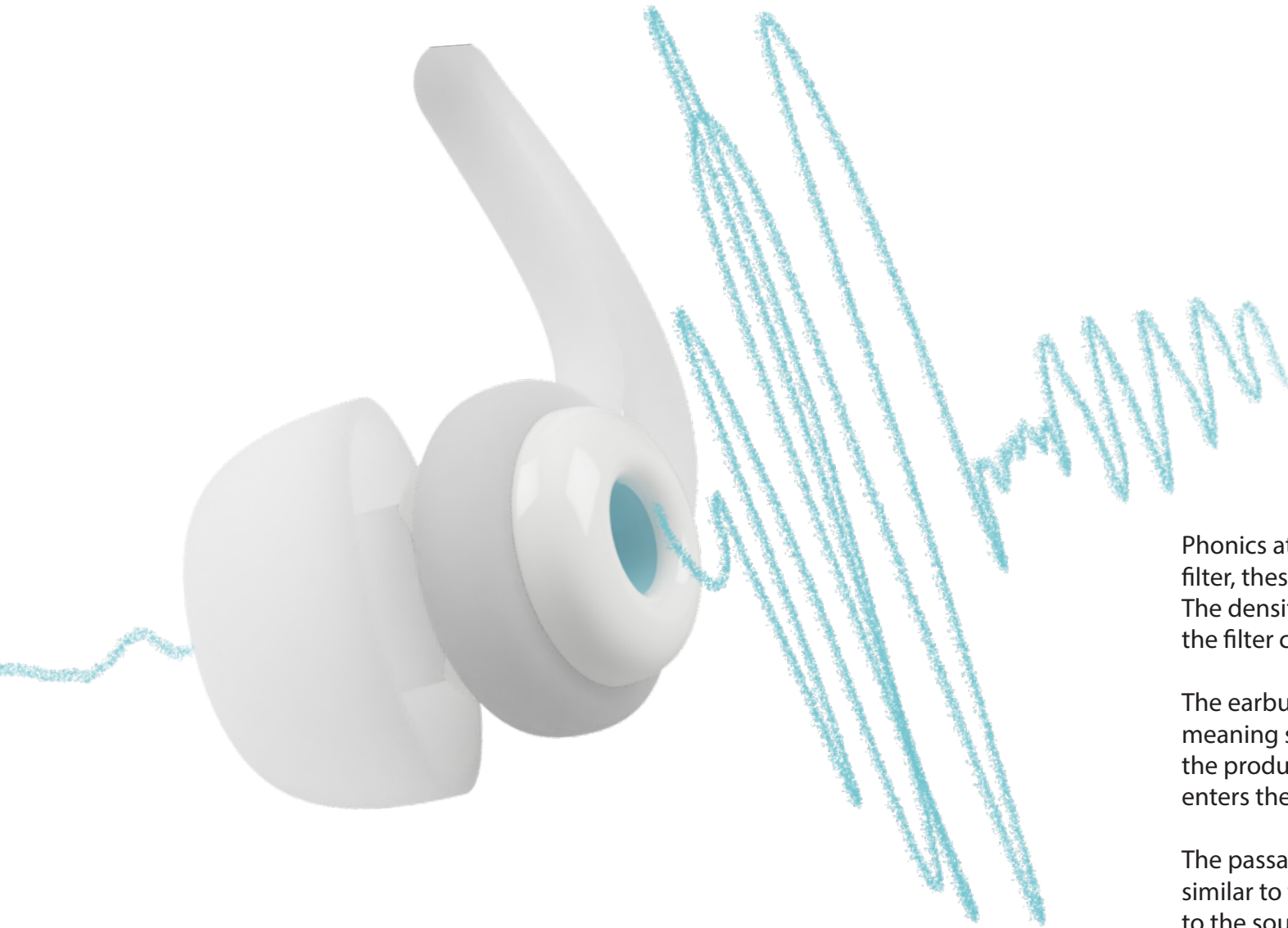
Final Concept



This is a discrete in-ear design that causes less auditory sensory issues through the use of acoustic filters. These filters are currently being outsourced in order to ensure that the production and quality of this product meet demands.

The product will come with different acoustic filters that can be interchanged in order to allow the user to customise their use of the product to ensure they have minimal effects to their hypersensitivity

How it Works



Phonics attenuates sound using a nonlinear acoustic filter, these filters are made from a diaphragmatic mesh. The density of this mesh determines what frequencies the filter can attenuate.

The earbud creates a tight seal in the users' ear, meaning sound is forced to pass through the passage in the product to enter the ear. As a result, all sound that enters the child's ear also passes through the filter.

The passage in Phonics has a resonance of 2500hz similar to that of the ear, meaning there is no distortion to the sound.

Prototyping

The final prototype was 3D printed. This consisted of a case 4 filter housings and 2 silicon ear hooks. In order to reduce costs, preowned ear tips of different sizes were used also. The printed prototypes were hand-finished and painted. Although it was not a functioning prototype it allowed the user to interact with the product and confirmed that the correct sizing of the product from the human factors and ergonomics studies.

