PROJECT VITAL PRESENTS

Spiritus

DESIGNING A DATA SUPPORTED BREATH PRACTICE FOR A TU DELFT STUDENT'S JOURNEY TOWARDS INNER PEACE

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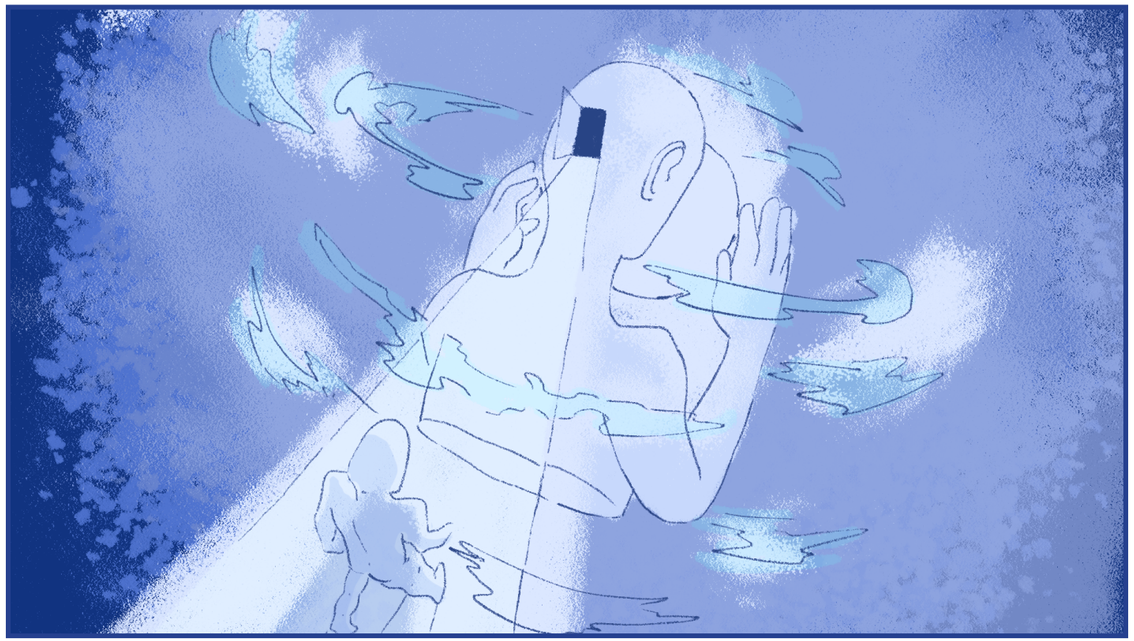

"Breathing in, I know I am breathing in. Breathing out, I know I am breathing out.
Breathing in, I see myself as a flower. Breathing out, I feel fresh.
Breathing in, I see myself as a mountain. Breathing out, I feel solid.
Breathing in, I see myself as still water. Breathing out, I reflect all that is.
Breathing in, I see myself as space. *BREATHING OUT, I FEEL FREE.*"

THICH NHAT HANH

Preface

I had started the Design for Interaction programme at TU Delft as a first step towards a journey that I have wanted to be on for quite a few years of my academic life. I had come here with the intention and hope that through design I could explore areas of study I am passionate about and further treat aspects of those disciplines as design material. I remember looking up research and the pages of professors at the university even before coming to the Netherlands and aspiring to do work on areas where I could bring together my various interests in philosophy, data and emotion to produce a new knowledge that would be potentially be considered important not only for design but for the sciences at large.

My graduation project was an attempt to answer this dream. As I am writing this at the end of the project, I express my heartfelt gratitude for everything that has happened over the course of the project. Both the highs and lows, as I look back, are moments that I will cherish for a long time to come.

Given my background in engineering and the liberal arts, there was a lot I had to learn, unlearn and re-learn. The process of building myself up as a designer was one that I undertook with just pure curiosity and is a process I am grateful to say presented me with one of the happiest periods of my life.

I would like to thank all those who have been instrumental on this journey. First, I would like to mention my supervisors, who have been with me throughtout the process but have also inspired me in their own way as to what I should be professional and an aspiring design researcher.

Derek: When I speak to you, I find that there is very little that is not possible. During the instances when I thought the technical aspects were too difficult or new, you saying that it can be done and I can do it, has influenced me greatly in terms of how I will approach challenges in the future. Thank you for supporting and trusting me throughout the process. It means a lot to me. When I came to you with my interests as well, you helped me narrow down on an area that I was inspired to work on and am still inspired to uncover further. The way you talk about and approach science and experiments and inspire people is something that I hope to learn as someone who hopes to coach students in the future.

Thank you for helping me express my voice as well as I can through my graduation project.

Marieke: The meetings we had from the very first meeting we had were immensely fruitful. Throughout the project, you had helped me identify my design fixations at times and have helped me pay attention to the narrative. Your feedback has been instrumental in making key improvements to both the project and narrative. You've also been extremely compassionate and understanding of not only the project process but also of my well-being. Thank you. I really cherish having being a part of the Design for the End of Life Lab. I have always looked forward to Monday meetings to meet up with the lab members. Given the complex and sensitive nature of the topics discussed in the lab, it was inspiring to listen to other graduation students talk about their projects.

Lisanne: Thank you for agreeing to be part of this journey with me. From accepting my request on LinkedIn to all the meetings we had and the sessions you conducted for me, I can't thank you enough. You inspire me as a professional and I hope to emulate how you have been with me to others I might come across in the future. You were always happy to help and always helped me gain more clarity; oftentimes of my own thoughts. Thank you for also welcoming me to your studio and also guiding me on my own personal practice. I hope to carry on exploring the breath both as a designer and in my personal life.

I also want to especially thank Pankaj and Caiseal. Pankaj: Even during your busy PhD schedule, you advised and helped me figure out aspects such as machine learning and data analysis. You have also gotten me really excited about brain science as well as you mention the interesting work being done in the domain. I hope we get a chance to work on something together too in the future. Caiseal: Thank you for walking me through NeuroPype and providing me pointers about the EEG setup. Without your help, the process of learning would have been far more convoluted!

There are a few people without whom my time in the Netherlands would have not been the same. Namitha: Even when you were in extremely difficult situations, you always were there for me and made sure that I am okay and made me smile. Thank you for being there for me and being instrumental in pursuing my masters here at TU Delft.

Sambhram and Meenu: Both of you have been really helpful and kind to me during a lot of instances where I really needed help. Thank you for always being willing to help me out and for making me feel that I can always count on you for help or advice.

Thomas and Shreyas: You guys made me feel welcome in Delft. From inviting me to dinner to our long conversations, thank you!

There are many great friends at TU Delft who have always not even hesitated as I asked

them about user tests or advice about my design. Chia-Ling, Yujie, David, Stefan, Aravind, Mikel, Pranav, Marjolein, Puck, Team Breathe (Rojin, Myra & Saki), Tess, Gijs, Kamil; thank you all for being amazing co-travellers on my journey.

I would like to also thank Jeff Love for helping me with the HREC application for the project. You have been very patient and positive and was a person I could reach out to for any queries about data management.

I really am thankful for how TU Delft has shaped my design career. While I refrain from mentioning the names of my several coaches, thank you TU Delft and all my coaches for making me the designer that I am today.

Lastly, I would like to thank those without whom none of this would have even been possible. Jesus: Thank you for everything. Absolutely everything. My parents (John & Annie): Amm (My mom): Thank you for being my inspiration and for supporting me unconditionally. My scientific curiosity and passion for learning were instilled by you. It is a part of me that I perhaps cherish the most. Dad: Thank you for being the pillar that you are. Your strength and character has largely influenced me as a person and will shape me as a new Industrial Design Engineering Graduate.

Arun Abraham John

Executive Summary

Spiritual well-being is a facet of human well-being that has been identified as indispensable. As the field of positive design aims to design for human wellbeing, how might we approach designing for spiritual wellbeing?

Given the increasingly secular society we live in, addressing spirituality is a challenge. However, while the role of religion is seen to have diminished, there is a rise in past spiritual practices that were in the past considered esoteric. These 'esoteric' practices are now quite mainstream and a particular set of practices stand out in their reach, historical significance and now recently active scientific discourse; *Breathwork*. Due to the international Dutch phenomenon that is Wim Hof, breathwork is part of popular culture. Other than this, breath modulation also has very identifiable effects on the body. Could an ideal route to address spiritual well-being in a secular society potentially be breath-enabled design? The question raised is one that I hoped to address through a PhD for which I aimed to lay the foundations for in my master thesis.

To narrow down the scope of the project to one that could be completed in the given time frame, I focused on a group of individuals who were significantly affected by the COVID-19 pandemic as it started in February 2020. The students at TU Delft.

"More than a million young people have been receiving online education for over a year, and the consequences are serious. We are seeing mental and spiritual problems much more often, due to less guidance and social contact." - *Mark Rutte, Prime Minister of the Netherlands*

Addressing both my personal motivations for laying the foundations of a PhD and the concerns of the target group, the project was formulated according to the Research through Design methodology wherein the design created would be intended to address the needs of the target group and at the same time develop knowledge about how one could design for and better understand breath-enabled experiences.

Further, paraphrasing D.L. Spivak, an understanding of the spiritual and immensely subjective nature of such experiences can be furthered through an understanding of the associated objective i.e., quantitative qualities. Drawing from this, the project focused on looking at bio-sensor data and data feedback in particular. As a starting point, neurological data (Electroencephalogram data) and respiratory data (chest expansion and contraction) were chosen.

With the above mentioned focus, the project started with two goals:

1. *Create a breath enabled design that would aid TU Delft students in improving their spiritual well-being.*
2. *Create a system that design researchers can use to explore bio-sensor data and qualitative data in tandem so as to characterize and generate knowledge to design breath-enabled spiritual experiences.*

Literature research on the aspects of spirituality, on breathwork and how the breath affects the mind and body was conducted. I also had the privilege to attend a breathwork session guided by my external mentor, due to which I was able to understand how the various elements contribute to the experience and how they come together. To understand the target group better, research activities were conducted to shed light on how TU Delft students recount spiritual experiences and to understand what aspects of spiritual well-being revealed that inner peace - an aspect of spiritual well-being, was one students identified with and rated themselves lower on.

To address this, the first goal was revised to:

"My design goal is to make the journey towards acquiring inner peace accessible for TU Delft students through a desirable breath enabled experience they can practice."

Following this, a series of iterations were done with the aim of understanding what elements contribute to a breath experience. At the same time, bio-sensor data was collected and analysed to understand how the data could be processed in such a way so as to make it available as design material.

With the insights collected, several concepts were produced to map out the opportunities available. Personally, as feasibility was important to me given that I aimed to use what I create to further my own research, I landed on a concept which I could feasibly develop and one which would be viable for the research I had intended to conduct. This culminated in Project Vital.

Project Vital, is a research platform focused on producing knowledge about breath experiences and its contribution to well-being (goal 1) and Spritus, a data supported breath practice aimed at guiding TU Delft students on their journey towards inner peace (goal 2). In this case, Spiritus acts as a research through design artefact, which while addressing the needs of the target group also produces knowledge about breath enabled experiences.

At the conceptualization stage itself, the elements that were required for the same were outlined which included a website for Project Vital to showcase the work done and to enlist participants under its ambit. Spiritus fits into the website as one of these projects as well which invites participants to enlist in order to start their journey towards inner peace. This journey was formulated as one that started off with an in person session with the design researcher who would guide them through a breath session intended to quiet their mind during which their bio-sensor data would be collected. This is followed by a data-supported reflection process. This reflection process is meant to engage participants to start their journey as they would now be aware of how the breath affects their mind and body. The in-person session equips them to continue their journey through Spiritus towards inner peace as they continue with their lives. The bio-sensor data generated and the reflections people have on their data is meant to further knowledge about the breath; the raison d'etre of Project Vital.

After the conceptualization phase, another round of evaluation of the elements that were chosen after the first iteration cycle was done so as to verify its efficacy and to ascertain what data features are most relevant for the design and beneficial for the participants to reflect on. This addressed the gaps there were present and led to the final complete design which at this point was developed and ready to be deployed.

This enabled the testing of this design in a manner very similar to which it would be used in the real world context wherein the participants would get to experience Spiritus in a way that is close to how it would be and the data collected during the process would directly be useful for further research.

An evaluation of these aspects along with the improvements made was evaluated further with the intention of validating the design. Spiritus as a breath practice was distinctly different given that it utilizes data in a manner that allows for better, more detailed reflection, shedding light on what the breath experience truly entails. The data collected was also analyzed and processed for creating machine learning models which demonstrated the potential Project Vital has as a research platform. The data and insights produced indicated that data supported inquiry of experiences could be a new way of conducting research.

