
Task 1: Research report

Thomas Brettell

480361110

Tbre2522

Abstract

As private companies from around the world have started to invest in space travel and looking to make it viable, there is more of a need for UI (user interface) designers to design and develop solutions for this widening market. A major problem area that needs to be addressed is the prevalent and severe mental health concerns faced by the future users of interplanetary modes of transport. An online ethnography and a competitor analysis were used to generate insights into this user groups needs and issues and determine gaps and opportunities in the market. Through the insights that were discovered, personas were created that embodied potential users and the problems they may face. Kees Dorst Frame Creation Model and story boarding was then used to ideate potential concepts that could address these user's needs.

Introduction

Space travel involves the act of journeying beyond Earth's atmosphere to elsewhere in the physical universe. Since Yuri Gagarin became the first man to go to space in 1961, 575 individuals have been to outer space, 24 of whom have also travelled to Earth's closest astronomical neighbour, the Moon (Zelazko, 2020)(Wall, 2019). These numbers are very small as

the current state of space travel is largely inaccessible due to the massive cost of space ventures, limitations on the necessary technology and the high-risk factor involved (Holmes, 2018). Due to this, out of the small number of people that have been able to travel into space, the vast majority were professional scientists and engineers. The few general public 'tourists' that have gone, had to pay astronomical amounts of money for the opportunity (Pelt, 2005).

After the space race in the '60s between the United States and the Soviet Union, funding for space travel was given less of a priority, slowing the development of space technology and achievements but recently, private companies and government agencies from around the world have entered the space industry to research, design and develop solutions to problems facing human space exploration (Extra Credits, 2019). There has been a surge in the launch of privately funded space programs such as SpaceX, Boeing, Virgin Galactic and Origin Blue, creating a potential new 'space race between billionaires' which is estimated to grow the space travel industry to approximately \$20 billion USD by 2030 (Sycheva, 2020)(Sheetz, 2019). Additionally, as opposed to during mankind's initial ventures into space, space travel is now an international interest as countries from all continents of the world have begun developing space agencies (McKie, 2020). This new funding and research opens up the possibility of achieving aspirational leaps for space travel in the near and distant future. These

improvements on existing areas and potential establishment of new ones increases the importance of UI (User Interface) designers to design intuitive and useful concepts for an expanding and emerging pool of users.

This report documents a user-centric design process being utilised to fulfil a brief of *designing for space travel*. Preliminary background research will be used to understand the context and discover a problem area. User-research methodologies of an online ethnography and a competitor analysis will be used to gather necessary data on user insights through analysis of the relevant communities, markets and competitors. These insights will be used to create personas which embody the discovered users and what problems they may face. The ideation techniques of Kees Dorst's Frame Creation Model and storyboarding will then be used to assist with the development of ideas and potential concepts. The aim of this process is to design and deliver a prototype of a potential screen-based UI which will act as a solution to the problem area.

Background Research

Interpretation of the brief

The design brief which was assigned had the task of designing a prototype screen-based UI for a problem facing space travel. The application needs to address a potential problem area facing users during the pre-trip, mid-trip or post-trip stage of the space travel experience. This problem area doesn't have to be one that currently exists, it can be for an area which modern day space organisations predict will be necessary in the future.

Discovering the Problem Area

The initial steps that were taken was to become more familiar with the context of space travel and the current and potential future process that is involved. This was done in order to narrow down the problem area that the design will take place within. This context is incredibly broad as the future of space exploration could take many forms as space organisations design and develop aspirational missions and programmes.

The United Arab Emirates National Space Programme aims to contribute to sustainable interplanetary settlement by building a city on Mars in the distant future of 2117 (see Figure 1).



Figure 1: Digital concept art of Emirates city on Mars (Mohammed bin Rashid Space Centre, 2019).

SpaceX also has a plan to get humans to Mars using an innovative procedure of refuelling the passenger ship after launch using a second ship (SpaceX, 2020). This procedure is necessary to ensure the ship has enough fuel to make 255 million kilometres to Mars, especially since it takes a lot of fuel to break out of Earth's'

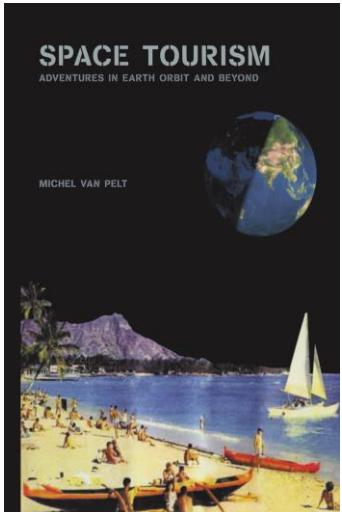


Figure 5: Cover of Michel Van Pelt's *Space Tourism: Adventures in Earth Orbit and Beyond* (Pelt, 2005)

atmosphere. Figure 2 shows an infographic visualising this travel process.

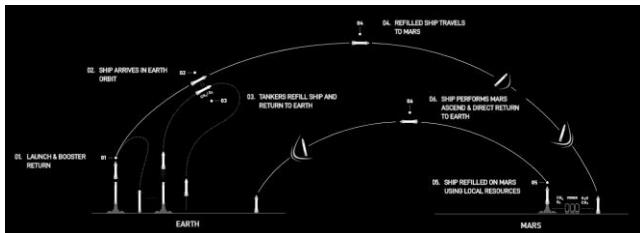


Figure 2: Modified infographic communicating SpaceX's travel procedure to transport people to Mars (SpaceX, 2020).

Orion Space has developed a program to allow individuals to go on a 12-day holiday to a 'Space Hotel' orbiting Earth that is planned to launch in 2021 (see Figure 3). It will involve a 3-month training period. The theory component will be completed via the Orion Span Astronaut Certification app or website. The physical component will be conducted at a Training Facility where the user will learn about and practise using the spacecraft, contingency scenarios and weightlessness. There will be additional training and orientation that would take place aboard the space station.

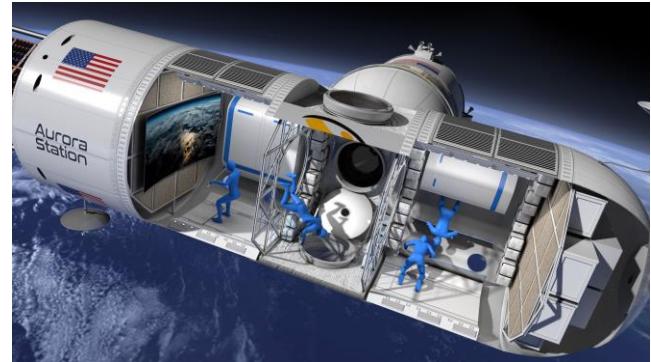


Figure 3: Digital concept art of Orion Space's Space Hotel, Aurora Station (Orion Span, 2019).

Michel van Pelt's book *Space Tourism: Adventures in Earth Orbit and Beyond* was used to gain a broad picture of the current space travel process with estimations of what the process will look like and involve in the future when there is technology and commercial demand for tourism into space (see Figure 4). Van Pelt has the credibility to discuss this topic as he has worked as a space engineer for over two decades and is currently working at the European Space Agency (Pelt, 2020). The process and information provided by the book was converted into a mind map (see Figure 5).