Our test user found the product comfortable in the ear and easy to take in and out. He was happy that they did not stand out like his current ear muffers and he confirmed that he felt less self conscious using them.

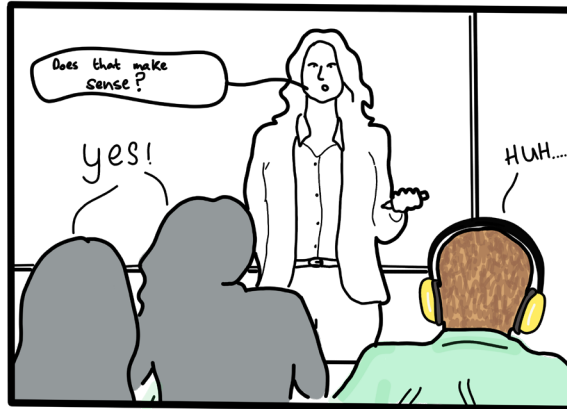
If there was more time to work on this project further prototyping would be explore, potentially testing other shapes and designs that may suit the user more accurately.



Storyboard



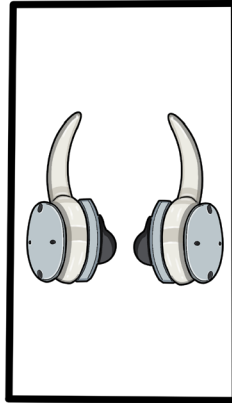
With no aid Simon suffers from a sensory overload



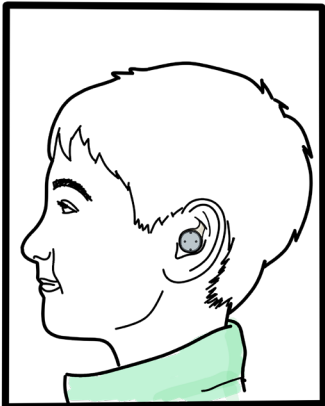
Simon tries ear muffs but struggles to hear the teacher or his friends



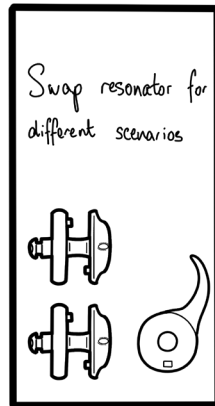
His parents are being told over and over that he is not listening and it takes its toll



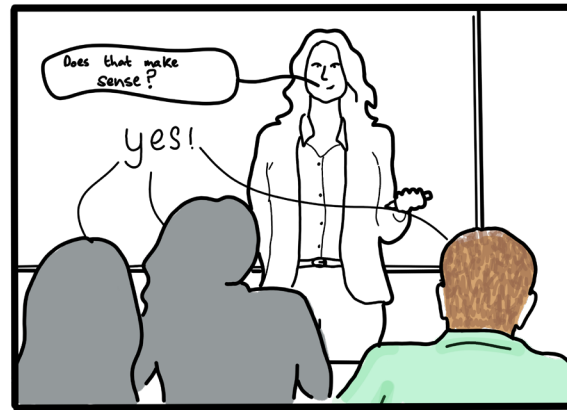
Introducing Phonics



Simon no longer has to wear large headphones during class time



he can change the attachments depending on how sensitive he feels



Now he can listen in class without a problem.



Simons relationship with his parents has improved greatly

User Interface Design - Area22

What is Andy and Area22...

Human Centred Design

Andy is an artificial intelligence assistant that helps its user reach their viewing content in a faster, more accessible fashion, by learning from the user's personality and mood. Doing this allows Andy to identify the users tastes, likes, and dislikes, allowing Andy to give the user more accurate and consistent content as it learns more about its users.

The app is currently still in its early development phase; however, the technology has since been adopted by Tellus in Canada and a TV version of the app is now in development.