Through Spiritus and Project Vital, I hope to have created a system that improves the spiritual well-being of TU Delft students and at the same time to have set the stage for design researchers to deeply look into what the breath, an activity that is tied in with our very existence, has to offer.

Glossary

Design Researcher: While there are several definitions for a design researcher, in the context of this project, a design researcher is one who produces new knowledge through the artefacts of the design process (Zimmerman, 2003).

Archetype: It is an original model or "form" on which all other things are based. For Eg. the mentor archetype marked by qualities of a guiding figure for the hero of a story is seen in Gandalf from the Lord of the Rings and Dumbledore from Harry Potter.

Design Goal: A focal point defined to open up the solution space for the design process while avoiding any preconceptions of what the solution would be.

Interaction vision: A method where an experience that is familiar to the designer is used as an analogy during which its qualities are used to inspire and craft the interactions with the design.

Machine Learning: A field that focuses on having computers to act or provide output (predict) based on what it learnt from large datasets.

Data feature: Data that could be provided as inputs for a machine learning algorithm to learn from to produce an output with certain accuracy. Eg. ages of students in a class.

Machine Learning Model: The output of a machine learning algorithm that is trained on a set of data features. The model produced is able to provide a value as output when given a set of values. Eg. If a model is trained with the weather data and day of the week as input data features, and cricket scores which have been collected for one year as output, the model can be used to predict the cricket scores in the second year by providing the weather and day of the week at that point in year 2.

Table of Contents

1 Introduction

This chapter provides a general overview of the project which ncludes an elaboration of the background, aim of the project and the stakeholders involved. An overview of the adopted process and methodology is also provided in this chapter.

1.1 Rediscovering Spiritual Well-being

With the enlightenment and the new proponents of the enlightenment, such as Steven Pinker, we see in academia as well, a fetishisation of reason (Hazony, 2018). On the other hand, while not as powerful a voice as it used to be, religions and religious scholarship hold onto what they hold as an all defining truth. Even as certain religious or spiritual communities invite scientific scrutiny, it does so mostly in a patronising manner where it holds itself superior to and beyond the scientific method. This, unfortunately, leads to a dearth of dialogue where either party fails to benefit and learn from the other.

There, is however an underlying need for transcendence that all human beings share. This lies in a 'non-physical dimension of awareness and experience' and is that which is best described as spiritual (Ellison, 1983). This dimension is one that is often reported in spiritual and religious communities and, seldom and with scepticism in the scientific realm. While defining the 'Spiritual' is impossible, attempts have been made to understand the indicators of the spiritual and more concretely, spiritual well-being. As these measures still depend on subjective human experience, there is still a lack of objective understanding in terms of what these experiences truly entail.

The capacity of human beings to experience certain experiences as those that are spiritual or those that improve spiritual well-being are immensely valuable to just hold within certain echo chambers. It is important to operationalize these concepts with the aim of 'transcending' its current limitations.

1.2 Radical Responsibility During Emerging Adulthood

Individuals constitute their understanding of the world largely through their personal experience of the world around. As children, our values and worldview are shaped by our parents and educators and it is mostly left unchallenged. This applies to religious identification, spiritual sensitivity or scientific temperament among other aspects. During childhood, individuals are at the receiving end of education for the most part.

This passive nature of receiving education gets challenged as individuals reach the age of 18, which is when in emerging countries these individuals pursue higher education. Arnett calls the ages between 18-25, 'Emerging Adulthood'.

This period is marked by a perceived departure from normative expectations of childhood and not entering the expectations of adulthood. During this state of flux, these individuals explore and ponder upon the routes that they could explore to help them define their roles in society. This stage hence is marked by a sense of opportunity as well as instability. While the entry to this period is more generalisable, many people find themselves transitioning to adulthood also at even later ages based on their choices or circumstances (Arnett, 2000).

At this age, a majority of individuals in the western world pursue a college education. As these students are faced with many worldviews, the comfort of the passive acceptance of an all-encompassing worldview is lost. Especially for those pursuing STEM fields, reason and that which can be proven often objectively becomes a favourable worldview to adopt to stay within the discourse. However, due to this, the ineffable nature of the spiritual realm is left unexplored or worse, dismissed. That said, a ripe opportunity does exist in this state of flux to make a convincing case to embrace the spiritual.

The case to take radical responsibility of what one believes through careful inspection and personal experience rather than to accept world defining truths.

1.3 Breath-enabled Well-being

In this project, based on the advice from my project chair, Prof Derek Lomas, I specifically looked at the role of breath in contributing to subjective well-being. I started this project with little experience of the potential of breath and came in with a healthy amount of scepticism. Being from India, I was always around people who practised Yoga or more specifically Pranayama for which the predominant physiological component is the control of breathing. That said, I never did completely accept the notion due to my own allopathic indoctrination.

Wim Hof has been advocating for the power of the breath in the Netherlands and the world. His readiness for subjecting what he preaches to scientific scrutiny without being condescending of the scientific method but rather using it as a tool for strengthening his message is inspiring. That aside, the breath has also been prevalent across history in traditional spiritual practices and rituals and has reportedly led to *altered, transcendent states of consciousness.*

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1.3.1 Altered States of Consciousness

To clarify, the term altered states of consciousness, I first define what I mean by a 'state of consciousness' and 'Normal state of consciousness'. A state of consciousness is the relationship between the factors of consciousness, (for example, vision, sound, emotions, memory, thoughts etc.) and how these influence how the individual interacts with the world around them. A normal state of consciousness is defined by that in which the subjective experience of an individual closely resembles the actual world around (Revonsuo et al., 2009).

An altered state of consciousness can be identified by a deviation from what is characterised by a normal state i.e., when what is perceived does not reflect the state of the physical world.

1.4 Embodied Cognition: Mind and Body, as One

Varga & Heck (2017) in their research suggest that the body exerts a significant effect on cognition and that the body is also a 'partial realizer' of cognitive processes that are distributed amongst both neural and non-neural systems. Particularly, respiration has been shown to have a significant bottom-up effect on cognition. Based on this understanding, a specific focus was placed on the response of the brain to breathing.

The experiential qualities associated with this relation is particularly interesting and will be explored through the course of this project by looking into the relationship between breathing, neural response and how participants recount their experience.

Exploring these relationships enable:

1. Participants in Breathwork to understand their experience in an entirely new way and in a way they can objectively communicate to others.
2. Breathwork facilitators to approach their practice in a data-driven manner.

3. Researchers both within Industrial Design and beyond to explore spiritual experiences and broadly altered states of consciousness while staying within scientific discourse.

One of my primary motivations, as I started this project, was to attempt to lay the foundations for a PhD with a focus on using bio-sensor data and qualitative data to promote human wellbeing. The aims of the project and the method were also defined with the support of my supervisory team to address this personal aspiration for a career in design research.

1.5 Project Aim

This project started by aiming to explore the questions below:

How should designers approach the design of spiritual experiences in a secular context?
This addresses the challenge the subjective nature of spirituality presents designers as they attempt to design spiritual experiences in a secular society given that a large number of people in the Netherlands do not practice any particular religion actively.

How might we design data feedback to assist breath-work? What data might characterize spiritual or transcendental experiences?
To bring the spiritual into the scientific discourse, as Spivak writes, requires a quantitative approach (Spivak, 1992). To enable this, looking for the right physiological data to explore spiritual experiences or more generally altered states of consciousness, is paramount. This would enable juxtaposing how participants recount their experiences along with their physiological data.

Personalized feedback could prove to be valuable given that breath-work affects each individual in a different manner. An exploration of the data could also help in the data-driven classification of spiritual experiences in association with breath. For the scope of this project, respiratory data and EEG data were identified as possible physiological indicators.

Can breathwork help TU Delft students achieve greater spiritual well-being?
The majority of the students at the TU Delft are 18-25 years of age and as mentioned before belong to the group in the 'Emerging Adulthood' phase. Given the opportunity for a change in worldview, the students of TU Delft were chosen as the target group. It has also been noted that a lack of spiritual well-being among students is shown to decrease their ability to handle high stress they encounter on a regular basis. This project would aim to explore whether breathwork can improve their spiritual well-being.

1.6 Goals

With the aim of exploring the questions mentioned above, the following goals were defined:

1. *Create a breath enabled design that would aid TU Delft students in improving their spiritual well-being.*
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1.7 Approach

Unlike traditional problem focused design processes, positive design as a means to design for subjective well-being focuses on opportunities to enable people to flourish and to have a lasting impact on their lives. (Desmet & Pohlmeyer, 2013). This ethos extends to the design for spiritual well-being on understanding it is indispensable to subjective well-being.

I would argue that design specifically plays a crucial role in understanding and drawing from aspects of the human experience that are considered spiritual.

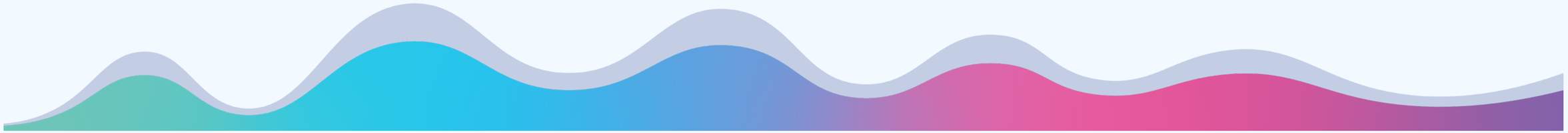
Design assimilates multiple perspectives and explores the experiences themselves through the artefacts of the exploration i.e., through prototypes.

1.7.1 Research Through Design

In order to best serve the goals defined for the project, an approach that incorporates 'doing design as a part of doing research' was adopted. This approach is called *Research through Design.* This method entails the creation of an artefact that can take the role of a product or service but at the same time actively contributes and generates knowledge. This generation is done through a process of making the prototypes, the results of the user testing and reflection. This reflection process is inherent in the act of making and analysis with the aim of generating knowledge (Stappers & Giaccardi, 2017).

In this project, design research is carried through iteratively doing design. As Zimmerman (Zimmerman, 2003) has stated, this mode of design research not only addresses the identified needs or problems of the target group but further raise new questions. This approach hence also helps me lay the foundations for a PhD position as well. In this project, prototyping sessions were conducted with the intention of sticking to a strict time window as a COVID-19 safety precaution. This also led to a kind of iterative prototyping that focused on elements of the concept which were later collated, evaluated and analyzed to lead to the final design. This final design was validated and the results were used to reflect on what the outcomes mean for the future.

The next pages illustrate the process adopted during this project (figure 1).



Defining the Scope

Set the stage for the project outlining the scope and aim of the project.

Understanding Spirituality, Breath & the Body

Conducted literature research to identify the relationships between the 3 elements identified within the scope.

Exploring the Target User

Conducted generative sessions and floated a questionnaire to understand how spirituality is understood by students at TU Delft.

Design Cycle 1: Goal Oriented Parametric Exploration

Based on the exploration of the target group and the resulting refined design goal, a breathing modality and the associated data features were identified and tested.

Design Cycle 2: Concept Definition & Evaluation of Elements

The insights of the the parametric exploration were used to define a concept and further its individual elements were evaluated.

Final Design: Project Vital presents *SPIRITUS*

The refined elements were put together to detail the final design.

Evaluation, validation and Reflection

The final Design is evaluated and validated. Reflections on what the design could entail is also further shared.

Figure 1: Visualization of the project process

2 Spirituality, Breathwork and the Body

This chapter presents an overview of the literature research conducted to understand how spirituality has evolved over the years and its current relevance. The role of breathwork in improving human well-being and altered states of consciousness is covered as well. Certain kinds of breathwork are explored to understand the possible qualities of the breath-enabled spiritual experience. Finally, possible effects of breathing on cognition and affective states is explored along with identifying the possible data parameters that could be used for measurement.

2.1 Spirituality

2.1.1 What is Spiritual-Well Being?

Pamela Reed states that self-transcendence is a stage that people should attain to be fulfilled and to have a sense of purpose (Reed, 2008). This involves a non-physical dimension of awareness and experience which could be referred to as spiritual. The distinction that could be drawn between religion and spirituality is that one is a subjective experience of the transcendental nature of the world around while religion prescribes a lens through which this experience is to be understood (Kelly, 1995).

Spiritual well-being is another term that many have tried to operationalize, with still no definitive consensus. It has been often noted to consist of two identifiable components, namely the connection to a higher power which could be termed the religious component and secondly that which is concerned with living a life of purpose i.e., a sense of existential well-being. Both of these components point towards that which is transcendent or that which states something beyond what is momentary (Ellison, 1983). Traditionally there has been an overlap between the two aspects but given the rise in the number of people moving away from religion, these principles stand to be tested.