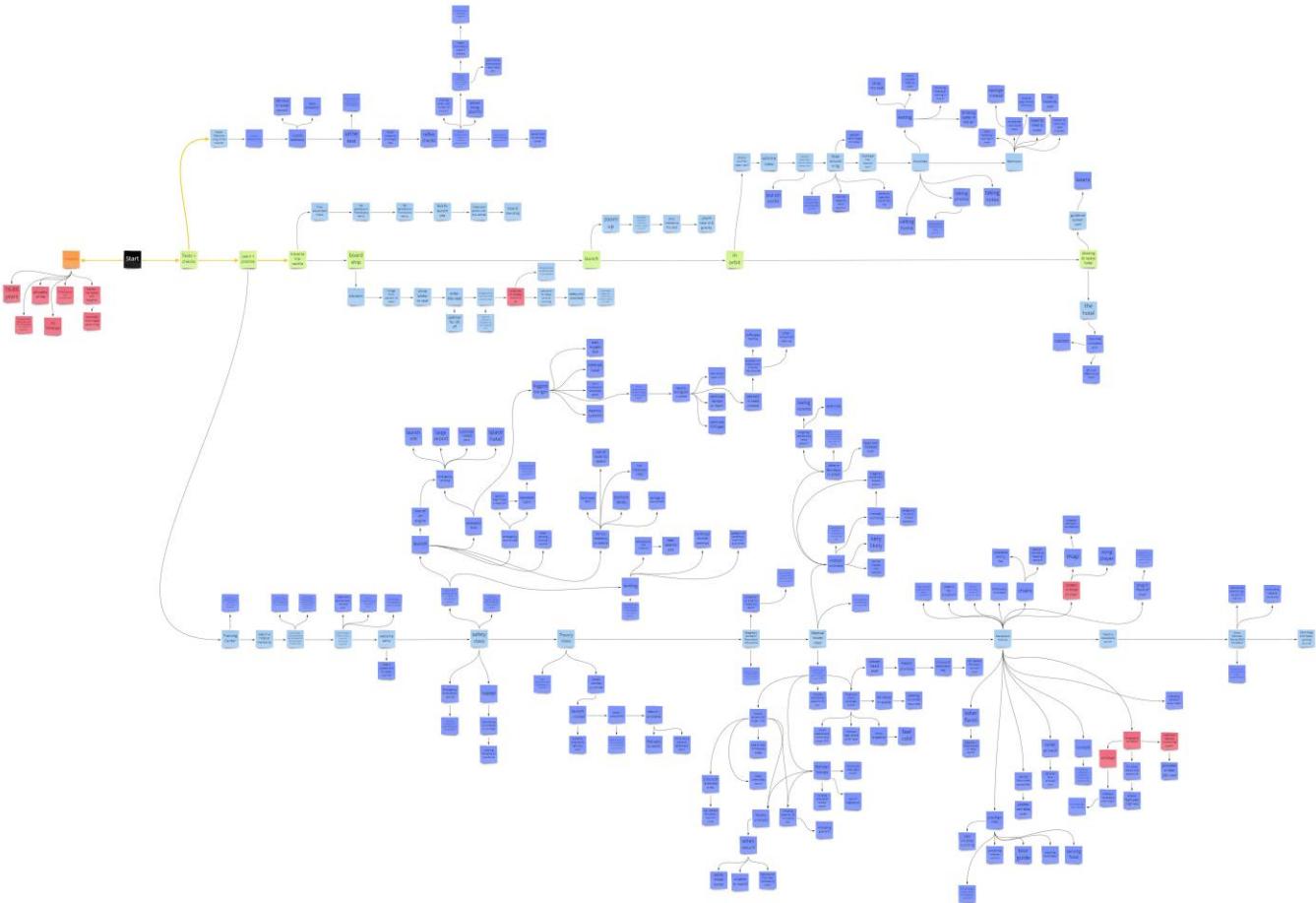


Figure 5: Mind map depicting the future 'Space Tourism' process according to Michel Van Pelt's book *Space Tourism*. Readable PDF version available on request.

Based on this preliminary contextual research, Table 1 below was created which conveys the potential problem areas that a screen-based solution could resolve.



Figure 6: Photo of Chris Hadfield who has flown two missions into space and commanding the International Space Station (ISS) (Markowitz, 2011)

Table 1: Discovered problem areas

PHASE	POTENTIAL PROBLEMS
PRE	<ul style="list-style-type: none"> • Complete theory training • assess necessary information • Preview of accommodation • Preview of travel process • Simulation/emulation of training • Information/infostructure of pre-flight hotel • Medical check-up
MID	<ul style="list-style-type: none"> • Controlling the spacecraft • Mid-flight entertainment • Obtaining food • Mid-flight information • Annotating the planet • Radiation dose meter • Bathroom struggles • Sleeping • Mid-flight emergency • Health issues • Communication with others • Radiation
POST	<ul style="list-style-type: none"> • Psychological harm of being isolated and away • Communication with others • Obtaining food • Keeping healthy • Post-flight emergency • Conducting research • Power

I received feedback based on these potential problem areas from users and peers in order to narrow down which area I should address. The users ranked the top 3 areas which they felt were the most important and able to be addressed through a screen (see Appendix 2).

Based on that feedback I decided to narrow down my problem area to *maintaining the traveller's mental health during the mid and post-flight phase*, as it was the highest ranked problem.

Understanding the Problem Area

When asked what the big hazards of space travel are, Chris Hadfield, an engineer and astronaut who spent 166 days in space, said "psychological. How do you keep people sane?" (Rogan, 2013). Hadfield is referring to the punishing effects that space travel has on a person's mental health (see Figure 6).

During a 1982 mission, cosmonaut Valentin Lebedev reported becoming irritable towards his fellow crew and mission control and depressed after spending an extended period in space (Turner, 2019). Studies have shown that there are lots of reasons behind the increase and prevalence of mental health issues while in space. The major issues are lack of sleep, radiation and emotional strain.

Space causes a major disruption to sleep times and schedules. As there is no 24-hour day/night loop it can be hard to adjust to a new sleeping habit resulting in sleep deprivation (Turner, 2019). This can result in memory issues, mood changes, weakened immune system, reduce coordination and trouble with thinking and concentration (see Figure 7).

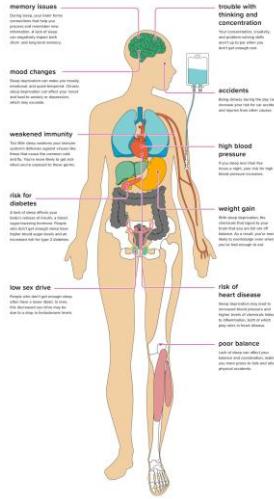


Figure 7: Infographic showing the effects of sleep deprivation (Watson, 2020)



Figure 8: Headspace provides the user with meditation and mindfulness techniques to reduce stress, anxiety, depression and more (Rabang, 2019).

Space travellers are exposed to, on average, radiation amounts equal to three times that of Earth as there is no ozone layer and atmosphere for protection (Lloyd, 2015). The high amounts of radiation that one is exposed to can cause sickness and damage to the nervous system resulting in agitation and what has been described as 'flashes... tearing through their eyes and brains' (Moore, 2018). This is also a fact that could exacerbates the difficulty of sleeping. The potential psychic health risks from radiation, but also the lessened activity caused by the microgravity and its effect on the autonomy have been linked to anxiety and depression faced by astronauts (Kanas, 2008).

Space expeditions involve an unnaturally long travel duration (it is estimated to take 7 months to get to Mars (MarsOne, 2018) and 3 days to get to the Moon (Cool Cosmos, 2014) and will likely involve remaining at the destination for a considerable amount of time. While in space, an individual could be hundreds of thousands to millions of kilometres away from their friends, family and rest of humanity, a daunting fact that could cause a pensive feeling of isolation and loneliness. Furthermore, the current and future trend of space travel involves a small amount of people residing within a relatively small area, increasing the prevalence of claustrophobia, going 'stir-crazy', having personality clashes with the other occupants and becoming bored due to reduced amount of options for activities. Additionally, the many potential dangers and hazards of traveling and living in space can cause fear within the participants. Astronaut Harry Hartfield is quoted saying 'You mean all I got to do is turn that handle and the hatch opens and all the air goes out?... kind of scary' (Turner, 2019). This will be especially relevant if space travel was accessible to the broader public and not just

experts with psychological training and preparation. All these facts could contribute to the psychological issues users may face during the space travel process.

User Research

User research methods were utilised to gain insights into the issues and needs of the target users for the screen-based application. A Competitor Analysis and an Online Ethnography were performed on a variety of relevant competitors and communities to discover these insights.

Online Ethnography

An online ethnography was used to obtain qualitative data on the target audience. As space travel is a very exclusive community with few of the general population having endured the relevant psychological effects, the community for the online ethnography focused on experts within the space and psychology field as well as users of the mobile application *Headspace: Meditation & Space* as it is a very popular mental health application (see Figure 8). I kept the specific criteria broad as within the space travel industry a lot of the research and findings are still relevant as not many changes are yet to have taken place. Regarding Headspace, as it is a constantly updated app, I only accepted observations from the last 2 years in case the app had undergone any significant changes and comments with high relevance scores (upvotes and approvals). Observations from relevant members of these communities were recorded and analysed to determine relevant themes (see Appendix 3).

In order to synthesise and analyse the data from the online ethnography, an affinity diagram was created to reveal the basic needs of the target user and start

thinking about potential solutions (see Appendix 5).

The needs were:

- A widely accessible solution
- Having the route cause be addressed
- Having symptoms be elevated
- A need to be prepared for what's in store
- Being able to understand the problems.

ONLINE ETHNOGRAPHY KEY FINDINGS

Throughout the process of doing an Online Ethnography I obtained useful insights into psychological problems faced by potential space travel that need to be addressed.