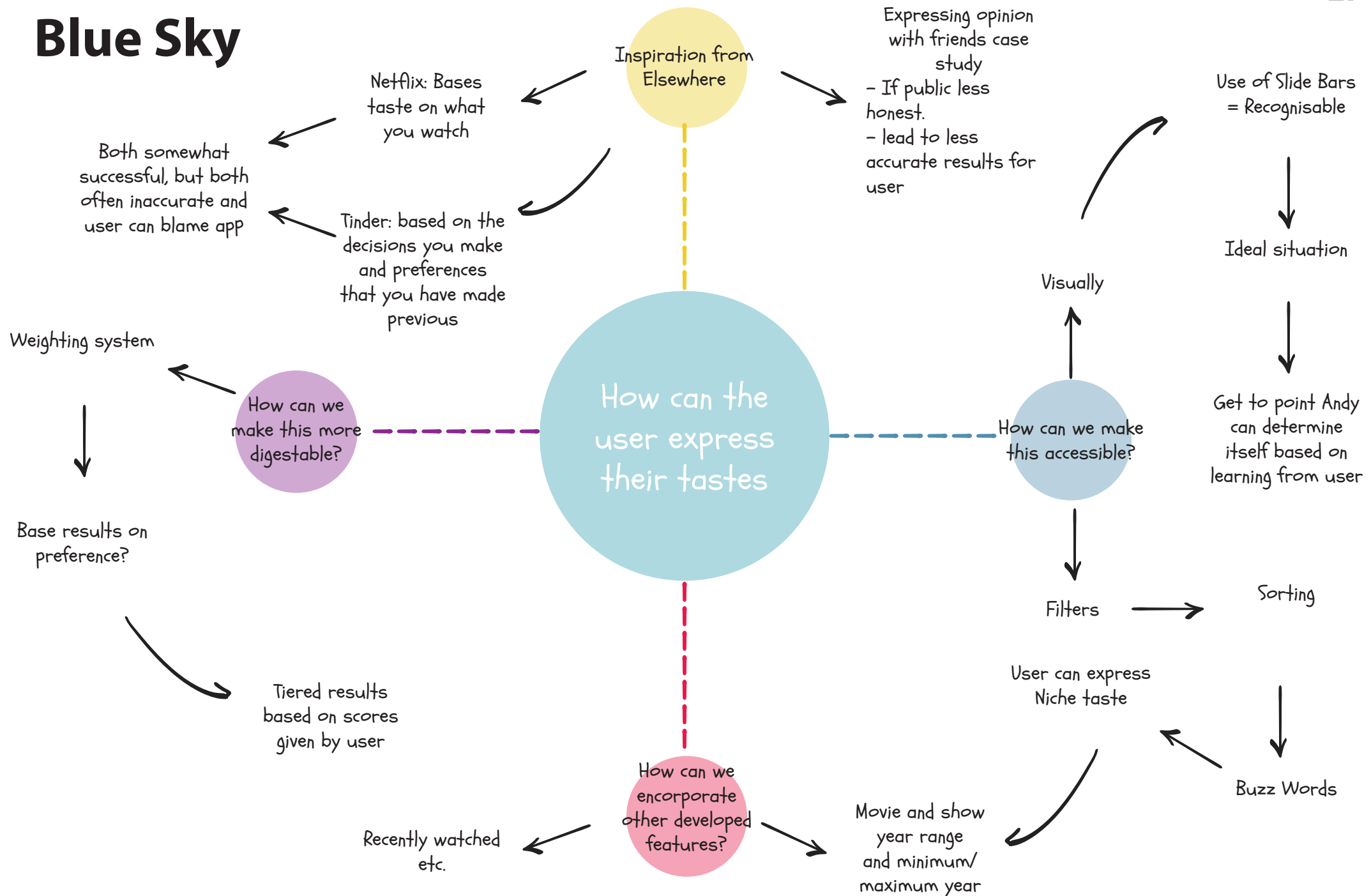
Throughout the process it has been a vital point to understand the user base, what they want from an app like this, and how they might want to interact with it. This has led to some very interesting explorations and feature developments.



**How might the user
express their tastes in an
accessible and digestible
fashion?**

Secondary Research

Blue Sky



Interviews



Jack - Student

Pain Points

Still haven't figured out how to control what shows netflix shows him.

Key Insight

Lack of accessibility and control lead to longer times spent for liam to consume content.

Opportunity

Give the user more control over their tastes through a potentially physical location within the app.



Liam - Student

Pain Points

Has very niche tastes depending on time of day and what's going on around him.