Fisher's model of spiritual well-being posits that spiritual well-being has inter-related domains that draw from and build upon each other (Gomez & Fisher, 2003). These domains are (figure 2):

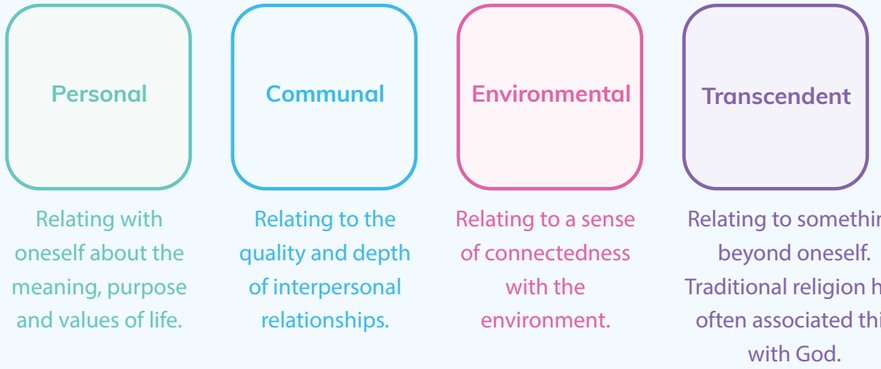


Figure 2: Domains of Spiritual Well-being

As can be observed the dimensions that Fisher has identified also address both the traditionally religious and the existential. Religious institutions reduced the agency the individual had in terms of defining the personal, communal, environmental and the transcendent, thereby providing a sense of perceived objectivity. With the decline of such systems or the decrease of the dependence on these institutions, the landscape is wide open to reconstruction.

2.1.2 A Departure from Religion?

Elementary forms of how we currently perceive and understand religion have existed for thousands of years. Since its conception, it was embellished by certain rituals and symbols and were practised and defined by specific and often geographically distant groups of people.

The philosophical treatment of perceived reality by the Greeks around 450 BC resulted in small groups of people starting to make sense of life independent of the supernatural. The dialogue persisted and flourished to this day with an increasing number of people questioning the very relevance of totalising religious explanations for the way one should live life. While aspects of organised religion such as that of a community committed to a defined creed have their merits individuals are looking towards achieving fulfilment through other means that support having authority over and caring for one's own self (Waggoner, 2016).

2.1.3 The Esoteric as a Route to Reconstruction

As mentioned, the decrease in the dependence on conventional religion has now left us with the danger of a world that might suffer from a lack of objective truth. If there is no singular truth and if everything is relative and subject to interpretation then the individual or groups of individuals are left to construct their own sense of truth. The risk here is the loss of aspects like the spiritual which were traditionally entangled with the totalising truths religion put forward.

This paradigm shift has also led to the shackles being taken off the western mind when it comes to practices that were once considered deviant and were practised in secret.

Ancient practices involved the use of drumming, chanting, breathing, sensory deprivation, pain and such to induce states of consciousness that aid one towards an altered state of being which provides individuals with a sense of being that is beyond themselves, i.e., a sense of transcendence. Some rituals also made use of psychedelic plants such as hemp, the Mexican cactus peyote, psilocybe mushrooms and the African shrub eboga. These transcendent states were also brought up through adopted spiritual practices which involved meditation, concentration and specific movements such as those seen in yogic practices.

The recent resurgence of such methods towards the spiritual has been met with criticism from those who practice traditional religion. This criticism has reached an extent where they look upon aspects they have in common between esoteric practices and their own religious practice with skepticism (Grof, 2000). Timothy Leary, when questioned about the use of psychedelics and its safety retorted, "Ah, consciousness is dangerous." LSD, he says, is a key.

Figure 3: Ayahuasca, made from Amazonian plants, is also known as 'the key to the universe'

The scientific community too, due to its materialistic inclinations is also sceptical and often dismisses that which is called spiritual. As it does not actively distinguish between the pathological and the spiritual, the resistance to study such phenomena remains.

2.2 Breathwork

The control of breathing has been seen ever since ancient times to be a means to bring about altered states of consciousness. Often it has often been associated with rituals bringing about these states of mind. This has even been encoded in the languages used by several cultures as well.

All these words associated with breath had spiritual connotations attached as shown in figure 4.

Ancient cultures like these knew of the power of controlling one's breathing to reach altered states of consciousness. Variations such as extremely slowing or

Indian Tradition | ***Prana*** | Sacred Essence of Life
Chinese Tradition | ***Chi*** | Cosmic Energy
Hawaiian Tradition | ***Ha*** | Divine Spirit
Hebrew Tradition | ***Ruach*** | Creative Spirit
Greek Tradition | ***Pneuma*** | Spirit
Roman Tradition | ***Spiritus*** | Breath of Life

Figure 4: Various traditions and their association with breath

increasing one's breathing rate, hyperventilating and holding one's breath; all of these had varying effects on the human body and mind. A predominant example in the Eastern tradition is Pranayama. This and practices similar to this, consist of a variety of breathing exercises that involve changing aspects like those mentioned above. On the other hand, Buddhism and Buddha emphasised on an awareness of the breath. In Buddhism the focus is to be aware of one's own breath and to increase awareness of the whole body through the breath (Grof et al., 2010).

Until the last few decades, none of these altered states of consciousness was seen as normal and were pathologized by western medicine. This started changing in the 1960's mainly due to the contributions of Stanislav and Christine Grof, Leonard Orr and Sondra Ray. They initiated the process of bringing 'Breathwork', a term now used to define a host of breathing practices, into the mainstream with the two original branches of breathwork namely, *Holotropic Breathwork and Rebirthing.*

2.2.1 Holotropic Breathwork

Stanislav Grof, the co-creator of Holotropic Breathwork observed the nature of the breath while conducting research on LSDs and altered states of consciousness. Based on these insights, Stanislav and Christine Grof developed Holotropic Breathwork.

As certain altered states of consciousness are due to neurological problems such as trauma, intoxication and infections, Grof found it important to define altered states that he sees as an expansion of the consciousness as Holotropic, which means "moving towards wholeness." (Grof, 2000).

In order to lead people to 'Holotropic' states of consciousness, people are asked to breathe deeper and faster than they usually do. The guidance is not strict and the participant usually finds their own rhythm in 15 to 20 minutes. Music is also an important aspect of the sessions where the selection of music is done in such a way as to avoid people thinking about the meaning behind the music itself. People have reported experiencing past memories, their own birth and even past lives.

2.2.2 Rebirthing

Leonard Orr, the creator of Rebirthing is said to have developed this technique while he was experimenting with various patterns of breathing while immersed in a tub filled with warm water. During this process, he is said to have experienced his own birth.

Rebirthing, the method that was developed, involved 'Connected breathing'. Connected breathing is practised by exhaling and inhaling till the extent of one's lung capacity without pausing between breaths. This implies that there is no retention of breath at any point of time. Rebirthing is conducted with more involvement from the facilitator in terms of continual guidance, compared to Holotropic Breathing. Unlike Holotropic Breathing, music is also not an integral part of Rebirthing. People have reported experiencing states that are similar to those mentioned by those who experience Holotropic states at least in terms of their descriptive quality such as seeing one's own birth or suggestive images that remind them of aspects of their past (Ashton, 2021).

Sondra Ray, one of the people who experienced Rebirthing, went on to be called the 'Mother of Rebirthing'. This is due to her experience in training facilitators and her expertise in realizing the impact of birth-related trauma on people's lives.
Currently, there are several types of Breathwork, all of which are unique in their own ways. Some of the more popular ones are the Wim Hof method, Liberation Breathwork, Integrative Breathwork and the breathwork that my mentor practices, Biodynamic Breathwork and & Trauma Release System.

2.2.3 Practical Concerns

The kinds of breathwork mentioned above were explored to understand the qualities of the experience that accompany altered states brought about by breathwork. That said, to attempt to create such powerful experiences on my own without proper training would not be safe for participants.

2.3 The Body

The kinds of breathwork mentioned above were explored to understand the qualities of the experience that accompany altered states brought about by breathwork. That said, to attempt to create such powerful experiences on my own without proper training would not be safe for participants.

Based on the notion proposed by Varga & Heck (2017) of the body as a partial realizer of cognitive processes and the proven bottom-up effect of respiration on cognition, a deep dive into understanding this phenomenon was important in order to create a system that can reliably measure and capture the associated data.

2.3.1 Understanding the Brain

The brain consists of billions of cells that communicate with each other through both electrical and chemical activity. This complex network and its processes enables all our cognitive processes such as thought, memory, reasoning and even our ability to empathize.

This electrical component of the brain activity can be measured using Electroencephalogram (EEG) readings. Electrical activity on the surface of the brain can vary from 1-2 hz to 100 hz. Specific frequency bands have been defined namely, Alpha, Beta, Gamma, Delta & Theta (figure 5). For the purpose of this project, it was important to know the possible experiential attributes of these frequencies.

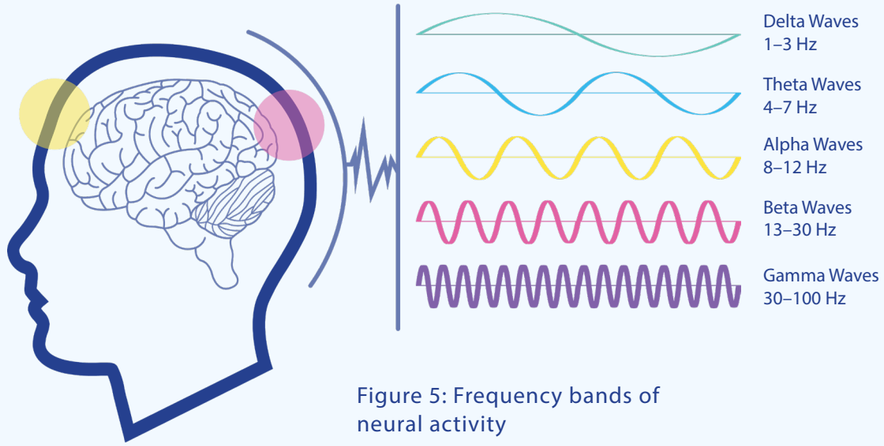


Figure 5: Frequency bands of neural activity

Delta Waves (0-4 hz)

This frequency is dominant when people are in a state of deep sleep.

Theta Waves (4-8 hz)

This frequency is dominant during memory retrieval and just before falling asleep. Theta bands are associated with periods when people are open and suggestible as well.

Alpha Waves (8-12 hz)

This frequency is dominant when people are feeling relaxed and are in a state of calm focus. It is seen when people are less stimulated by external factors. This state of calm focus is also associated with meditation and consequently also is the alpha frequency band.

Beta Waves (12-30 hz)

This frequency band is dominant when people are planning, processing information or worrying.

Gamma Waves (35-45 hz)

This frequency band is dominant during bursts of creativity and is associated with eureka moments or when people have very clear insights. This is often seen when various brain regions work together to integrate information.

2.3.2 Altered Cognition through the Breath

Zaccaro and Penazzi have defined a neurophysiological model of breathing techniques and how it affects brain activity and consciousness (Zaccaro & Penazzi, 2019). They identify the following factors (figure 6) as one of the ways that contribute to altered states of consciousness:

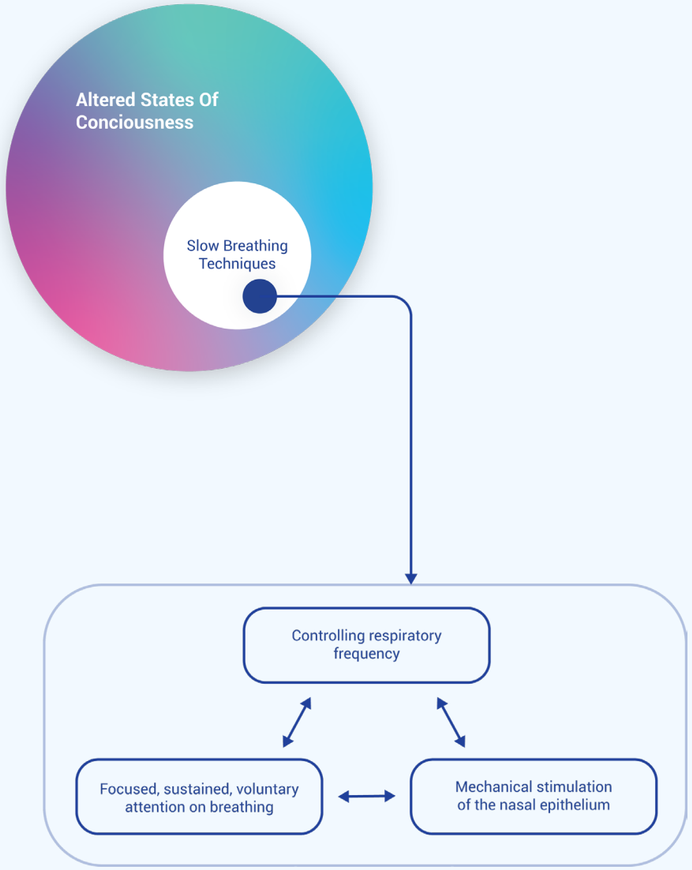


Figure 6: Neurophysiological model of slow nasal breathing techniques as a subset of experiences that lead to altered states of conciousness

Controlling respiratory frequency:

Slow breathing is related to areas in the brain responsible for attention, arousal and emotional expression. It has been noted that there are positive effects on cognition, relaxation is brought about and there is a reduction in anxiety. There is also a mention of its contribution to improved quality of life and well-being.