Some of the many problems and needs include:

- Stress and agitation linked to physical harm caused by radiation and inability to exercise in micro gravity
- Feeling of isolation and loneliness due to limited contact with others
- Issues with sleeping cause by physical restrictions, light and disrupted schedules.
- Fear and trauma associated with potential dangers and hazards
- Gravity distorting perceptions
- Not being prepared for the mental problems
- Needing easy to use and accessible solutions
- Needing constant and plentiful sources of stimulation
- Not being aware that they are suffering mentally due to unique problems and lack of understanding
- Irritability being taken out on other passengers and crew members

Psychological issues being a major issue for long trips as they generate over time. This is known as the 'third quarter phenomenon' (Purtill, 2020).

Competitor Analysis

A Competitor Analysis is used to evaluate the strengths and weakness of existing products in the target market, to find available gaps and opportunities that could be addressed. Currently there are a limited number of competitors as the psychological aspects of space travel has not been directly catered for. Furthermore, evidence from my research suggests that there aren't many existing solutions for psychological issues faced by past astronauts as instead they go through rigorous training and selection processes. This isn't currently feasible for future wide-scale commercial space travel.

Despite this, through the online ethnography, problems and needs relating to the potential users were uncovered which allowed for a more abstract search for competitors. This led me to narrow down the competitors to:

- *Calm* as it a mindfulness application that has been supported by astronaut Terry Virts (*Calm*, 2020)
- *Wysa: Mental Health Support* as it provides online therapy which in theory could be used in space
- *Sleep Cycle* as it could be used to assist with sleeping struggles while in space
- *WhatsApp* as it is a popular application that individuals currently use to stay in contact with friends and family

- *HeadSpace: Meditation & Space* as my research leads me to believe that it is one of the most popular applications that deals with mental health.
- Dr Susan Jewell's yoga therapy which uses virtual reality (VR) and body computer interfaces (BCI) to address the effects of isolation and confinement during future space ventures. The only solution I could find that addresses the future issues of space travel.
- Quanta's inflight entertainment as it is a currently existing flight interface that addresses peoples mental state during travel.
- *Elevate* as it aims to improve the user's cognitive ability
- 2001: A Space Odyssey communication booth as a space traveller uses it to talk to his family.

These competitors were evaluated using the Mobile Application Rating Scale (MARS) which is a commonly used set of criteria developed and validated by Queensland University to assess well-being apps (Health Gov NZ, 2017). Additionally, their user interface elements were also evaluated. Variables include:

- Engagement – fun, interesting, customisable, interactive, well-targeted
- Functionality – performance, easy to learn, navigation, flow logic, gestural
- Aesthetics – graphics, visual appeal, colour scheme, consistent style
- Information – quality information, credible information

The results from the competitor analysis can be found in Appendix 4. Note that not all elements of the competitors were accessible for evaluation. Below are the strengths and weaknesses of the competitors as determined throughout the competitor analysis.



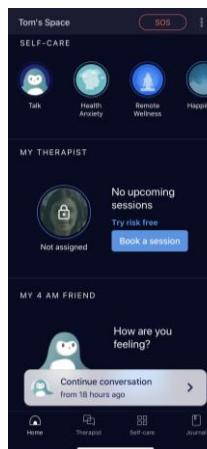
Calm (Calm.com, Inc, 2020)

Strengths

- Consistent, professional visual style
- Responsive
- In-depth and variety of content
- Logical flow and intuitive mapping
- Effective touch screen affordances
- Perfect UX (user experience)
- Meaningful visual elements

Weaknesses

- Expensive
- Can never fully own



Wysa (Touchkin eServices Pvt Ltd, 2020)

Strengths

- Free except for addons
- Covers many bases, therapy, meditation
- Covers lots of needs
- Logical flow and intuitive mapping
- Effective touch screen affordances
- Good UX – some frustration with AI
- Innovative concept

Weaknesses

- Most effective content (professional therapy) costs
- AI therapy doesn't work well



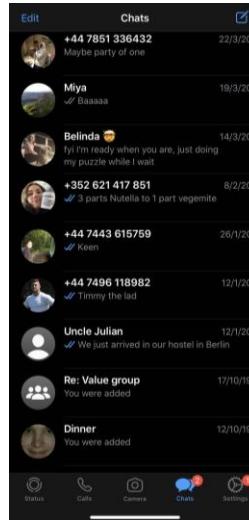
Sleep Cycle (Sleep Cycle AB, 2018)

Strengths

- Understandable insights and information through graphics and data
- Innovative concept
- Covers many bases
- Meaningful visual elements
- Logical flow and intuitive mapping
- Effective touch screen affordances
- Perfect UX

Weaknesses

- Remembering to use it
- expensive



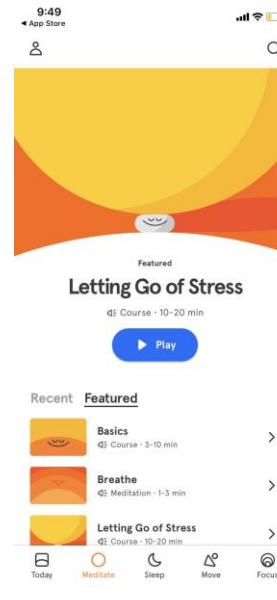
WhatsApp (WhatsApp Inc., 2020)

Strengths

- Simple concept which offers a variety of different methods
- Logical flow and mapping
- Effective touch screen affordances
- Simple but effective UX
- Meaningful visual elements

Weaknesses

- Basic visual style
- Not innovative



Headspace (Headspace Inc., 2019)

Strengths

- Consistent, professional visual style
- Responsive
- In-depth and variety of content
- Logical flow and intuitive mapping
- Effective touch screen affordances
- Perfect UX (user experience)
- Meaningful visual elements
- Accessible to more demographics

Weaknesses

- Expensive
- Can never fully own



VR + EEG Yoga (Jewell, 2019)

Strengths

- Innovative form, VR and EEG
- Gestural affordances
- Stimulating
- Directly applicable to space

Weaknesses

- Inaccessible through difficulty of use
- More difficult controls
- Can't judge screen UI elements



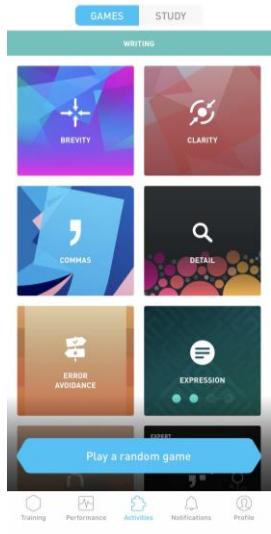
Quanta's inflight entertainment (Freed, 2014)

Strengths

- Lots of content
- Tested effectiveness during flight/travel
- Highly stimulating and entertaining
- Provide useful information

Weaknesses

- Slow processing
- Unresponsive



Elevate (Elevate, Inc., 2018)

Strengths

- Understandable insights and information through graphics and data
- Innovative concept
- Covers many bases
- Meaningful visual elements
- Logical flow and intuitive mapping
- Effective touch screen affordances
- Perfect UX
- Fun through gamification

Weaknesses

- Covers academics not mental preparedness
- Expensive



2001: A Space Odyssey Videophone (Kubrick, 1968)

Strengths

- Affords to be used with writing implementations
- Face call time
- Clear feedback
- Good key mapping to follow consistent user understanding
- Directly relevant to space travel

Weaknesses

- Slow UI
- Poor visual quality
- Slow input process
- Unintuitive use as the user is expected to read lots
- Constrained use by being locked in place
- Fictional

COMPETITOR ANALYSIS KEY FINDINGS

The major findings found through the competitor analysis are that the currently existing competitors that deal with psychological issues offer professional UIs and effective solutions to a variety of psychological issues. These applications could work just as well on Earth as they would in space which narrows the gaps and opportunities to develop a new solution within these marks. The major areas that need to be addressed are

the specific nuances of space that have not has solutions developed as there is currently few comparable experiences and no actual users. Despite this, by doing the competitor analysis I was able to find reoccurring themes that should be incorporated into a solution that addresses the problems identified through the online ethnography. These needs include:

- Being entertaining/interesting
- Address personalised user experiences
- Be quick and responsive
- Have a logical flow and intuitive use through consistent visual elements, layout and controls
- Have a high quality, consistent and applicable visual style
- Have information validated through reliable sources
- Oversaturation of contemporary UI forms

Summary of needs and issues

As space travel is not currently available for mass transit there is little research and developed solutions for the potential psychological issues which may be involved. Very few people throughout human history have come close to dealing with the psychological strain equivalent to both long term and short-term space travel. As space travel become more viable, there is a large gap in the market and lots of opportunities for the design and development of innovative ideas that address these issues. This was the main key insight through the user research.