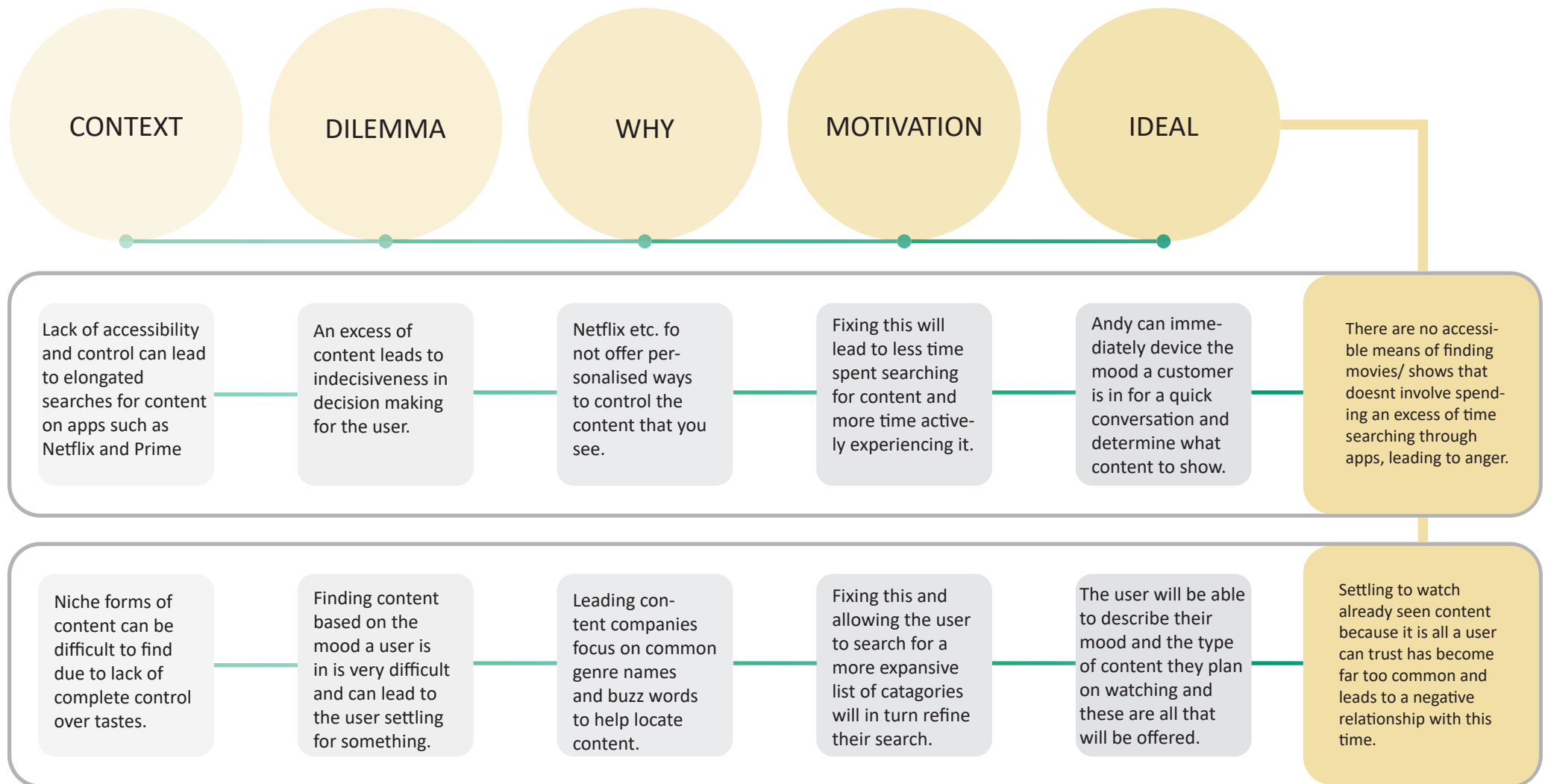
Key Insight

Liam often feels like the content that he knows he wants to watch is not readily available to him.

Opportunity

Give the user the ability to adjust their niche tastes as according to their mood. This could lead to more accurate content retrieval.