Focused, sustained, voluntary attention on breathing:

This is related to the regions of the brain that are responsible for attention and working memory as controlling the breath is a voluntarily modulated process. The brain regions that respond to activities that involve top-down attention on breathing and the associated state of consciousness are the default mode network and the anterior cingulate cortex.

Mechanical stimulation of the nasal epithelium:

Mechanical stimulation here refers to the stimulation that is caused due to the pressure of the airflow. Breathing through the nose is shown to have a definite effect on neural activity as opposed to breathing through the mouth.

Zaccaro & Penazzi (2019) proposes that these three aspects of the model on interacting with each other could potentially bring about altered states of consciousness. While the authors do not touch upon faster-paced breathing techniques in the model, the model does provide a framework and a starting point for understanding and identifying the parameters of the breath that affect certain aspects of cognition.

2.4 Experiencing Breathwork

In order to understand what a breathwork session entails, I took part in a session guided by my external mentor, Lisanne van Niekerk who is a Biodynamic Breathwork and Trauma Release System (BBTRS) facilitator. BBTRS was also uniquely interesting to look at as it involved the use of 6 elements namely meditation, breath, sound, movement, emotions & touch. Having a clearer understanding of how a combination of these aspects are used would shed light on a breath enabled experience that could be created and what could be the potential benefits of each of these aspects.

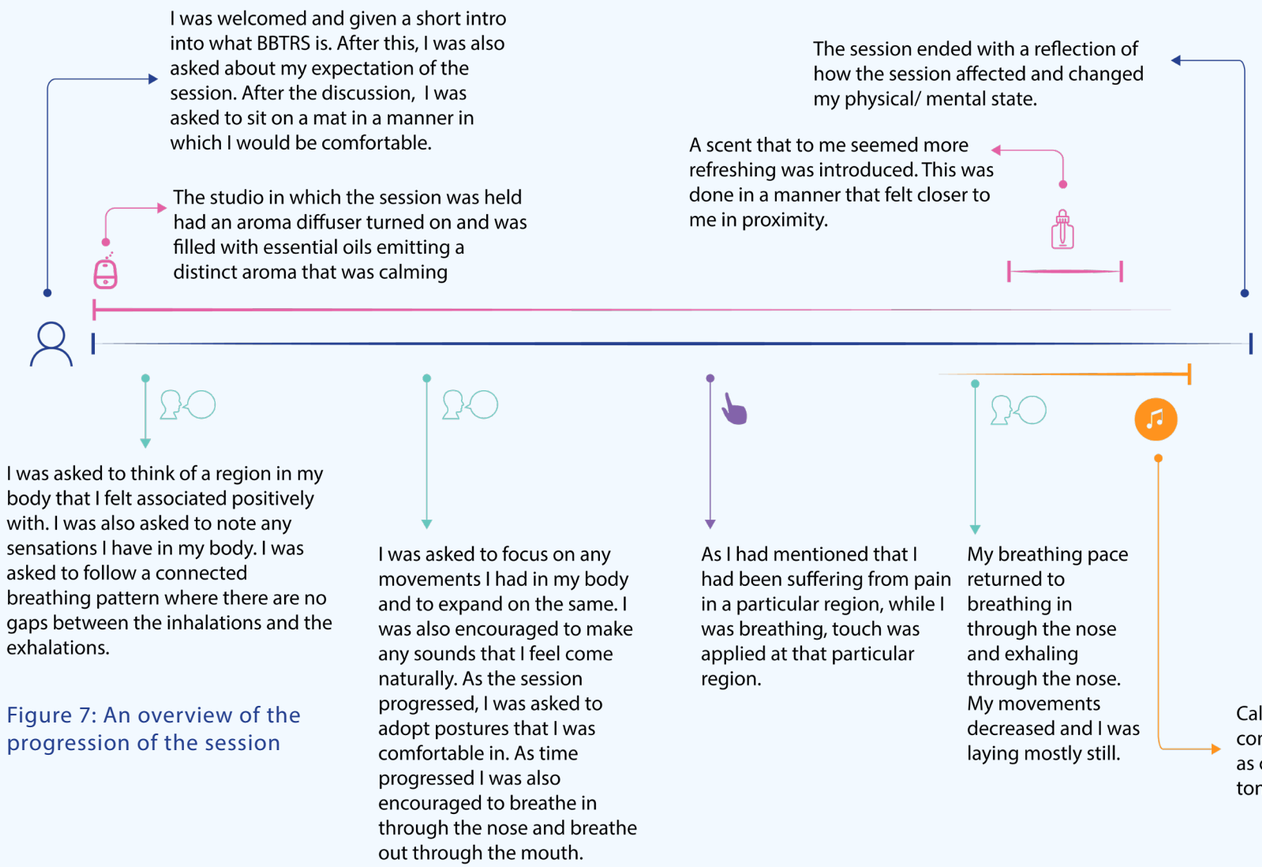


Figure 7: An overview of the progression of the session

The overview shown is in no way as detailed as the original experience. It was truly one that was personalized to what I was going through at each moment as observed by Lisanne. While characterzing what this experience entails would be interesting, the scope of the project involved looking at cues and insights that could be instrumental as I go forward in the design process.

Insights from the Session

- The use of various stimuli throughout the session had a significant contribution to how immersed I was. It provided a sensation of dissolution of the surroundings and enriched the experience I had with my eyes closed.
- The focus on finding a pace and position I would be comfortable in had a significant impact on the experience. This process was one that took time and one for which I was given time to adapt to.
- There were moments during the session where I had no thoughts but rather was completely present in my body. Characterizing experiences like these, as mentioned previously is a challenge that needs to be addressed.
- The integration after the session ended with me reflecting on the experience with Lisanne was hugely beneficial. I found a distinct difference in my mind and body between how I had started and how the session had ended. For instance, the pain that I had when I started the session turned to not one of pain but just one where I was aware of a particular sensation. That said, I would not call the reflection process one that is straightforward or easy to do. As I was preparing the visual for presenting the overview as well, it proved difficult to pinpoint when a particular sensation arose or even what that sensation meant. This would be interesting to look into as there were several points during the session that were noticeable and had certain feelings associated with them.

3 Exploring the Target User

This chapter presents an exploration of how the target user, i.e, how the students of TU Delft perceive and express spirituality and spiritual well-being. The chapter elaborates on the qualitative methods used to understand how students recount peak spiritual experiences and aspects of their daily life that they see contribute to their spiritual well-being. A survey was also conducted to identify what aspects of spiritual well-being resonate with students and how well do they rate themselves on these aspects.

3.1 How do TU Delft students Recount Spiritual Experiences?

Earlier in the report, I had mentioned states of consciousness and what could entail an altered state of consciousness. An important aspect was the orientation of the self towards the external world and a change to the same. With this in mind, generative sessions were conducted for which I had based the structure of the interviews on the concept of the Hero's Journey and that of Universal Archetypes as defined by Joseph Campbell.

3.1.1 The Hero's Journey

Joseph Campbell concluded that all myths are based on one single story - a monomyth. According to him the several myths we encounter and even those created by us reveal facets of this monomyth (Campbell et al., 2014). The several stages of this monomyth are shown in figure 8. As Johann Wolfgang von Goethe has written, "All that is, is a metaphor.". Even as we share our experiences, we most often employ metaphors to describe the qualities of the experience as individual words often fall short of describing the same comprehensively. The generative sessions were conducted with the intention to discover this potential narrative.

Figure 8: Stages of the Hero's Journey

3.1.2 Recounting Peak Spiritual Experiences

To understand how the students of TU Delft recount spiritual experiences, 4 generative sessions were conducted online (Using Miro & Zoom). To understand how students orient themselves in the experience, a set of images of characters from pop culture was selected from which they could choose the character they relate to in that experience and another set of images were used to illustrate the nature of the experience (figure 9).

The experiences participants mentioned:

1. Experience caused due to meditation
2. Experience due to seeing someone miraculously coming for help to help a loved one when the participant prayed
3. Experience caused due to seeing the end of the Great Wall of China
4. Experience of climbing the Bhagsunag Falls

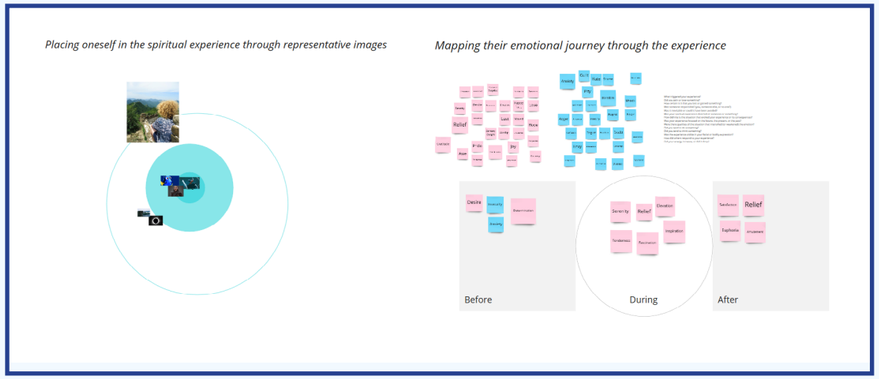


Figure 9: Generative Session - Peak Experiences

The main takeaways from these sessions were:

1. Spiritual experiences are accompanied by states of increased attention. "Addition by subtraction.".
2. Spiritual experiences are pursued when other methods don't seem to work.
3. Negative emotions that are always felt also seem to fade away after a spiritual experience at least for a short while even after the experience.
4. In most cases, there is an expectation of some sort from a spiritual experience. The spiritual aspect is validated when the expectation is met. The expectations are often about relief from the stress related to unsurpassable barriers.
5. Spiritual experiences benefit from other individuals that share the experiences and react to them similarly. The effect is harmed by people who do not experience it the same way.

3.1.3 Recounting Spiritual Experiences in Daily Life

After looking at peak experiences which people were able to express with relative ease, it was also important to look at spiritual experience in the context of their daily lives. This was done using the PrEmo images to identify how their emotions were during the day and how it changed around the experience (figure 10). 4 such sessions were conducted and a TU Delft psychologist was also interviewed to understand his point of view when it came to spiritual well-being in the daily lives of students.
The main takeaways from these sessions were:

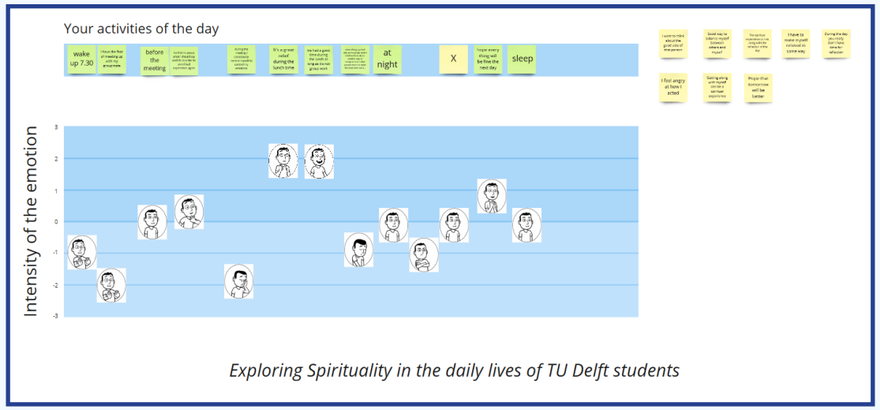


Figure 10: Generative Session - Daily Experiences

1. Students do not often think about spirituality. The term causes them to fixate on religion. Further clarification regarding the existential aspect was needed to continue the interview.
2. Experiences that were identified as spiritual through the interview were dependent heavily on self-reflection. This reflection was focused on personal values and acting upon those values to give life meaning. The process of reflection was noted to be spiritual. An experience can be spiritual even if it is accompanied by a painful realization. The realization helps in corrective action. Self-acceptance and acknowledging the capacity to improve is seen as the desired result of reflection.