An additional aspect of my findings was the importance of high quality and user-interface elements such as intuitive use, consistent and appropriate style, level of interaction.

The main psychological problems and needs that were identified from the user research have been represented on the infographic below for improved clarity and efficiency (see Figure 9).

psychological problems and needs of space travel

issues

loneliness

'One crew member's sleep cycle diverged from the rest so much that he spent 20% of this time the only one awake'
-Mars 500 researcher

depression

'The crew expressed increased feelings of loneliness and received less support from colleagues over time'
- Researcher Danielle Dallas

anxiety

'On short term space missions psychological issues are manageable but on longer term they are more important'
- Dr. Sarita Robinson

agitation

'Microgravity can cause stress and strain'
- Dr. Nick Kanas

irritability

'Inter group conflict... if you're put in a very closed environment with a lot of other people this can cause problems'
- Dr. Sarita Robinson

stress

'You don't have the variety of people and things and possibilities when you're living in a confined closed environment for so long'
- Astronaut Scott Kelly

fear

'Boredom leads us to search for variety and stimulation because it results in neurogenous'
- Micheal Stevens

anger

The main factor that people don't like is the price'
- Headspace user

problems

difficulty sleeping

'As soon as you start to go to mars you will never have a normal conversation with earth again'
- NASA astronaut

reduced socialisation

'It can be hard... to say I have anxiety or depression.
It can be easier to cover up'
- Dr. Sarita Robinson

seperation from humans

'We have practised looking at what are the risks are and the dangers because the best antidote for stress is competence'
- Astronaut Chris Hadfield

unaware of mental health problems

'Recordings showed that a speaker had a changed mood or level of excitement through analysis of their voice'
- Psychologist Mark Huckvale

little knowledge of mental health problems

scared of dangers and hazards

mental strain

weakened anatomy

'You don't have the variety of people and things and possibilities when you're living in a confined closed environment for so long'
- Astronaut Scott Kelly

cooped up

restricted access

limited variety

user needs

socialisation

maintained connection

awareness

support

preparation

maintaining psychical activity

stimulation

entertainment

easy to use application

affordability

Figure 9: Infographics of key insights discovered through user research

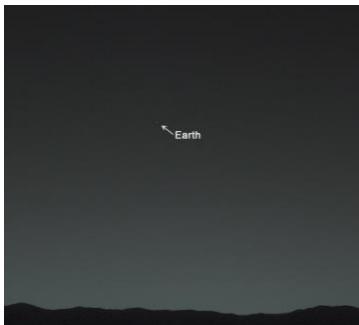


Figure 10: Photo showing a view of Earth from Mars. It is so far away you essentially can't see it (NASA/JPL-Caltech/MSSS/TAMU/, 2014).

Ideation

In order to develop concepts to address the needs of the users, personas were created that embodied different types of users and identified the struggles that they faced, and need addressed. Reframing techniques of Kees Dorst Frame Creation Model were then utilised

to look at the problem statements from a fresh perspective to develop innovative and new ideas that address the personas needs (see Appendix 1). The concepts highlighted in grey were then storyboarded to explore the idea within its appropriate context.

Persona #1

Homesick Harriet



Setting

Harriet is going to be leaving on a trip into space by herself and will be leaving her friends and family behind. Harriet will be staying in accommodation on the Moon as she will be taking a vacation there for a few weeks. She knows that she will be able to cope with separation from those in her life for a while but eventually the separation may cause her to start feeling depressed.

GAP/OPPORTUNITY

The main competitors that exist for Harriet's problem area are text messages and video call applications. The gaps and opportunities are to design a solution which allows for more personal interactions with people on Earth and deals with some of the specific communication issues present during space travel. An example of this could include, if Harriet was to travel further away from Earth, she would become unable to see it which would exacerbate her isolation and loneliness. This is an issue which contemporary designs have not directly addressed (see Figure 10).

Problem

Harriet will be unable to see, interact and communicate with her friends and family in person while she is on the Moon and it is unrealistic for her to go see them or for them to see her due to the time and cost involved. This separation may start to effect her mood and emotions as she becomes lonely and isolated.

Needs

Harriet needs help dealing with emotional issues that may arise from being unable to be in the presence of her friends and family.

REFRAMING

Because we are going far away for a vacation, we may feel home sick.

Because we may feel home sick, we will start to feel lonely and isolated.

Because we will start to feel lonely and isolated, we will struggle with being away for a vacation.

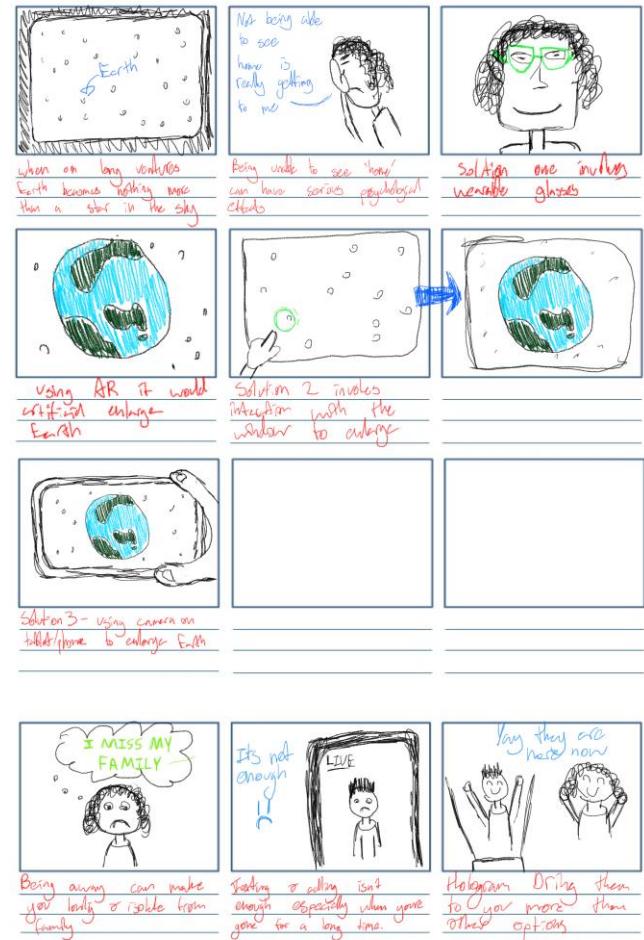
If the problem situation of struggling with being far away for a vacation, is approached as if it is a problem

of being home sick, then struggling with being away for a vacation should be with home.

CONCEPTS

- Glasses, window/transparent screen or tablet/phone application which enlarges the Earth to the size it would be if you were in the nearby atmosphere.
- Holographic communication system which brings your friends, family or whoever to you physically through a hologram.
- Artificial intelligence companion

STORY BOARDS



Persona #2

Anxious Andrew



Setting

Andrew will be going to stay in a space hotel for a couple days as part of his job. Andrew is relatively prone to anxiety and worries. He gets nervous when flying in a plane and often finds himself expecting the worst. The thought of flying in a rocket and living in space is causing him a lot of distress as he is scared of all the potential dangers.

Problem

Andrew needs to go into space for work but he is anxious and stressed about it due to the safety factor and danger involved. While in space, these mental struggles in combination with the difficulties of being in space makes it hard for Andrew to sleep, which in turn worsens the strain of this mental wellbeing.

Needs

Andrew needs help dealing with emotional issues that he may face during the flight process and while living in space. He has fears about the potential dangers which make him anxious and stressed. Andrew's problems could be alleviated through training and support pre-flight and access to sleep, mindfulness and mental health support while in space.

GAP/OPPORTUNITY

Andrew has to deal with general anxiety, stress and psychological problems on a day to day basis but it is even more important to be addressed when engaging in space travel as it takes a mental toll. There are lots of currently existing products that help deal with general mental struggles which my user research concluded were effective. As Andrew could easily use these products in space there is less of a gap here to be addressed. On the other hand, these products don't address problems specific to space. These factors tend to be more extreme and multifaceted causing substantial mental distress.

REFRAMING

Because we need to go far away for work, we may feel anxious due to the potential hazards.

Because we may feel anxious due to the potential hazards., we may start to suffer from mental health troubles.

Because we may start to suffer from mental health troubles, we will struggle to go far away for work

If the problem situation of struggling to go far away for work, is approached as if it is a problem of suffering with mental health troubles, then struggling to go far away for work should be with mental health support.

CONCEPTS

- Therapy dog application. Bring a therapy dog with you in space through a screen
- Cognitive games to build up resilience and prepare the user for space travel
- Mindfulness/meditation application
- Artificial Intelligence therapist

- Application specifically for sleeping in space

STORY BOARDS



Persona #3

Stir-crazy Sally



Setting

Sally is going on a temporary trip to Mars as part of mankind's efforts to undergo interplanetary colonisation. The trip is very long, 3 years, and Sally might begin to struggle with being cooped up inside a spaceship for that long.