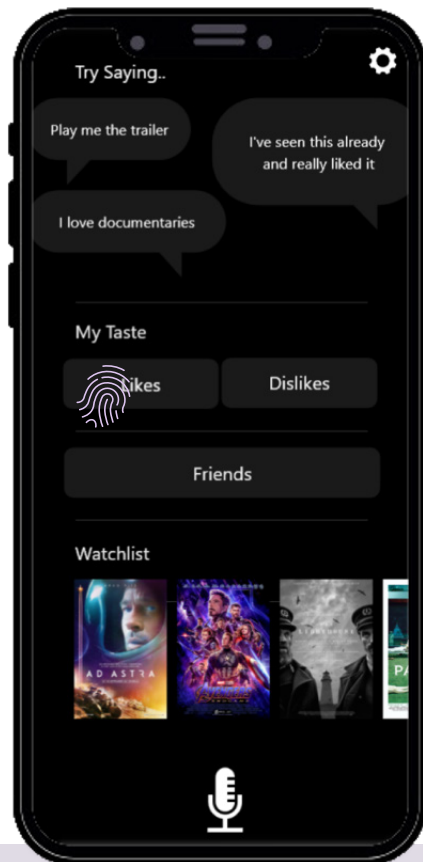
Insights Statements



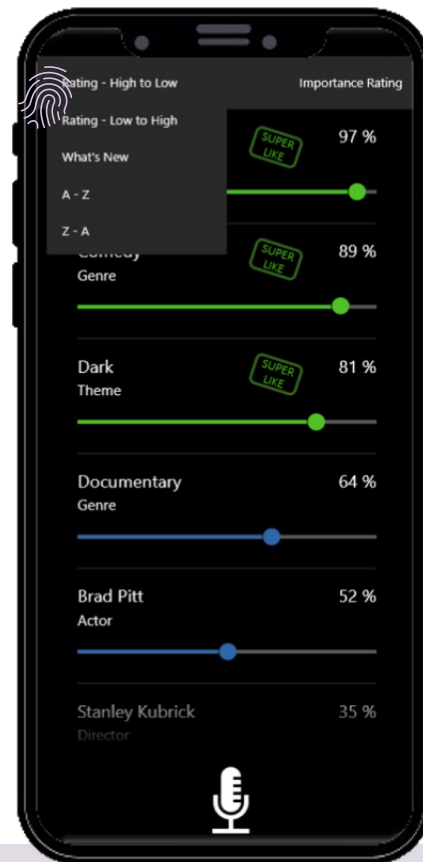
Feature Development Process

Wireframing

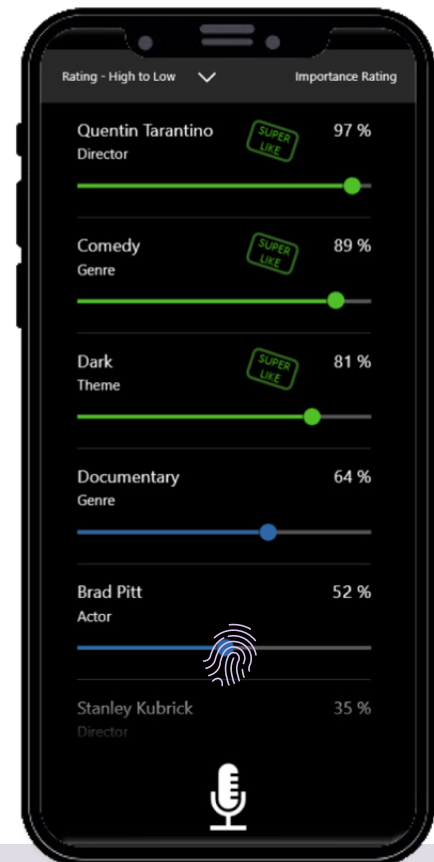
*Wireframing through XD



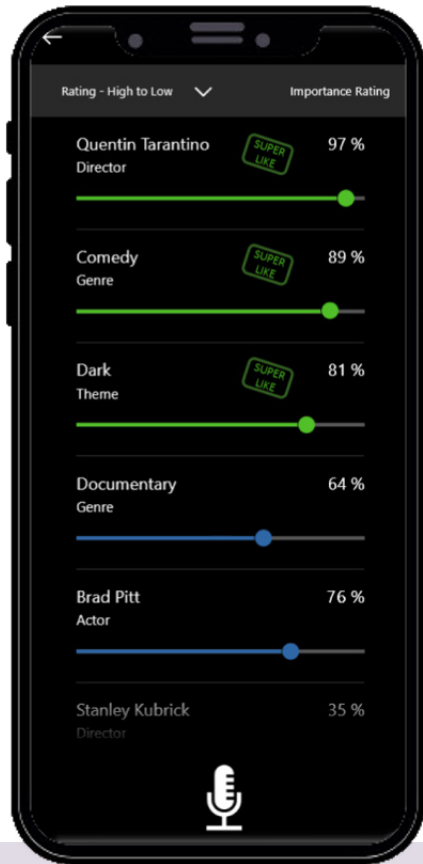
Access Tastes from home screen. This is divided into likes and Dislikes allowing the user to ammend these are their own will.



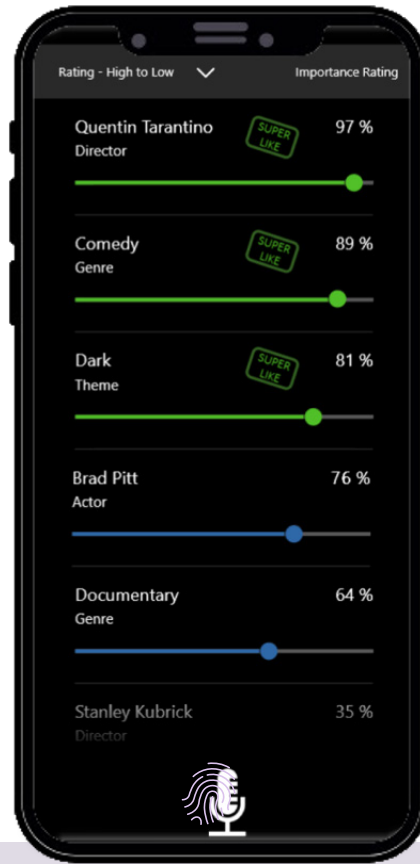
User can sort these buzzwords based on alphabetical order or rating.



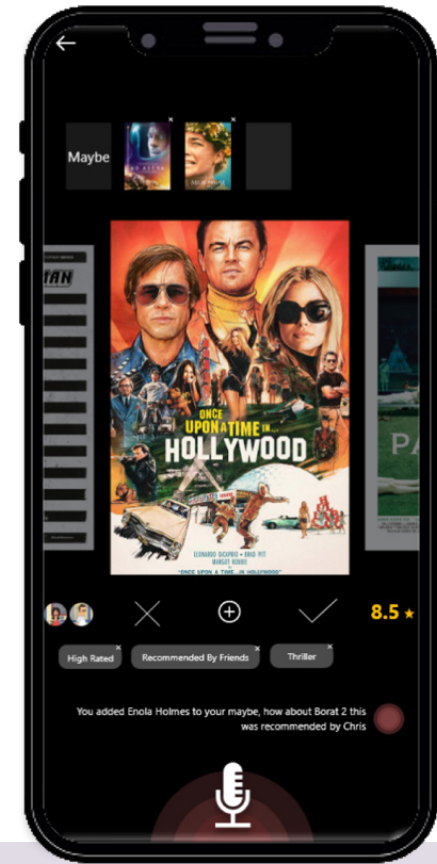
Drag the slider up or down to change your thoughts on an actor, genre or sub genre.