3. The interview with the TU Delft psychologist reinforced a lot of the comments mentioned by students. He mentioned that reflecting on values and taking action accordingly has proven effective in his experience. This was one of the aspects of the experiences people had which they said contributed to their spiritual well-being.
4. While interviewees struggled to pinpoint a spiritual experience, personal stories and experiences made it easier for them.

3.1.4 Understanding Our Hero's Journey

The results of the sessions were compared to and analysed using the Hero's Journey framework to map out the underlying narrative structure of the experience along with its affective qualities (figure 11). The results of the interviews and the analysis is shared in appendix 1.

Even after the experience, the feeling of the experience persits for a while longer in the process of getting back to a normal state of mind.

This is the 'aha' moment of the experience that is associated with a sense of clarity and at this point, the students mentioned they feel unburdened or relieved from whatever was the reason they sought out the experience.

The experience feels satisfying when there is a barrier to cross to reach the same. As these experiences are sought, more often than not as a last resort, in this process, they deal with themselves. While this process of dealing with oneself is difficult, it is certainly one that adds to the experience and the process.

The participants mentioned that the experience occupies their mind and all other thoughts and worries fade away. This state is a state of serenity.

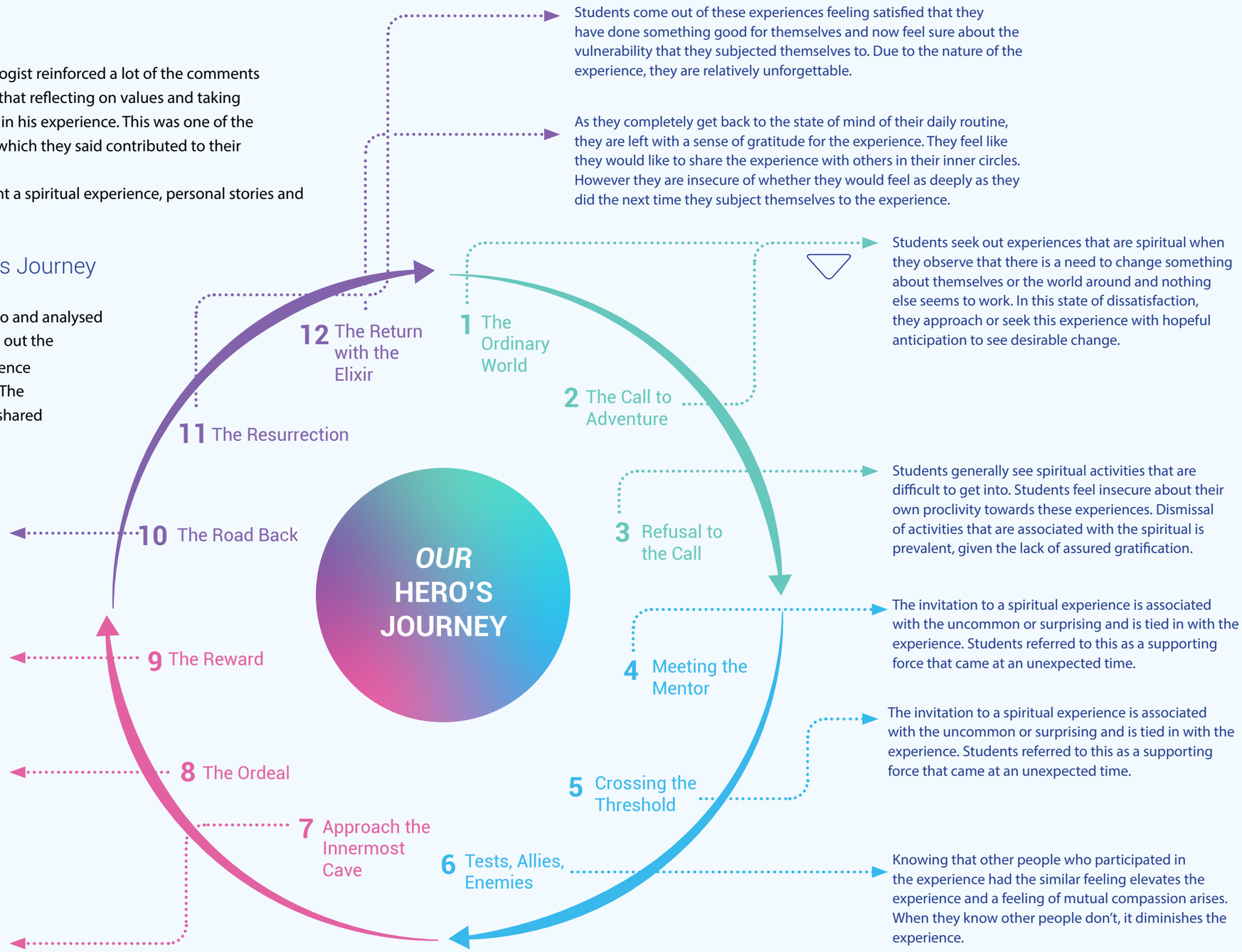


Figure 11: Hero's Journey - TU Delft students

3.2 Gauging Spiritual Well-being

Since my research activities revealed that there was a reluctance to the term Spiritual well-being, it was important to know what aspects students relate to and to what they do not. In order to understand this, an appropriate questionnaire was selected to understand what aspects students relate to and how they score themselves on the several parameters of the scale.

Gomez & Fisher have elaborated on what they see as elements of spiritual-well being. These were, as mentioned previously, categorized as the personal, communal, environmental and the transcendent. Based on their research, they devised the Spiritual Well-being Questionnaire which consisted of 20 items (5 point likert type) pertaining to various aspects of what constitutes spiritual well-being according to them. This model and the subsequent framework was chosen for this project as the questionnaire itself was formulated with a sample (university students) that most closely reflected the target group for the project. It also is seen to be the most applicable in more secular contexts where participants would not be alienated based on religious inclination (de Jager Meezenbroek et al., 2010)(Lu et al., 2018).

The main insights from the results (39 respondents) of the survey are shown below. The complete results can be found in appendix 2.

Results

1. The results were in accordance with the assumption that the crowd is secular. Those aspects of spiritual well-being that touch upon religion were either ignored or the students disagreed with religion being important or relatable i.e., the distribution was right skewed.
2. Generally, most other aspects indicated were scored 4 or 5 on the scale by a large majority of respondents i.e., the distribution was left skewed.
3. It was interesting to note however that students felt that they lacked inner peace. Only 36.9% of students indicated that they have a sense of inner peace (4 or 5). It also proved to be a component of spiritual well-being that students were able to identify with.

4 *Design Cycle 1:* Parametric Exploration

This chapter presents the exploration and definition of the external parameters that can help achieve the design goal and reflect the qualities of the interaction vision. This is done in a total of 4 iterations, which look at various combinations of the elements to come to the most appropriate set of parameters. During these iterations, the data collection and exploration system is also defined and developed with the goal of best utilizing the data related to the design goal.

4.1 Defining the Design Goal and Interaction Vision

4.1.1 Design Goal

As mentioned previously, the project had started with 2 goals which were:

1. "Create a breath enabled design that would aid TU Delft students in improving their spiritual well-being."
2. "Create a system that designers can use to explore bio-sensor data and qualitative data in tandem so as to characterize and design for breath-enabled spiritual experiences."

Based on the literature research and the interviews conducted with students, the first goal was redefined to:

"My design goal is to make the journey towards acquiring inner peace accessible for TU Delft students through a desirable breath enabled experience they can practice."

The design goal focuses on inner peace as it was an aspect of spiritual well-being that resonated with TU Delft students. In addition, 63.1% percent of respondents of the survey rated themselves 3 or lower (on the 5 point likert type scale) on the questionnaire item pertaining to that of them having a sense of inner peace. Figure 12 shows inner peace as a component of spiritual well-being according to the formulation by Gomez and Fisher.

Accessibility as mentioned in the design goal, refers to the ease of access participants have to the practice when they feel the need to and also their ability to understand the experience and comprehend the benefits of their own personal experience.

The second goal defined initially was addressed through iterative exploration and definition of the relevant data features and their most effective representation when pertaining to this design goal.

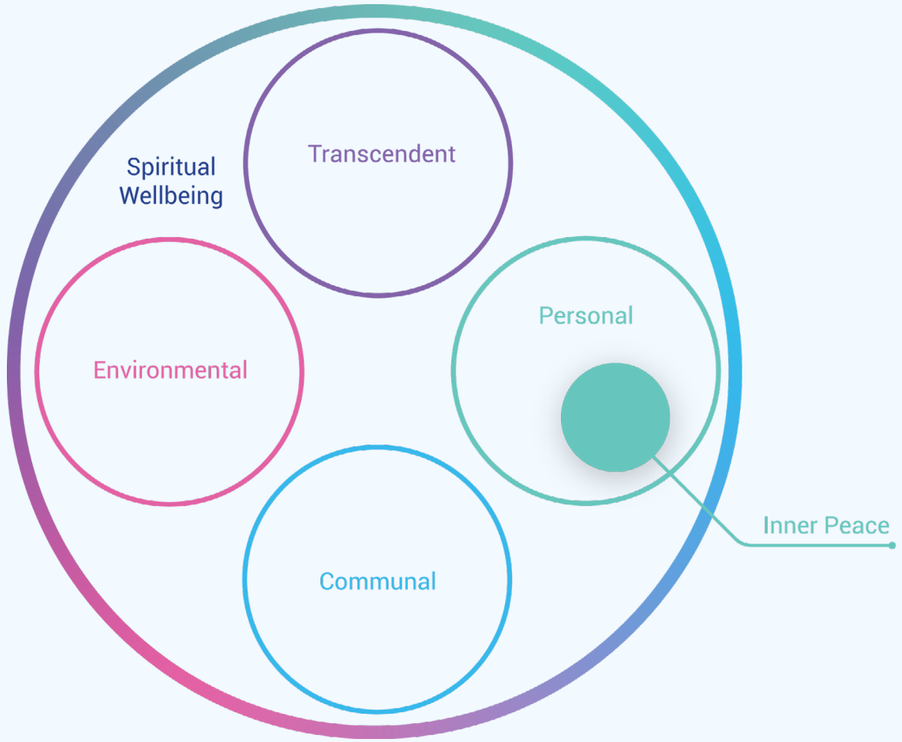


Figure 12: Inner Peace - A component of personal spiritual wellbeing

Defining Inner Peace

While there is no general consensus regarding how one can precisely define inner peace, attempts have been made to operationalize this term. For this project, the notion of inner peace is one that is based on the definitions proposed by Ward (2010) and Gogava, Poghosyan, and Aslanov (2018).

"Inner peace refers to emotional self-regulation and the ability to achieve a state of dynamic emotional equilibrium and competence" - Ward, 2010

"a state of calm, serenity and tranquillity of mind that arise due to having no sufferings or mental disturbances such as worry, anxiety, greed, desire, hatred, ill-will, delusion and/or other defilements"- Gogava et al., 2018

As suggested in the design goal, the goal is to make this state of reduced mental disturbance and emotional self-regulation more accessible. The project aims to hence guide TU Delft students to a state of higher competence to head on their journey towards inner peace.

4.1.2 Interaction Vision

Interacting with the design should feel like ***"Painting like what one feels like through expressive brush strokes using water-colours."***

Qualities:

Slow, Intimate, Controlled Disorder, Calm Focus

Properties:

The 'predictable' unpredictable nature of the water-colour, the deliberate amount of pressure applied on the brush strokes, building the image as the person progresses, self-exploration

4.2 Conceptual Starting Point - Breath Enabled Journey

While the mode of delivery of the design could be clearly understood through prototyping given the strongly subjective experiential nature of the breath, a conceptual starting point can still be defined based on the insights gathered until now. As the experience associated with breathwork varies each time it is practised, the benefits or difficulties involved also vary. As mentioned in the design goal and reflected in the interaction vision, the emphasis should be on a journey towards inner peace accepting the difficulties along the way as part of the process; each journey is special in its own manner. The design can support this journey of self-exploration.

4.3 Resonant Breathing for Inner Peace

There are a large number of breathing techniques and online sources suggest inconsistent benefits. Due to this, an exploration of scientific literature was done to look at breath experiences that suggest the desired experience with sensor-data backed evidence. Sherlin, Muench and Wyckoff (Sherlin et al., 2010) in their research discovered when participants with high levels of anxiety engaged in a breathing pattern (Lin et al., 2014) of 5.5 seconds equally for the inhalation and exhalation reduces stress response by quieting certain regions of the brain.