Problem

Sally may become agitated, irritable and antisocial as a result of being stuck within the confines of a spaceship for a considerable amount of time. She may struggle from claustrophobia and boredom as her options for activities are limited and restricted to what is possible from the confines of the ship. It is unrealistic for more things from Earth to be sent to her as it would take too long to arrive. This problem is exacerbated as the current concepts for Mars trips don't have windows in order to reduce radiation.

Needs

Sally needs a variety of different and very stimulating applications so she doesn't get bored while travelling and elevates her from the compact nature of spaceships.

GAP/OPPORTUNITY

Sally's problems are very unique to space travel. The only situations that are remotely relatable would be living in Antarctica (or another isolated location) or being in solitary confinement for an inhuman amount of time. As a result, there is a large gap and lots of opportunities that the application could exist within.

REFRAMING

Because we are travelling for a long time, we may start to struggle with being confined.

Because we may start to struggle with being confined, we may become agitated, irritable and antisocial.

Because we may become agitated, irritable and antisocial, we will struggle to travel for a long time.

If the problem situation of struggling with travelling for a long time, is approached as if it is a problem of becoming agitated, irritable and antisocial, then travelling for a long time should be a stimulating and enjoyable experience.

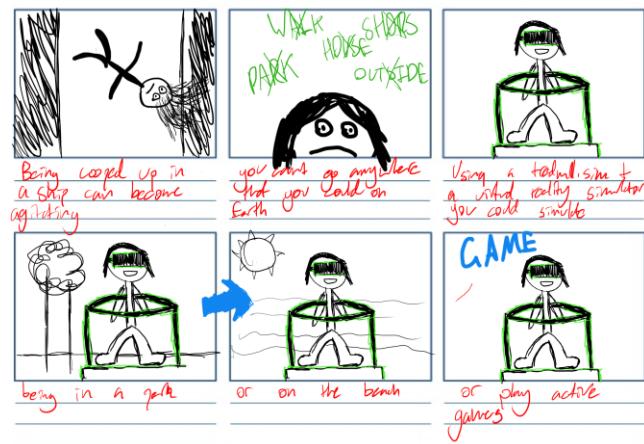
CONCEPTS

- Virtual reality + Virtuix Omni game or mindfulness experience. It would allow for physical activity and a stimulating experience

despite the restrictions of the tight environment.

- 3D printer + application to make and design objects. Make objects to play with to reduce boredom.
- Inflight entertainment.
- Exercising while in micro gravity guide application
- VR windows/way to see outside the ship through a screen

STORY BOARDS



Persona #4

Stoic Stanly



Setting

Stanly is going on a holiday with his wife to a space hotel for a couple days. Stanly and his wife are enjoying their trip a lot as they admire the views of Earth and the Cosmos. Stanly has been fortunate enough to rarely be inflicted with mental health issues while on Earth but while in space the strain is beginning to wear on him. Being unfamiliar with the issue and not wanting to ruin the experience, Stanly ignores any symptoms and doesn't have them addressed.

Problem

Stanly is less likely to identify and become aware that he is dealing with psychological issues as a result of travelling in space. This will only exacerbate what he is currently dealing with and could have residual effects.

Needs

Stanly needs assistance with identifying when he is struggling mentally and needs to be prompted to seek help. For Stanly, an easy, quickly effective and sensitive solution may help him with addressing his problems.

GAP/OPPORTUNITY

Similarly, to Andrew, many of the competitors identified in the competitor analysis would be applicable to help Stanly address his psychological problems when/if they arise. The gap and opportunity available for his problems would be to determine the fact he is unknowingly in need of mental health help as he is incapable of doing it for himself.

REFRAMING

Because we are going on a holiday to a unique place, there may be unexpected mental health problems.

Because there may be unexpected mental health problems, we may not notice them or want to raise them.

Because we may not notice them or want to raise them, going on holiday to a unique place could result in unaddressed mental health problems.

If the problem situation of going on holiday to a unique place resulting in unaddressed mental health problems, is approached as if it is a problem of not noticing or seeking help for mental health problems, then going on holiday to a unique place resulting in unaddressed mental health problems should be accompanied with ensuring you are aware of and address mental health while you are there.

CONCEPTS

- Monitoring mental state through a watch. A watch would measure speech, pulse, blood pressure, brain waves and other things to track the mental stability of the wearer. If it finds any issues it would notify the wearer and they could have it addressed through digital therapy or mindfulness techniques etc. Through the online ethnography I discovered that monitoring motor activity and speech patterns

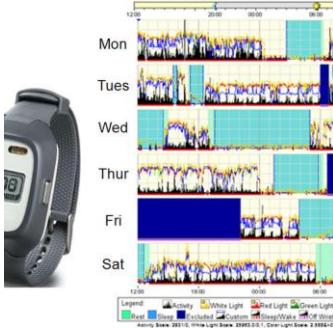
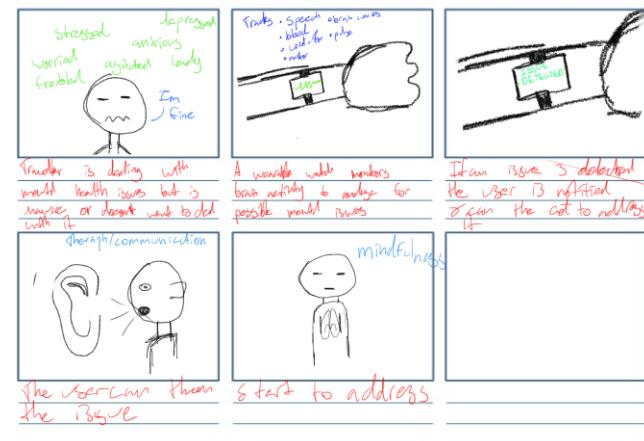


Figure 11: Picture of an Actigraphy which uses an accelerometer to analyse motor activity (Joo, 2015).

- allow for the determining a personals mental state (see Figure 11).
- Some of Andrews concepts are also applicable to Stanly as they deal with providing mental health help directly

STORY BOARDS



References

- Calm.com, Inc. (2020). Calm – Meditation and Sleep.
- Calm. (2020). Terry Virtis. Retrieved 28 September 2020, from <https://www.calm.com/narrators/ZzyKa6jkD/terry-virts>
- Cool Cosmos. (2014). How long does it take to travel to the Moon?. Cool Cosmos. Retrieved 28 September 2020, from <https://coolcosmos.ipac.caltech.edu/ask/174-How-long-does-it-take-to-travel-to-the-Moon-#:~:text=It%20takes%20about%203%20days,between%20Earth%20and%20the%20Moon.>
- Elevate, Inc.. (2018). Elevate – Brain Training.
- Extra Credits. *History of Space Travel - Guided by Starlight - Extra History - #6.* (2019, Dec 12). Retrieved 28 September 2020, from https://www.youtube.com/watch?v=i2CwEBaLU8U&t=313s&ab_channel=ExtraCredits
- Freed, J. (2014, Nov 6). Qantas in-flight entertainment: New system for Airbus A330s. Traveller.com. Retrieved 28 September 2020, from <https://www.traveller.com.au/qantas-inflight-entertainment-new-system-for-airbus-a330s-11hqt>
- Headspace Inc.. (2019). Headspace: Meditation & Sleep.
- Health Gov NZ. (2017, Oct). Guidance on evaluating or developing a health app. Retrieved 28 September 2020, from <https://www.health.govt.nz/system/files/documents/pages/guidance-evaluating-developing-health-app-oct17-v2.pdf>
- Holmes, O. (2018, Nov 19). Space: how far have we gone – and where are we going?. The Guardian.
- Retrieved 28 September 2020, from <https://www.theguardian.com/science/2018/nov/19/space-how-far-have-we-gone-and-where-are-we-going>
- Idea Pod. (2019) *female-3.* Retrieved 28 September 2020, from <https://ideapod.com/wp-content/uploads/2019/01/female-3.jpg>
- Jewell, S. (2019). MINDFULNESS MEDITATION & YOGA FOR SPACE EXPLORATION. Mars Without Borders. Retrieved 28 September 2020, from <https://marswithoutborders.wordpress.com/yoga-and-meditation-for-human-space-exploration/>
- Joo, E.Y (2015, Dec). Photo of Actigraphy. Retrieved 28 September 2020, from https://www.researchgate.net/figure/Actigraphy-and-actogram-of-a-patient-with-disturbed-sleep-wake-pattern-A-patient-is-a-22_fig1_288688548
- Kanas, Nicholas; Manzey, D. (2008). Space Psychology and Psychiatry (2nd ed.). El Segundo, California, and Dordrecht, The Netherlands: Microcosm Press and Springer.
- Kubrick, S., & Clarke, A. C. (1968). 2001: A space odyssey. United States: Metro-Goldwyn-Mayer Corp.
- Lloyd, C., Pharm, D. (2015). Space Radiation. NASA. Retrieved 28 September 2020, from https://www.nasa.gov/sites/default/files/atoms/files/space_radiation_ebook.pdf
- Markowitz, R. (2011, July 19). Canadian Space Agency astronaut Chris Hadfield, attired in a training version of his Extravehicular Mobility Unit (EMU) spacesuit. NASA. Retrieved 28 September 2020, from https://en.wikipedia.org/wiki/Chris_Hadfield#/media/File:Chris_Hadfield_2011.jpg
- MarsOne. (2018). How long does it take to travel to Mars?. MarsOne. Retrieved 28 September 2020, from