By dragging the bar the user will change the percentage for this bar. 100% is super like while 0% is never show.



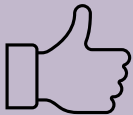
This will rearrange the order and allow the user to begin their search for content with Andy now having learnt from their changes.



User can search for their content. If it is not as expected the process can be completed.

User Testing & Feedback

We run all features through a rigorous testing system in order to realise their best forms. Currently this is done with family and friends as this is still a small start up. A briefing of what the feature is is given to the test group. They are then given time to use it and report any confusion they may have had. These are then filtered and addressed accordingly.



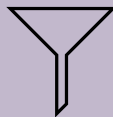
No need to split up the likes and dislikes section as this creates extra steps



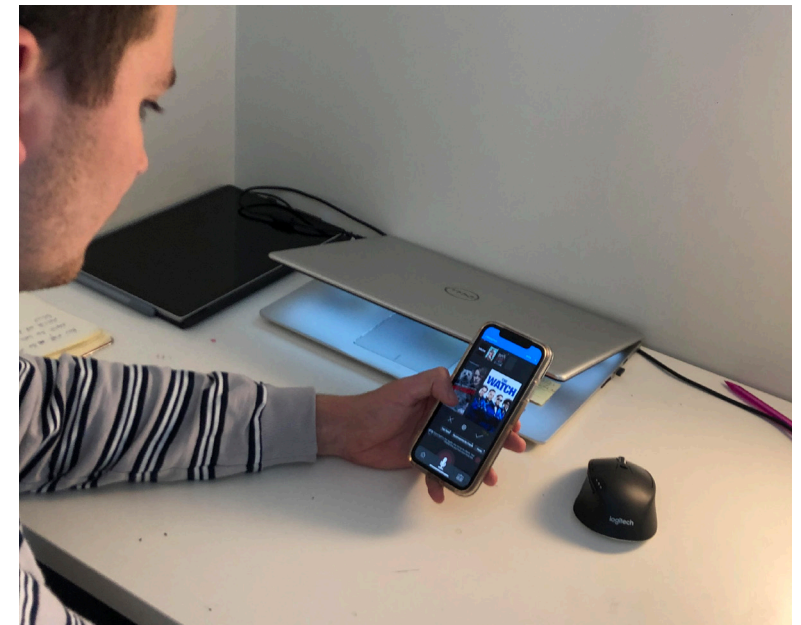
Include buzz word search



Include features that are shown elsewhere in app such as minimum rating or year range

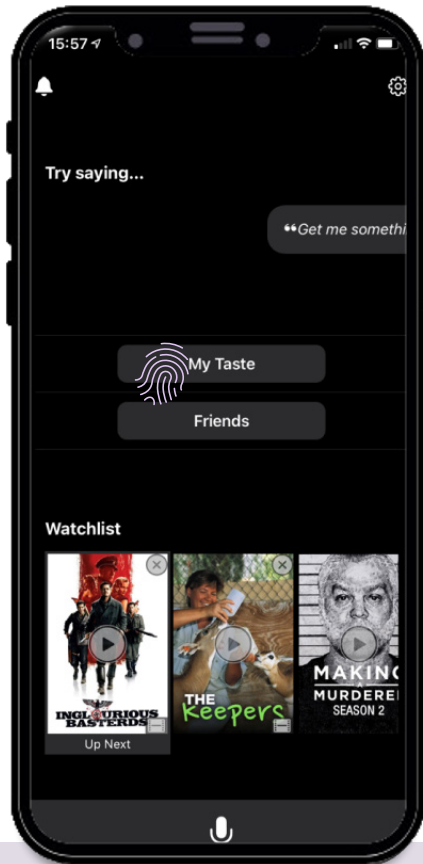


Allow for topics to be removed from list through filter system.