Following this breathing results in synchronisation of various bodily systems as well (Tarrant, 2017). Following this pattern has been noted to show a dominance of alpha band activity in the anterior cingulate cortex (ACC) and a decrease beta band activity in the posterior regions of the brain that include parts of the default mode network (DMN). *This quieting down of the brain on following the breathing pattern and the discovered associated decrease in the stress response is hypothesized as an experience of accessible moments of inner peace as defined previously.*

Furthermore, frontal alpha power (observable in the ACC as well) is observed to be seen in states of calm focus and flow (Katahira et al., 2018) (Tarrant, 2017). Similarly, beta power that can be observed from Pz is seen to be associated with mind wandering which includes such thoughts about oneself, others and planning when not attending a particular task (MacLean et al., 2012).

These reasons, the noted effects of the breathing practice and the fact that this technique is safe to test with participants without underlying conditions led to it being chosen as the technique best in line with the design goal.

4.4 Practice Oriented Design

Based on the initial conceptual direction, a framework that best fits the process of a journey that integrates into the lives of people is that of a practice. For the purpose of understanding how a practice could be designed, it was important to know what a practice entails. To understand this further, I looked in Practice Oriented Design (Shove et al., 2007).

A practice is defined as "A routinized type of behaviour which consists of several elements, interconnected to one another: forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge." (Reckwitz, 2002). This can also be classified as a living, evolving relationship between the competencies of the user, the materials involved and the meanings associated with practice (figure 13).
In the context of a breath-enabled practice, this can be construed as the external

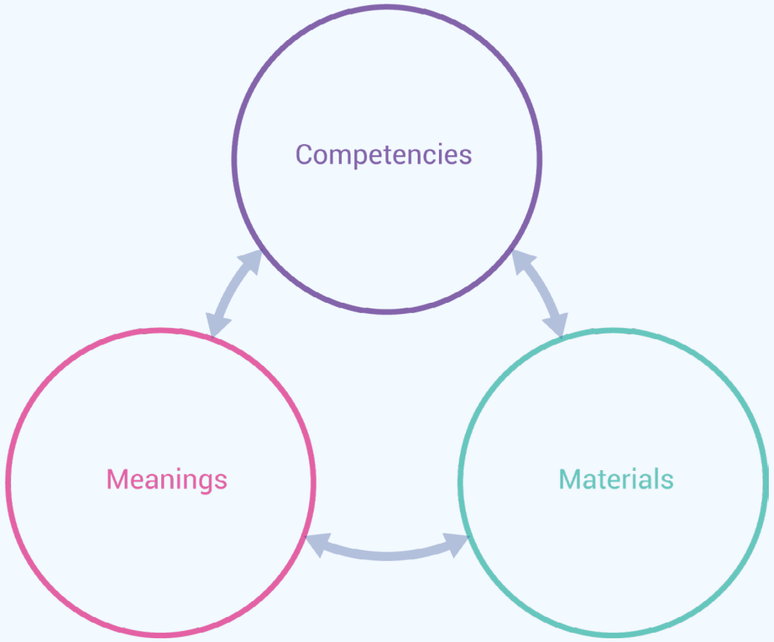


Figure 13: Components of a practice and the connections between them

parameters that guide the breathing, the subjective experience of the user and how it contributes to their well-being and how they understand the workings of the experience.

Based on Practice Oriented Design theory, the following are the insights drawn from factors that were identified:

1. In order for individuals to start a practice, they are to be initiated into the practice and they further have to stay engaged. Based on previous research, mystical connotations should be replaced by the rational as participants are enlisted. This is due to the evident resistance students had as they see the word spiritual.
2. To stick to a practice, participants need to find themselves growing in some manner. This should be done in such a way that they also don't get into a state where they consider themselves not good enough according to a certain metric because of which they might drop out. As self-acceptance was seen to be an important factor for participants, the designed practice should promote that. This could be done in a manner that emphasises how people could improve without constantly receiving feedback about how they are doing during the experience. The constant feedback could push people into an evaluative frame of mind rather than one of self-acceptance.
3. The objects involved and the person are to be in a shared relationship. This implies that there should be ample room for personalization and for developing and perceiving the practice according to one's own needs and values.

4.5 Observing and Experiencing Heartfulness

In order to understand how a spiritual practice functions, I decided to enrol myself in a practice. I stumbled across Heartfulness during my search and decided to pursue the same given that the entry and training was free of charge. The practice, while now internationally known, originated in India. The practice focuses on meditating while focusing on the heart.

Observing the steps of the practice:

1. Through the website, volunteer trainers can be contacted. These trainers reply via email and set a date and time for either an online or offline session.
2. In a period of 3 days, the trainer explains and takes the participant through the steps of the practice.
3. On the last day, the trainer asks whether the participant would like to be part of upcoming updates and events and if the participant replies yes, the trainer adds the participant to mailing lists and a whatsapp group.
4. Over the whatsapp group, the trainer reminds initiated practitioners to start the meditation at a particular time during the day. The trainer also messages at the end of the session suggesting the end. This, I was told, was based on the yogic tradition of transmission of energy from trainer to participant, even as they are separated by miles.

My reflections:

1. Practices like these need not be widely advertised. If there is a clear benefit, those who need it will seek it out via friends or family. It goes without saying, the need is intrinsic and the motivation to keep following the same also comes from a need. This was also identified during my research activities with the target group.
2. The initiation process was really important as I was able to get an experience of how the practice was and also know the spiritual reasoning behind the practice. Sharing my experiences with the trainer was a really powerful process and her ability to tell me the 'reasons' behind my feelings, created a feeling of confirmation. After a few weeks, there was also another meeting to share my insights with the trainer. This was especially nice as a reflective moment.
3. The use of 'materials' should be kept to a minimum and only should be used if it has proven benefits. Any more than that presents a barrier of entry.

4.6 Designing the Data Collection System

A system had to be created to collect EEG and thoracic (inhalation and exhalation) data and for interpreting the same real-time. This required the definition of the kind of data required and the implementation of the hardware and software components required for the implementation of the system.

4.6.1 Building the Breath Strap

To collect thoracic data from participants, a simple arduino based breath strap was made (figure 14). The strap enables collecting data that shows how the thorax moves as the person is breathing and in effect how they breathe.

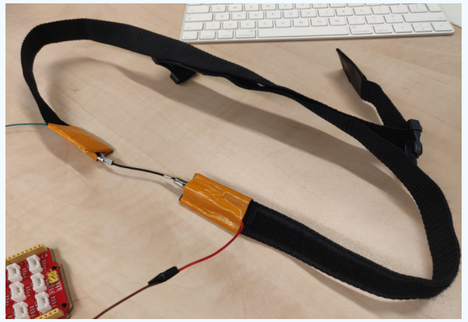


Figure 14: Arduino based breath strap

4.6.2 Defining the EEG setup

As mentioned previously, the regions of the brain that are affected by resonant breathing are the anterior cingulate cortex and the parts behind the brain which are part of the default mode network. To measure the electrical activity across these areas, commercial brain wave detecting devices such as the Muse headband or the NeuroSky headband will not work. This is because neither of these looks at areas behind the brain. Other than that, certain studies do mention the effect of the breath on emotional states. These emotional states can be potentially characterized by frontal alpha asymmetry (Barnhofer et al., 2007).

For both these conditions, higher resolution EEG equipment would be more appropriate. Due to this, for the purpose of the project, a wet electrode EEG cap (8 channel) was used (figure 15). The channels mentioned here refer to the electrodes that are to be placed on the scalp to measure the electrical activity. Channel names such as Pz and Fz correspond to where the electrode is to be placed on the scalp.

Specifically important channels to observe were Pz (Tang et al., 2009), to observe DMN activity and Fz, to observe ACC activity (Domic-Siede et al., 2019).

Figure 15: Enobio 8 - wet electrode cap

Data Collection and Visualization

EEG data streams can be transmitted across the network through the lab streaming layer (LSL) protocol. Raw EEG signals are quite difficult to interpret given the presence of noise and other unrelated artefacts that show up due to body and facial movement. Other than processing the data, it is also important to convert the values into a form that can be interpreted. The raw signals contain voltage readings taken over the surface of the scalp and are streamed from the device through the LSL as time-series data.

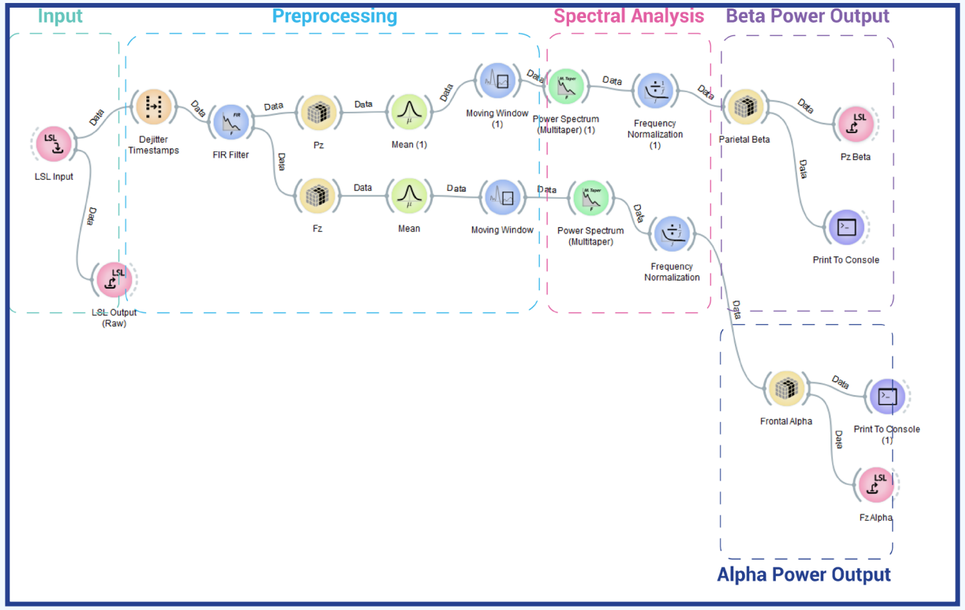


Figure 16: Neuropype Pipeline

To make sense of the live data, it is important to process the data and to convert it into a form that is suitable for interpretation. Since the literature points to specific changes in the dominance of certain frequency bands, looking at changes in ACC alpha and DMN beta spectral density was important in tandem with the respiratory data.

Neuropype, a software suite built on Python, was used for creating a data processing pipeline (figure 16). The pipeline streams both alpha and beta spectral density values as time-series data. I wrote a python script to receive the time series data from the arduino

based breath strap and the Neuropype pipeline to visualize the data in real time and also to record the data in a csv(comma-separated values) file. Running this script creates a visual interface that shows both respiratory data and EEG data in tandem (figure 17).

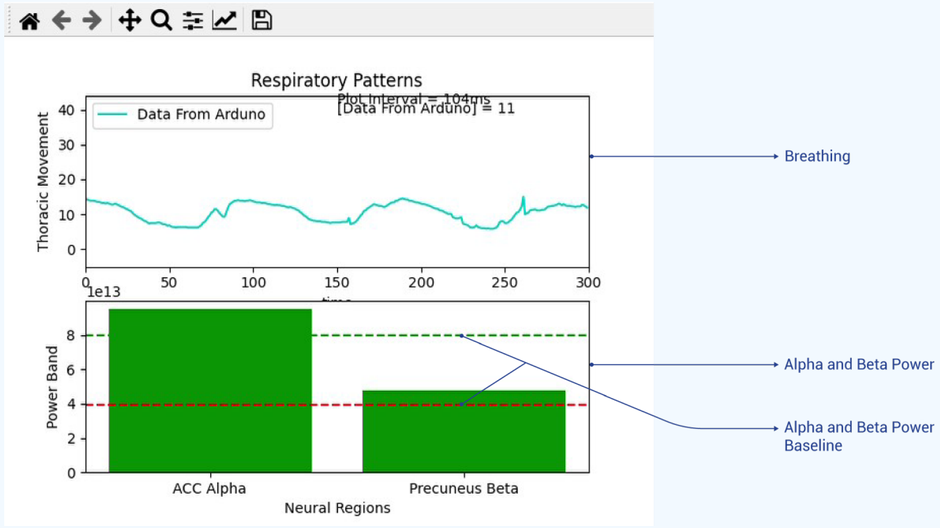


Figure 17: First iteration of the data dashboard showing neural and respiratory data in tandem

4.7 Iterative Parametric Exploration

In order to understand how a breath-based practice can be defined and what parameters could contribute to the user experience conducive to the journey towards inner peace, four incremental iterations with the combination of various parameters were conducted. As identified when looking at practice oriented design theory, components that are only indispensable to the practice are to be included. Given the COVID-19 pandemic, it was important to keep participants to a minimum as they would be in a very involved experiment where they would have to wear the associated equipment and also given that the experiment involves a breathing technique. For each iteration that required the participant to be present on site, the test was conducted with 1 participant. The last iteration was conducted online asynchronously and had 3 participants.