- <https://www.mars-one.com/faq/mission-to-mars/how-long-does-it-take-to-travel-to-mars#:~:text=The%20trip%20takes%20around%20seven,from%20six%20to%20eight%20months>
- McKie, R. (2020, Jan 5). *The moon, Mars and beyond... the space race in 2020*. The Guardian. Retrieved 28 September 2020, from <https://www.theguardian.com/science/2020/jan/05/pace-race-moon-mars-asteroids-commercial-launches#:~:text=India%2CJapan%20and%20China%20are,moon%2CMars%20and%20the%20asteroids>
- Medical News Today. (2020). *aging-man*. Retrieved 28 September 2020, from <https://i0.wp.com/cdn-prod.medicalnewstoday.com/content/images/articles/266/266749/aging-man.jpg?w=1155&h=1>
- Mohammed bin Rashid Space Centre. (2019). Mars 2117. Retrieved 28 September 2020, from <https://www.mbrsc.ae/mars-2117>
- NASA/JPL-Caltech/MSSS/TAMU/. (2014, Jan 31). Photo of Mars from the Curiosity Rover. Retrieved 28 September 2020, from <https://www.space.com/24593-mars-rover-curiosity-sees-earth-photos.html>
- Orion Span. (2019). Aurora Space Station. Retrieved 28 September 2020, from <https://www.orionspan.com/>
- Outdoors-man-portrait*. Wikimedia. Retrieved 28 September 2020, from https://upload.wikimedia.org/wikipedia/commons/4/48/Outdoors-man-portrait_%28cropped%29.jpg
- Pelt, M. (2005). Space Tourism Adventures in Earth Orbit and Beyond . Springer New York.
- Pelt, M. (2020) Michel van Pelt LinkedIn Profile. LinkedIn. Retrieved 28 September 2020, from <https://www.linkedin.com/in/michel-van-pelt-7472245/?originalSubdomain=nl>
- Purtill, J. (2020, Apr 27). We have begun the dreaded third quarter of isolation, when — yes — things get weird. ABC. Retrieved 28 September 2020, from <https://www.abc.net.au/triplej/programs/hack/coronavirus-covid19-isolation-third-quarter-phenomenon-has-begun/12190270>
- Rabang, I. (2019, Apr 9). The Headspace Meditation App And The Lost Art Of Being Still. Bold Business. Retrieved 28 September 2020, from <https://www.boldbusiness.com/health/headspace-meditation-app-and-the-lost-art-of-being-still/>
- Rogan, J. (2013, Nov 11). Joe Rogan Experience #414 - Cmdr. Chris Hadfield. PowerfulJRE. Retrieved 28 September 2020, from https://www.youtube.com/watch?v=OS0laJvgVxo&ab_channel=PowerfulJRE
- Sheetz, M. (2019, Mar 18). *Super fast travel using outer space could be \$20 billion market, disrupting airlines, UBS predicts*. CNBC. Retrieved 28 September 2020, from <https://www.cnbc.com/2019/03/18/ubs-space-travel-and-space-tourism-a-23-billion-business-in-a-decade.html#:~:text=In%20a%20decade%2C%20high%20speed,to%20%24805%20billion%20by%202030>.
- Sleep Cycle AB. (2018). Sleep Cycle – Sleep Tracker.
- SpaceX. (2020). MARS & BEYOND THE ROAD TO MAKING HUMANITY MULTIPLANETARY. SpaceX. Retrieved 28 September 2020, from <https://www.spacex.com/human-spaceflight/mars/index.html>
- Sycheva, N. (2020, Sept 16). *The Rise Of The Space Economy (And The Opportunities It Presents For the UAE)*. Entrepreneur Middle East. Retrieved 28 September 2020, from <https://www.entrepreneur.com/article/356244>

The Spinoff. (2020). *Evaristo-edited*. Retrieved 28 September 2020, from <https://thespinoff.co.nz/wp-content/uploads/2020/02/Evaristo-edited.jpg>

Tomitsch, M. (2018). Design. Think. Make. Break. Repeat. : a handbook of methods . BIS Publishers.

Touchkin eServices Pvt Ltd (2020). Wysa: Mental Health Support.

Turner, D.D. (2019). Headspace: How Space Travel Affects Astronaut Mental Health. Retrieved 28 September 2020, from <https://cmsw.mit.edu/angles/2019/headspace-how-space-travel-affects-astronaut-mental-health/>

Wall, M. (2019, Apr 23). The Most Extreme Human Spaceflight Records. Space.com. Retrieved 28 September 2020, from [https://www.space.com/11337-human-spaceflight-records-50th-anniversary.html#:~:text=Farthest%20away,400%2C171%20km\)%20away%20from%20Earth.](https://www.space.com/11337-human-spaceflight-records-50th-anniversary.html#:~:text=Farthest%20away,400%2C171%20km)%20away%20from%20Earth.)

Watson S., Cherney, K. (2020, Mar 15). The Effects of Sleep Deprivation on Your Body. healthline. Retrieved 28 September 2020, from <https://www.healthline.com/health/sleep-deprivation/effects-on-body>

WhatsApp Inc.. (2020). WhatsApp Messenger.

Zelazko, A. (2020). How Many People Have Been to the Moon?. Britannica. Retrieved 28 September 2020, from <https://www.britannica.com/story/how-many-people-have-been-to-the-moon#:~:text=You%20might%20be%20wondering%20just,space%20to%20orbit%20Earth%2C%20Pres.>