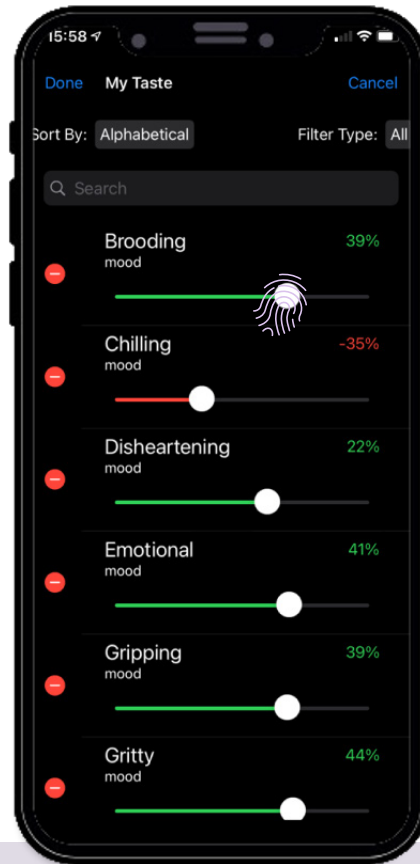


Final Outcome

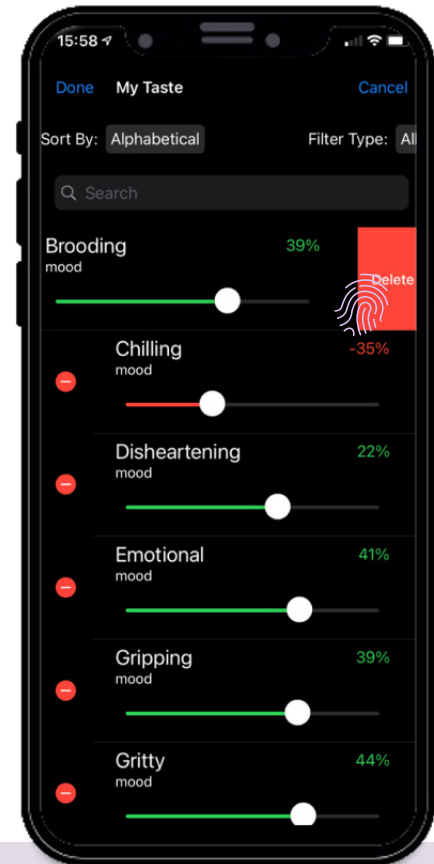
*Screenshots from Andy app



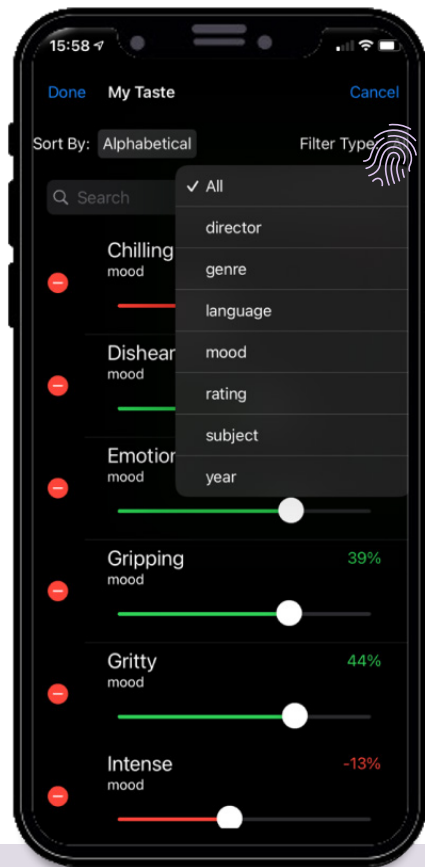
Access Tastes from home screen. TNo longer divided into likes and dislikes, making it more digestible.



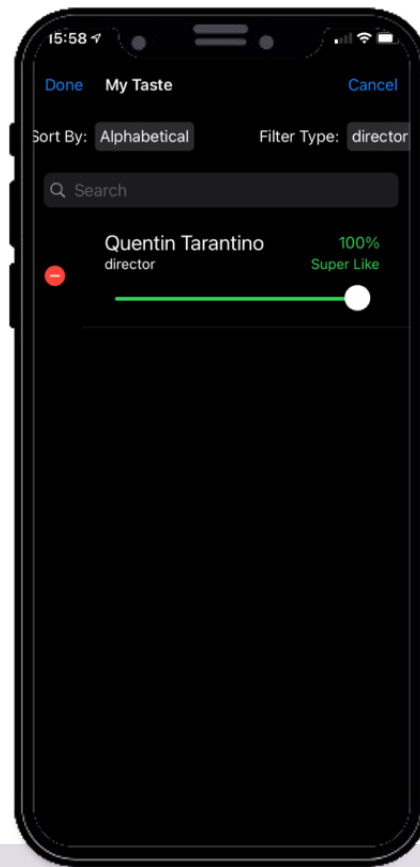
Change all ratings, now from -100% to 100%. Search bar has also been added in.