4.7.1 Iteration 1 | Narration, Alternating Chords & Aroma

This iteration, being the first one, was focused on understanding the potential qualities of the breath itself and the appropriateness of the guidance in guiding the participant to follow the resonant breathing technique. It was also important to know when the participant would practice this during the day. This was the first instance the data dashboard was also used with a participant and hence the effectiveness of the same was also gauged.

Participant Characteristics

- Male
- TU Delft Master student
- Previously has experience meditating

Experimental Setup

- Laptop running the python script and for viewing the data dashboard. This laptop also provides the sound for guiding the breathing
- Enobio 8 EEG cap
- Arduino based breath strap
- Lavender spray: The lavender scent was chosen as it is shown to have a calming effect on people (Tarrant, 2017)

Stimuli

- Narrated script and narrated cues when beta activity or shallow breaths are observed in the dashboard
- Two alternating chords that implied inhalation and exhalation guidance that went on for 10 minutes.
- Lavender fragrance spray a minute after the guiding alternating chords start.

Procedure

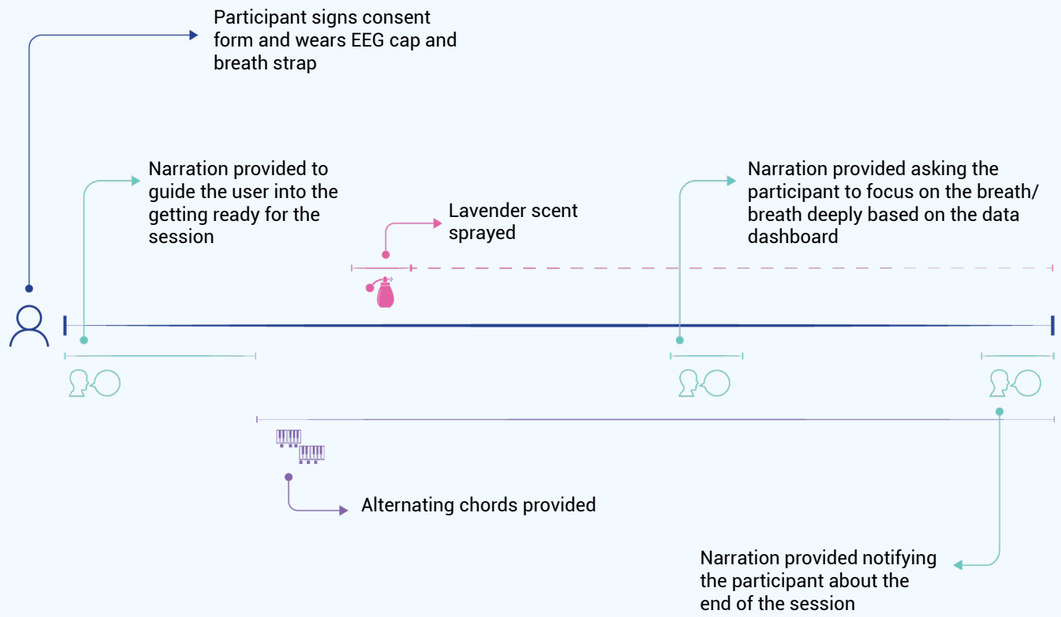


Figure 18: Procedure followed for the first iteration

Results & Insights

- The participant did not appreciate the narration or the intermittent guidance. The participant especially disliked the guidance to focus during the session as he said that it takes them out of the experience. He also did not like to be told when to end the session even after the alternating chords end. This implies that a clearly defined feedback creates a self-evaluative aspect that decreases the immersion.
- The lavender scent sprayed had the participant wonder about the scent and what it was. That said, he mentioned that since the scent was natural, it guided him into the experience.
- When asked when this practice would fit in his routine, he remarked that he would not want it enforced as a routine but would want it to be available easily whenever he wants to clear his mind.
- The data dashboard showed that he was unable to follow the chords immediately and that he took some time to adjust. On being asked about it, he said that he took some time to adjust his breathing to the chords.
- When asked whether the participant thought the experience to be spiritual, he remarked that he would not confine the experience to spirituality. This was due to the perceived importance of the religious element in the spiritual.

4.7.2 Iteration 2 | Audio-visual guidance, Ambiguous Neurofeedback and Aroma

Based on the previous test, a few improvements were directly incorporated into the next iteration. The dislike towards the narration and the evaluative nature of the neurofeedback was taken into consideration. In order to address this, a video was created to better guide the participant and instead of the facilitator provided evaluative feedback, ambiguous audio feedback was provided.

Designing the Video and the Ambiguous Neurofeedback

Designing the video

Instead of narration, the video displayed certain phrases (figure 19a) for 1 minute and 20 seconds that better prepared the person to adapt to the change to the new breathing pace.

Then a circle shaped breathing animation (figure 19b), with the circle growing and shrinking in size, shows the participant how to breathe. The audio guiding cue also is

in sync with the circle due to which the participant can understand which tone stands for inhalation and which stands for exhalation. Towards the end, the video ends with imploring the participant to reflect before continuing with their day.

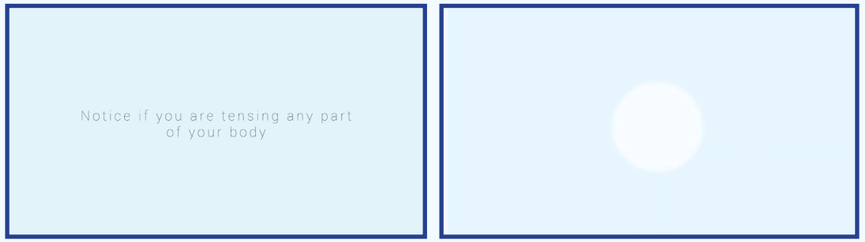


Figure 19a & 19b from left to right: Screenshots from the video (https://youtu.be/Q5OTkJ-gMV4)

Designing the audio guidance

The audio guidance instead of the chords in the first iteration, included alternating Tibetian bell sounds, each at a different frequency. This sound was selected as it has been shown to decrease anxiety and involuntary mental activity (Bidin et al., 2016). Given that these sounds are repetitive, a wind sound is added as a natural background sound to avoid a feeling of monotony.

Designing the audio feedback

The ambiguous audio feedback is provided based on the beta level activity. The rain sound volume was directly proportional to the beta band power. Rain sounds were chosen as the sound as it is a natural sound that closely resembles pink noise frequencies that are associated with improving focus (Wasserman & Segool, 2013). The participant would not be told the connection between the sound and their neural activity.

Participant Characteristics

- Female
- University of Amsterdam Master student
- Has no experience with meditation or breathwork. The participant had tried out an online yoga app a day before participating.
- The participant is a practising Christian

Experimental Setup

- Laptop running the python script and for viewing the data dashboard. This laptop also provides the sound for guiding the breathing.
- Laptop 2 for showing the participant the video
- Enobio 8 EEG cap
- Arduino based breath strap
- Aroma diffuser with Lavender oil

Stimuli

- The video that guides the participant. The video presents instructional text and has the guiding soundtrack.
- A rain sound of which the volume is increased or decreased based on an increase or decrease in beta power respectively.
- A lavender diffuser that is switched on as the video starts.

Procedure

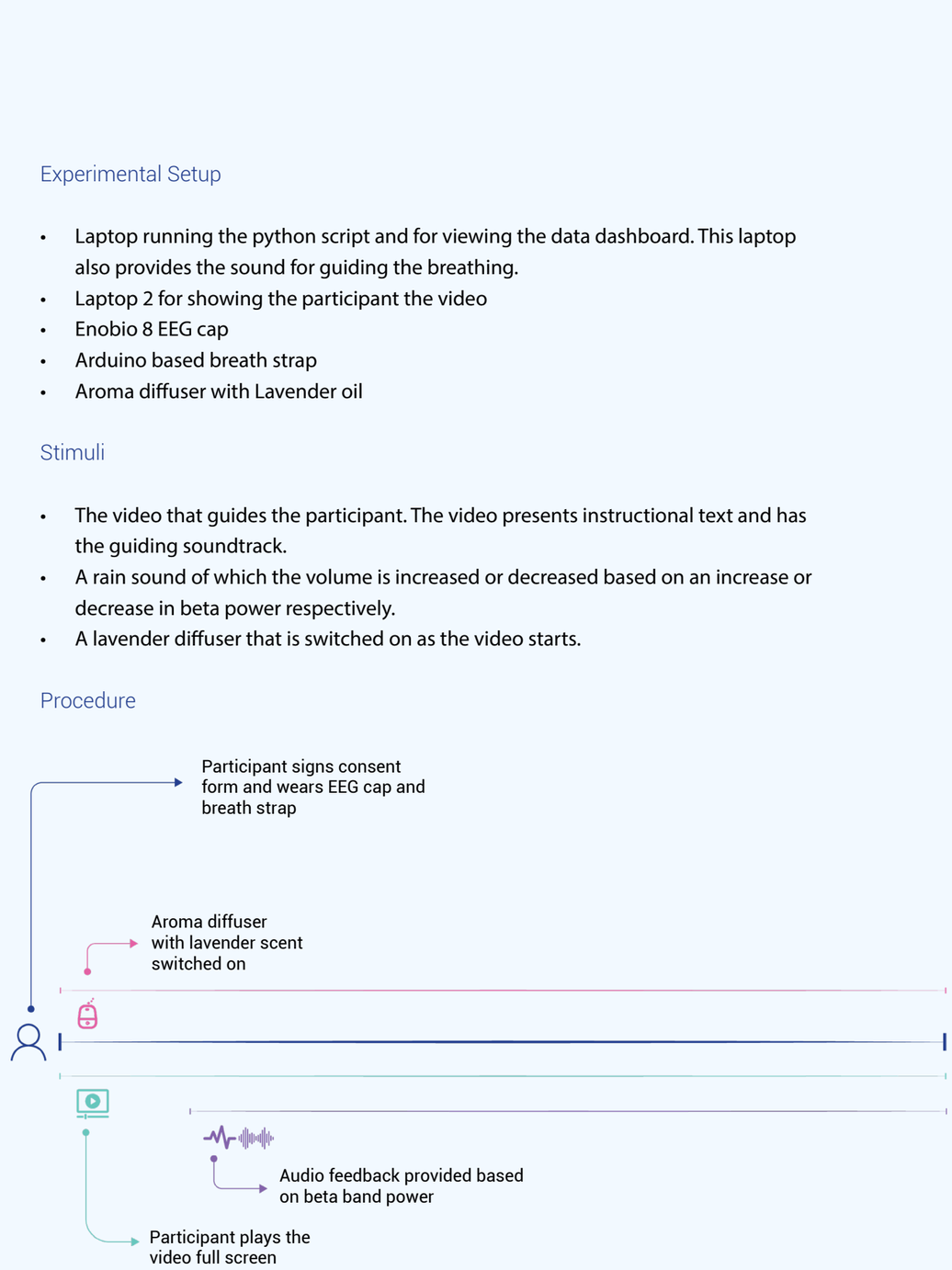


Figure 20: Procedure followed for the second iteration

Results & Insights

- The participant had a strong emotional response (started sobbing) during the session. The stimuli had the participant visualize certain images in her mind which led to the response. The details of the experience is elaborated in appendix 3. The trigger was strongly connected with the rain neurofeedback as the participant had personal memories associated with the sound.
- During the session, the participant had no associations with inner peace but mentioned that sobbing and talking to me about the experience made her feel at ease.
- The visualization was said to start just as the participant mentioned that her head started going backwards. This raises questions regarding the oxygen level of the participant as well as the prevalence of subtle bodily movement.
- The lavender scent in this case was not welcome. It reminded the participant of a car air freshener and hence was a distraction. This shows that this element is not indispensable.
- Reflection and wanting to know more about the 'why?' behind the experience was seen to be important.
- This iteration shows the potential personalized neurofeedback has in terms of creating strong experiences.

Quantitative Observations

- Lower beta activity meant lower volume for the rain sound. It was interesting to see that the participant's brain activity decreased each time the rain sound increased. During the interview, she mentioned that she wanted the rain sound to decrease. In effect, the feedback acted as the participant wanted according to her brain activity.
- Frontal alpha asymmetry was also observed across channels F3 and F4 which has been identified as a marker for affective states (figure 21). This was observed with right side activation being associated with negative emotions and left side activation with positive emotions (Ahern & Schwartz, 1985). Left side activation was observed for a substantial part of the session.

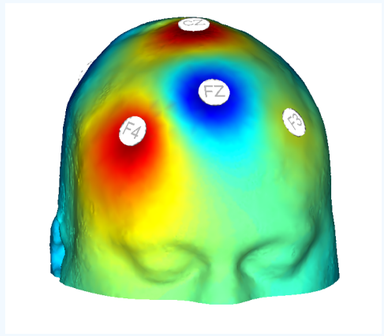


Figure 21: Frontal alpha asymmetry

4.7.3 Iteration 3 | Audio-visual guidance, Ambiguous Neurofeedback, Aroma and Reflection

This iteration followed the same setup as iteration 3, with the only difference being the addition of a reflection phase after the experiment.