Appendix

Appendix 1 - Kees Dorst Frame Creation Model



Appendix 2 - Problem area feedback

Feedback #1

1. Keeping physically & mentally healthy - POST

2. Need assistance for the infrastructure - POST & MID

3. Navigation - Mid & POST

PPA

Feedback #1 & 2

1. Maintaining mental health - POST

2. Communicating with others - POST & MID

3. Annotating the planet - MID & POST (my goal)

feedback #3

1. Medical health - POST

2. food - POST

3. Training - Pre

feedback #4

1. Necessary information - pre

2. flight control - mid

3. emergency - mid or post

Appendix 3 - Online ethnography

Source: space industry professionals			
Data record	Recorded observations	Interpretation	Themes
I was up there for a year and at some point I felt like I had lived my whole life up there' - Scott Kelly	NASA astronaut	Being in space can feel like it's a lot longer than it actually is	worn down mentally lack of gravity can cause mental issues. Moving around can be frustrating
'Microgravity can cause stress and strain' - Dr. Nick Kanas	Space Psychiatrist	the way you get around in space can cause frustration	
you don't have the variety of people and things and possibilities when you're living in a confined closed environment for so long - scott kelly what if I really did have... a problem here? There is nothing I can do about it. He started to worry and obsess about it' - Dr Nick Kanas	NASA astronaut	being in space limits the things you can do	there isn't much to do in space which causes boredom
the earth being out of view and everything that is important to you being so distant and so trivial may have a psychological effect on some of the astronauts' - dr nick kana try to keep things in perspective, manage your energy and fatigue' - scott kelly astronauts are more worried about screwing up than blowing up' - mike barratt	Space Psychiatrist	fear can be obsessive	becoming scared can spiral
one crew member's sleep cycle diverged from the rest so much that he spent 20% of this time the only one awake or asleep. Another slept for short and shorter periods. A third struggled with depression' - mars 500 researcher	space researcher	being unable to see earth is a cause of psychological issues	losing touch with humanity causes mental problems
its not so bad on the space station cause were closer to the world but as soon as you want to go to mars you will never have a normal conversation with earth again and the earth will shrink to just another star' - chris hadfield	NASA astronaut	managing energy and fatigue is a useful strategy	keeping physical healthy helps with mental health
astronauts go through rigorous screenings before flying. If you have manic depression or schizophrenia aren't allowed to go' - danielle dallas *in regards to an isolation experiment* 'the crew expressed increased feelings of loneliness and received less support from colleagues over time which had a negative effect on cognitive adaption' - danielle dallas	space researcher	people don't want to be personally responsible for something going wrong	people don't want to be the cause of a problem
in regards to an isolation experiment 'astronauts with psychological problems were found and reported using a ritatograph, a watch which monitors motor activity and vigilance task which is a button reaction activity' - danielle dallas	space researcher	an imbalanced sleep cycle can cause the individual to be unable to socially interact	maintaining social interaction is important. Sleep issues can disrupt social interactions
astronauts go through rigorous screenings before flying. If you have manic depression or schizophrenia aren't allowed to go' - danielle dallas *in regards to an isolation experiment* 'the crew expressed increased feelings of loneliness and received less support from colleagues over time which had a negative effect on cognitive adaption' - danielle dallas	NASA astronaut	communication is incredible hard when travelling far away	communicating takes a long time when far away. Maintaining social interaction is important
people that are prone to psychological issues can't fly	space researcher		currently only the most resilient and prepared can fly
loneliness and reduced support from those around you may occur	space researcher		people don't want to feel lonely. Interactions with crew will subside
in regards to an isolation experiment 'astronauts with psychological problems were found and reported using a ritatograph, a watch which monitors motor activity and vigilance task which is a button reaction activity' - danielle dallas	space researcher	a ritatograph or vigilance task were used to identify psycho problems	science allows for the detection of mental problems
being away from their friends, families and dogs won't be tolerable by everyone' - danielle dallas	space researcher	it is imperative that to remain in touch with family	social interaction is important
the crew must function autonomously... deal with medical and psychiatric emergencies such as trauma due to accidents or psychotic thinking. Because these trips are so long there will be a lot of leisure time which means there's gonna be a lot of time to think' - danielle dallas	space researcher	crew need to know how to address safety issues otherwise they may worry and leisure time is important	the fear of the unknown is a problem. Leisure time is important
What stresses me out is when something is gonna happen and I'm not ready for it' - chris hadfield we are ready, we have trained, we have practised to look at what are the risks and the dangers because the best antidote for stress is competence' - chris hadfield	NASA astronaut	not being prepared for it what causes mental issues	lack of preparation causes problems
	NASA astronaut	practising and being informed is a solution to mental issues	practise and knowledge can prevent mental issues

source: pshycology experts			
Data record	Recorded observations	Interpretation	Themes
inter group conflict. If you're put in a very closed environment with a lot of other people this can cause problems' - dr sarita robinson	university educated psychologist	being in a small area with people for extended time can result in clashes between those people	people need space. Consisted exposure to people can eventual cause conflict
it can be hard for being to say I have anxiety or depression. It can be easier to cover up those issues than be honest' - sarita robinson	university educated psychologist	people don't always express when they are having mental issues	people may not acknolegde or communicate their mental struggles
the way in which they use speech, the words that they say and how they sound... is a good test of wellbeing' - prof mark huckvale	university educated psychologist	analysis speech is a way to empirical determine the occurrence of mental issues	measuring voice is a potential solution for inability to express mental issues
analysis of recordsins showed that a speaker had a changed mood or level of excitement through analysis of their voice' - mark huckvale	- university educated psychologist	differences in voice that can me measured	measuring voice can help with identifiying mental issues
on short term space missions pshycological issues are managable but on longer term they are more important' - sariata robinson	university educated psychologist	short term missions can cause mental issues but it is more of an issue regarding the longer travels	the focus should be no longer missions (mars) but solution should also apply to short missions
in regards to an isolation experiment 'the crew expressed increased feelings of loneliness and received less support from colleges over time which had a negative effect on cognitive adaption'	university educated psychologist	effects	there are many ways that mental issues show could be presented and be an issue
bordem leads us to search for variety and stimulation because it results in neurogenisi' - micheal stevens	university educated psychologist	seeking solutions to bordem is hard wired into us and is important for development	people need to not be bored

source: headspace users			
Data record	Recorded observations	Interpretation	Themes
Finding just 10 minutes to be alone in the quiet is more challenging than I expected. Even just remembering to do it was difficult at first.	considerable upvotes. Thankful	It is hard to find time to use the application and often they forget to use it	hard to use/remember to use
My mood changed within days of starting. It amazed me how quickly it worked and how beneficial even just 10 minutes a day can be.	considerable upvotes. Surprised	very quick results with little effort	effective. Simple
I found myself meditating when I wasn't necessarily in the right mood for it	considerable upvotes. Passionate	outright enjoyed using the application	promotes mental health
I wanted to meditate on my own terms, without pressure or judgement from the app.	considerable upvotes. Analytical	didn't want to be restricted by the app	the app restricts actions
The explanations headspace provides are unparalleled IMO. However, it gets tedious	considerable upvotes. Well spoken	found information provided by the app useful but didn't always care for it	informative but sometimes too much so
it's a bit expensive	commonly rased point	too expensive for most people	too expensive
Headspace is great because it sets the bar low for beginners	considerable upvotes. Relatable	its good for learning but not as good for people that already know what they are doing	good for beginners, less so for seasoneds
Headspace app got me into meditation	considerable upvotes	is a gateway into meditation and pursuing mental health help	promotes mental health
it was a vital part of developing my practice. Headspace's rich, accessible lessons gently explore how to improve mindfulness	considerable upvotes. Professional	helped people with their future mediation even when they stopped using it	promotes mental health
I feel nearly all the negative reviews concentrating too much on the cost side of things.	5 stars. Official	lessons were good and educating mindfulness	informative but sometimes too much so
I have severe anxiety and use an asthma puffer and go to constant therapy and when I'm up at 1am and its impossible to fall asleep Headspace has a course.	5 stars. Assumptive	the main reason people don't like the app is because they don't think tis worth the price	too expensive
enjoyed my novices but people tend to use different platforms when they become more advance	5 stars. Speaking on behalf of others	good for beginners but after they learn they move to other platforms	good for beginners, less so for seasoneds
the main factor that people don't like is the price	5 stars. Assumptive	the main reason people don't like the app is because they don't think tis worth the price	too expensive

Appendix 4 - Competitor analysis

Variables	1 - Calm	2 - Wysa: Mental Health Support	3 - Sleep Cycle
Engagement – fun, interesting , customisable, interactive , well-targeted	<ul style="list-style-type: none"> Highly entertaining and fun, would stimulate repeat use Very interesting, would engage user in repeat use Allows complete tailoring to the individual's characteristics/preferences, retains all settings Very high level of responsiveness through interactive features/feedback/user input options Perfectly targeted, no issues found 	<ul style="list-style-type: none"> Moderately fun and entertaining, would entertain user for some time (5–10 minutes total) Moderately interesting; would engage user for some time (5–10 minutes total) Allows basic customisation to function adequately Offers a variety of interactive features/feedback/user input options Well-targeted, with negligible issues 	<ul style="list-style-type: none"> Highly entertaining and fun, would stimulate repeat use Very interesting, would engage user in repeat use Allows complete tailoring to the individual's characteristics/preferences, retains all settings Very high level of responsiveness through interactive features/feedback/user input options Perfectly targeted, no issues found
Functionality – performance, easy to learn, navigation , flow logic, gestural	<ul style="list-style-type: none"> Perfect/timely response; no technical bugs found/contains a 'loading time left' indicator Able to use app immediately; intuitive; simple Perfectly logical, easy, clear and intuitive screen flow throughout, or offers shortcuts Perfectly consistent and intuitive 	<ul style="list-style-type: none"> App works overall. Some technical problems need fixing/Slow at times Easy to learn how to use the app (or has clear instructions) Perfectly logical, easy, clear and intuitive screen flow throughout, or offers shortcuts Perfectly consistent and intuitive 	<ul style="list-style-type: none"> Perfect/timely response; no technical bugs found/contains a 'loading time left' indicator Able to use app immediately; intuitive; simple Perfectly logical, easy, clear and intuitive screen flow throughout, or offers shortcuts Perfectly consistent and intuitive
Aesthetics –	<ul style="list-style-type: none"> Professional, simple, clear, orderly, logically organised, 	<ul style="list-style-type: none"> Professional, simple, clear, orderly, logically organised, 	<ul style="list-style-type: none"> Professional, simple, clear, orderly, logically organised,