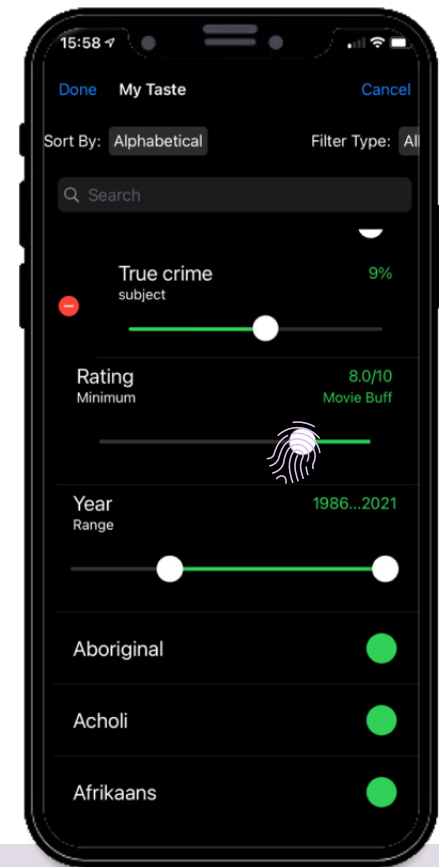
Slide taste to left to delete.



Access filters to allow for more digestable consumption of content. This is divided into director, genre, language, mood, rating, subject and year.



Filtering will only show you the taste that you have previously added to the list, to prevent a build up of clutter and confusion.



Added features of rating and min to max year bars.

Other Projects of Interest

Service System Design

This was likely one of my most enjoyable design projects as it was the last before Covid. It was also the first time i got to really engage with the user.

The idea was to design a manufacturing process for those that have a minimal skill base but want to make woodworked products to a high standard for sale in the WeMakeGood store. The users would be those working at Pace, a social enterprise.

The system that was designed was one focused on using 3D printed jigs(1), clear intruction manuals (2) for each machine that was to be used and how each part needed to be cut and finished. It also included a clear quality control checklist (3) for the supervisor to follow.

Step 1 Cutting List: One unit of Output - x4 (300 x 40 x 20) - x2 (200 x 25 x 20) - x1 (210 x 210 x 20)		Step 2 Using Jig 1, add both of the 6mm holes to each of the legs. Use a the drill press so to keep holes straight. Not depth stop is needed as holes go through.		Step 3 Using Jig 2, add the curves to the end of the leg with the holes have just been drilled. This can be done by using a belt sander or a table router, if using	
Step 4 Mark cross joint onto each of the (200 x 25 x 20) pieces. Using the table saw, set the blade to base of the cross joint and make multiple cuts.		Step 5 Using Jig 3, add all 4 6mm and 20mm deep holes to each cross joint. Using a hand saw and visual depth stop, drill holes while part sits in vice.		Step 6 Line out circle on (210 x 210 x 20) piece and cut of corners using band saw. Using overhead router cut 200mm circle out	
Step 7 Using a handheld router and a chamfer bit (30 degrees) complete chamfer around top of the circular top. Ensure this process is not rushed.		Step 8 Attach Dowels and fit all pieces together. Begin sanding down each part with 180 grit sand paper moving up to 220. Add glue and clamp accordingly, ensuring		Step 9 Once glue has fully dried final finishing can take place. Using and all wood natural teak varnish and a handheld cloth apply liberally. 3 coats should	

(2)

Glued Joints

Ensure that there is no visible glue residue at dovelled joints. If and joints look like this then it does not pass the quality check.



Chipped Wood

If there are any areas in which the wood has been chipped, scratched or damaged in any other way this must be scrapped for a



Cross Joint

The cross joint must be flush with the cross joint in which it sits into, there cannot be any visible extrusion, otherwise this part needs to be fixed.



Circular Top

The circular base must sit flush with all the legs. a tolerance of 0.5 mm is acceptable. However if the circular piece sits at an angle



Finishing

If any components have visible drips that have dried this component cannot be used. the use of Painters Pyramids will decrease visible



31

(3)

1. On the edge that has just been sanded fit this jig on ensuring it is sitting flush with all edges.	2. Using a 6mm drill bit, drill completely through the leg twice, once through each hole in the jig.	3. This will be completed 4 times.	1. Chose Base of circular top.
2. Using a 6mm drill bit, drill completely through the leg twice, once through each hole in the jig.	3. This will be completed 4 times.	1. Fit Jig on only the bottom beam	2. Drill, with a 6mm drill with depth stop 15mm.
3. This is drilled twice per unit	1. Fit the jig on each end of cross beam.	2. Drill with a 6mm drill bit, using depth stop of 10mm.	3. Used 4 times/ unit.

(1)



Design for Manufacturing

A project that I worked on recently was to design a pannier rack that was made from plastic. This was one of the more difficult projects as it had to be ready for manufacture. Therefore it meant exploring many new routes that I had not done before.

I had to find ways to minimise the material use in the design while ensuring that the strength of it was not effected. This meant to use of ribbing and numerous stress tests through fusion to ensure that the product remained within a 3.00 factor of safety.

In order to ensure a more realistic design I had to find a way to make the rack symmetrical so that only one mould would need to be used.

I had to design snap fits that worked in conjution with the design of the product and the injection moulding expectations. This entire process changed the way that i look at projects as I ended up having to restart my CAD multiple times.

Finally i had to ensure that the drafts of each face were compatible with a mould, along with the inclusion of potential ejection pins and split lines.