graphics, visual appeal, colour scheme, consistent style	<p>device display optimised. Every design component has a purpose</p> <ul style="list-style-type: none"> • Very high quality/resolution graphics and visual design - proportionate, stylistically consistent throughout • High level of visual appeal - seamless graphics - consistent and professionally designed 	<p>device display optimised. Every design component has a purpose</p> <ul style="list-style-type: none"> • Very high quality/resolution graphics and visual design - proportionate, stylistically consistent throughout • As above + very attractive, memorable, stands out; use of colour enhances app features/menus 	<p>device display optimised. Every design component has a purpose</p> <ul style="list-style-type: none"> • Very high quality/resolution graphics and visual design - proportionate, stylistically consistent throughout • High level of visual appeal - seamless graphics - consistent and professionally designed
Information – quality information, credible information	<ul style="list-style-type: none"> • High level of visual appeal - seamless graphics - consistent and professionally designed • OK. App has clear goals, which may be achievable. • Relevant/appropriate/coherent/correct • OK but not comprehensive or concise • Mostly clear/logical/correct with negligible issues • Source identified but legitimacy/trustworthiness of source is questionable (eg, commercial business with vested interest). • App has been trialled (eg, acceptability, usability, satisfaction ratings) and has positive outcomes in studies that are not RCTs, and there is no contradictory evidence. 	<ul style="list-style-type: none"> • Accurate. App contains most of the described components/functions. • OK. App has clear goals, which may be achievable. • Relevant/appropriate/coherent/correct • Offers a broad range of information, has some gaps or unnecessary detail; or has no links to more information and resources • Mostly clear/logical/correct with negligible issues • Source identified but legitimacy/trustworthiness of source is questionable (eg, commercial business with vested interest). • App has been trialled (eg, acceptability, usability, satisfaction ratings) and has partially positive outcomes in studies that are not 	<ul style="list-style-type: none"> • High level of visual appeal - seamless graphics - consistent and professionally designed • OK. App has clear goals, which may be achievable. • Relevant/appropriate/coherent/correct • OK but not comprehensive or concise • Mostly clear/logical/correct with negligible issues • Source identified but legitimacy/trustworthiness of source is questionable (eg, commercial business with vested interest). • App has been trialled (eg, acceptability, usability, satisfaction ratings) and has positive outcomes in studies that are not RCTs, and there

		randomised controlled trials (RCTs), or there is little or no contradictory evidence.	is no contradictory evidence.
--	--	---	-------------------------------

Variables	4 - HeadSpace: Meditation & Space	4 - Dr Susan Jewell's yoga therapy	5 - Quanta's inflight entertainment
Engagement – fun, interesting, customisable, interactive, well-targeted	<ul style="list-style-type: none"> Highly entertaining and fun, would stimulate repeat use Very interesting, would engage user in repeat use Allows complete tailoring to the individual's characteristics/preferences, retains all settings Very high level of responsiveness through interactive features/feedback/user input options Perfectly targeted, no issues found 	<ul style="list-style-type: none"> Highly entertaining and fun, would stimulate repeat use Very interesting, would engage user in repeat use Allows basic customisation to function adequately Well-targeted, with negligible issues 	<ul style="list-style-type: none"> Highly entertaining and fun, would stimulate repeat use Very interesting, would engage user in repeat use Allows basic customisation to function adequately Basic interactive features to function adequately Perfectly targeted, no issues found
Functionality – performance, easy to learn, navigation, flow logic, gestural	<ul style="list-style-type: none"> Perfect/timely response; no technical bugs found/contains a 'loading time left' indicator Able to use app immediately; intuitive; simple Perfectly logical, easy, clear and intuitive screen flow throughout, or offers shortcuts Perfectly consistent and intuitive 	<ul style="list-style-type: none"> Some functions work, but lagging or contains major technical problems Useable after a lot of time/effort OK with some inconsistencies/confusing elements 	<ul style="list-style-type: none"> Able to use app immediately; intuitive; simple Easy to use or missing a negligible link Mostly consistent/intuitive with negligible problem Mostly consistent/intuitive with negligible problem
Aesthetics – graphics,	<ul style="list-style-type: none"> Professional, simple, clear, orderly, logically organised, 	<ul style="list-style-type: none"> Satisfactory, few problems with 	<ul style="list-style-type: none"> Mostly clear, able to select/locate/see/read items

visual appeal, colour scheme, consistent style	<p>device display optimised. Every design component has a purpose</p> <ul style="list-style-type: none"> Very high quality/resolution graphics and visual design - proportionate, stylistically consistent throughout High level of visual appeal – seamless graphics – consistent and professionally designed 	<p>selecting/locating/seeing /reading items or with minor screen size problems</p> <ul style="list-style-type: none"> Moderate quality graphics and visual design (generally consistent in style) Some visual appeal – average, neither pleasant, nor unpleasant 	<ul style="list-style-type: none"> High quality/resolution graphics and visual design – mostly proportionate, stylistically consistent High level of visual appeal – seamless graphics – consistent and professionally designed
Information – quality information, credible information	<ul style="list-style-type: none"> High level of visual appeal – seamless graphics – consistent and professionally designed OK. App has clear goals, which may be achievable. Relevant/appropriate/coherent/correct OK but not comprehensive or concise Mostly clear/logical/correct with negligible issues Source identified but legitimacy/trustworthiness of source is questionable (eg, commercial business with vested interest). App has been trialled (eg, acceptability, usability, satisfaction ratings) and has positive outcomes in studies that are not RCTs, and there is no contradictory evidence. 	<ul style="list-style-type: none"> Accurate. App contains most of the described components/functions. App has specific and measurable goals, which are highly likely to be achieved. Offers a broad range of information, has some gaps or unnecessary detail; or has no links to more information and resources Mostly clear/logical/correct with negligible issues Developed by government, university or as above but larger in scale. App has been trialled and outcome tested in > 3 high-quality RCTs with positive results. 	<ul style="list-style-type: none"> OK. App has clear goals, which may be achievable. Relevant/appropriate/coherent/correct OK but not comprehensive or concise Mostly clear/logical/correct with negligible issues Source identified but legitimacy/trustworthiness of source is questionable (eg, commercial business with vested interest). App has been trialled (eg, acceptability, usability, satisfaction ratings) and has positive outcomes in studies that are not RCTs, and there is no contradictory evidence.

Variables	6 - Elevate	7 - 2001: A Space Odyssey communication booth	
Engagement – fun, interesting, customisable, interactive, well-targeted	<ul style="list-style-type: none"> Highly entertaining and fun, would stimulate repeat use Very interesting, would engage user in repeat use Allows complete tailoring to the individual's characteristics/preferences, retains all settings Very high level of responsiveness through interactive features/feedback/user input options Perfectly targeted, no issues found 	<ul style="list-style-type: none"> Highly entertaining and fun, would stimulate repeat use Very interesting, would engage user in repeat use Well-targeted, with negligible issues 	
Functionality – performance, easy to learn, navigation, flow logic, gestural	<ul style="list-style-type: none"> Perfect/timely response; no technical bugs found/contains a 'loading time left' indicator Able to use app immediately; intuitive; simple Perfectly logical, easy, clear and intuitive screen flow throughout, or offers shortcuts Perfectly consistent and intuitive 	<ul style="list-style-type: none"> Some functions work, but lagging or contains major technical problems Useable after a lot of time/effort OK with some inconsistencies/confusing elements 	
Aesthetics – graphics, visual appeal, colour scheme,	<ul style="list-style-type: none"> Professional, simple, clear, orderly, logically organised, device display optimised. Every design component has a purpose Very high quality/resolution graphics and visual design - 	<ul style="list-style-type: none"> Satisfactory, few problems with selecting/locating/seeing /reading items or with minor screen size problems 	

consistent style	<p>proportionate, stylistically consistent throughout</p> <ul style="list-style-type: none"> High level of visual appeal – seamless graphics – consistent and professionally designed 	<ul style="list-style-type: none"> Low quality/low resolution graphics; low quality visual design – disproportionate, stylistically inconsistent Little visual appeal – poorly designed, bad use of colour, visually boring 	
Information – quality information, credible information	<ul style="list-style-type: none"> High level of visual appeal – seamless graphics – consistent and professionally designed OK. App has clear goals, which may be achievable. Relevant/appropriate/coherent/correct OK but not comprehensive or concise Mostly clear/logical/correct with negligible issues Source identified but legitimacy/trustworthiness of source is questionable (eg, commercial business with vested interest). App has been trialled (eg, acceptability, usability, satisfaction ratings) and has positive outcomes in studies that are not RCTs, and there is no contradictory evidence. 	<ul style="list-style-type: none"> OK. App contains some of the described components/functions OK. App has clear goals, which may be achievable. 	

Appendix 5 – Affinity diagram