Participant Characteristics

- Male
- TU Delft Master student
- Previously has experience meditating and with breathwork

Procedure

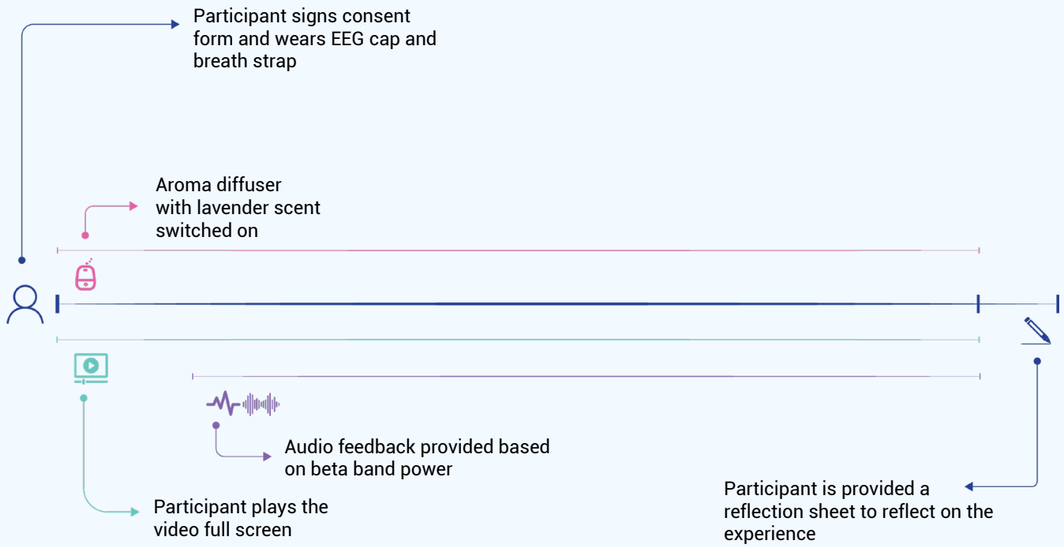


Figure 22: Procedure followed for the third iteration

Results & Insights

- The participant had a preconceived notion of the effect of what the experience should entail. The participant associated wandering thoughts as undesirable. The issue here would be that the session would be regarded as a breathing technique aimed at reducing thoughts. The participant should ideally trust the process more than get into a self evaluative state.
- The rain neurofeedback had no noticeable effect on the person. On asking whether he noticed it, the participant responded that he thought it was just some layered arbitrary rain sound. This would indicate the importance of neurofeedback that is related to personal experience.
- The participant was asked to visually represent their reflections on the experience. The reflections were very much literal, with the participant mentioning the actual events that took place around him such as phone vibrations. When asked about the reflection, the participant mentioned that it made him think about the experience deeply. That said, he also mentioned that he has been practising meditation and breathwork for a substantial time and that he prefers to have very few steps to the process other than the actual breathwork or meditation. If reflection is to be incorporated, perhaps it needs an extrinsically provided structure to do so.
- Since the participant had experience meditating, he was curious about how the EEG indicates that he quieted his mind and indicated an interest in seeing the data dashboard to see the activity for himself.

4.7.4 Iteration 4 | Online Video Sharing

In the initial phase of the research, people reported that the spiritual experience is enhanced if they hear another person say they had similar takeaways from the experience. This inspired sharing the created video mentioned in iteration 3 over Youtube and to collect responses for a fixed set of questions aimed at identifying how would people be affected by seeing how other people they know recount their experience and when they would find the practice most useful. The responses were collected over email/Whatsapp. This also was done with the intention of seeing the effect of the video in isolation on the participant.

Participant Characteristics

There were a total of 3 participants for this test; 2 female and 1 male TU Delft students.

One of the female participants practices yoga but the other 2 participants had no prior experience.

Procedure

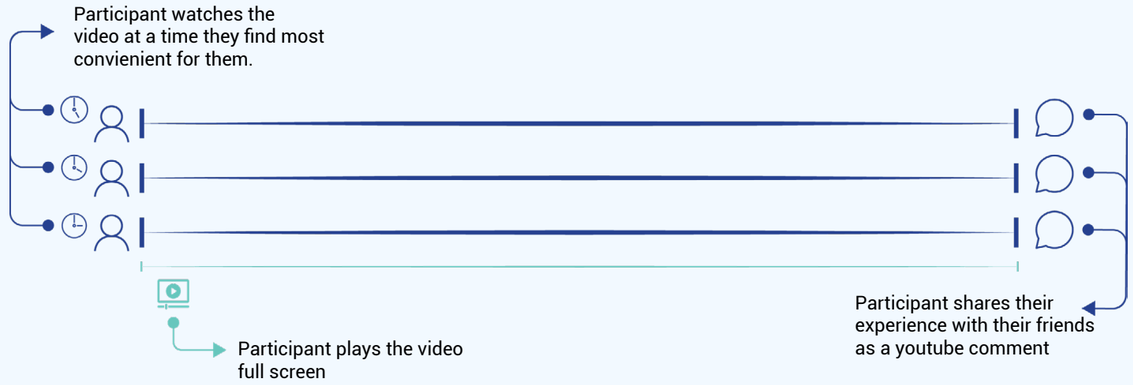


Figure 23: Procedure followed for the fourth iteration

Results & Insights

- This method made it possible for participants to watch the video at whatever time they found comfortable. This provides a sort of data that removes factors such as the presence of the researcher observing them and the data collection equipment that they would be wearing. Given the nature of this medium of collecting data, the process of collecting this sort of data could also adopt question items that result in quantitative data.
- In the context of their lives participants mentioned that they would follow the video in times of stress or anxiety as the video did seem to provide relief.
- In terms of a community, participants do not look at the social network modality positively. However, they mentioned that sharing it personally with those they think might benefit from it is a possibility.

4.8 Defining the Persona

The iterations had also shed light on the nature of the persona that would potentially benefit from the design goals outlined earlier. Based on the insights, a particular persona, Tresa is introduced below.

Bio

Tresa, is a student at TU Delft. After her first year at the university, she is feeling really anxious. She tried several things such as binge watching shows, had a period where she tried out pursuing a hobby and none of these things seemed to work. She met the therapist at TU Delft as well who had her do a short breathing exercise. Seeing that the exercise helped her, she looked up a few meditation videos on YouTube. She did try out a few but none of them seemed to click as she could not place a finger on how this is helping her. It was also difficult to know which one is better. She just stopped looking for such videos.

She does feel that it is important to keep herself healthy. Tresa also finds it important to know whether she maintains progress on this front. In order to do this, she goes for a morning run every morning and she tracks her progress using Strava and her smartwatch. Being fascinated with numbers and data, she keeps track of her other health metrics as well.

Figure 24: Tresa and her ecosystem

Demographics

Age: 24
Location: Delft, Netherlands
Education: Applied Mathematics Master Student
Religion/Faith: Agnostic
Experience with breathing practices: Recently started

Goals

- Learn to manage ever increasing levels of stress through an healthier means
- Understand how to make sense of various claims made by breathing practices so as to adopt one that is most appropriate

Information Channels

General Information: Google News, NOS, de Volkskrant
TU Delft Information: Brightspace, email, TU Delta
Social Media: Youtube, Instagram

Personality and Preferences

- Data and progress-driven
- Prefers minimal living and a decluttered life
- At times prioritises work over self-care
- Thinks critically and does not accept anything blindly

5 *Design Cycle 2:* Concept Definition and Evaluation of Elements

This chapter presents the process of conceptualization based on the collected data and the definition of the final concept. Certain elements required more clarity in terms of what would constitute the final design. In order to clarify this, individual components of the concept are tested and evaluated to gain a better understanding of the same.

5.1 Mapping the Design Space

Based on the research done, a few potential directions were identified with the experiential aspect in mind as those which can be developed further. The main directions identified are elaborated below and are reflected upon. These directions were crafted as a thinking tool reflecting on the possibilities identified after the various iterations.

5.1.1 Spiritus Connect | A Neurofeedback Application

'Spiritus Connect' is a web application TU Delft students can download to follow the practice. Similar to how X! Delft already promotes a lot of well-being related activities, they could also add Spiritus to their portfolio. The application provides the option to connect to an EEG headset that provides ambiguous neurofeedback. The EEG headset would be provided by X! Delft as part of the subscription (figure 24). The web application would allow the user to set the duration of the session (figure 25 c) and select the neurofeedback sound from a predefined collection (figure 25 d). It also would have a community aspect where one can add other users to their 'community of users' (figure 25 b). Through this feature, it would be possible to know the number of people using the application at a given time (figure 25 a).

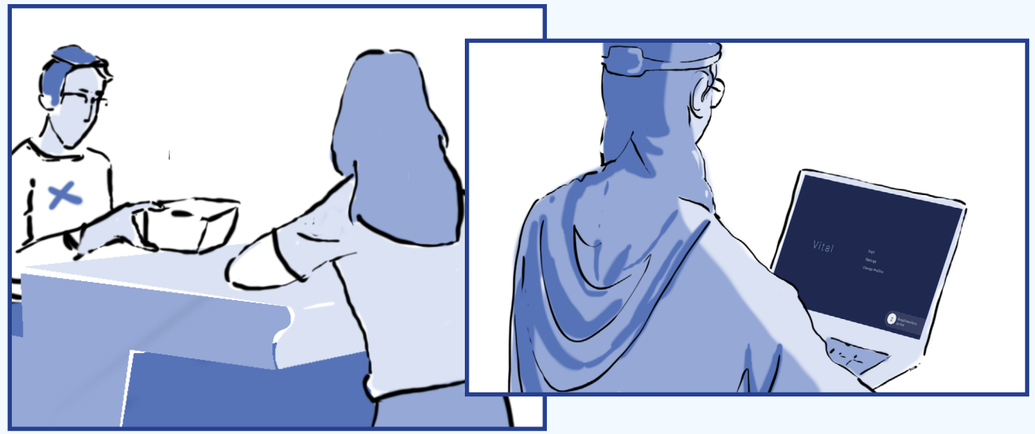


Figure 24: Collecting the headset from X!Delft and later using it at home

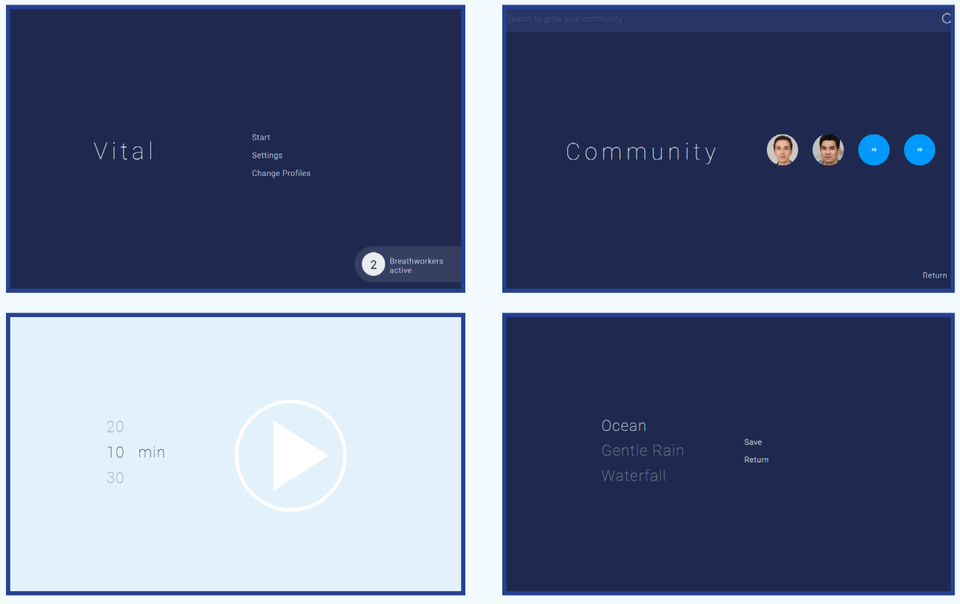


Figure 25 a, b, c & d (top left, top right, bottom left, bottom right respectively): a) Showing the start screen with the number of active users. b) Showing the community page. c) Setting the duration of the session d)Choosing the audio for the

Benefits of the concept

- The ability to set the duration and the feedback sound allows the user to make this application their own.
- The community aspect is provided based on initial research which suggested that seeing other people share the experience enhances it.

Weaknesses of the concept

- The neurofeedback effect is not consistent according to the data and has varying effects on people. Because of this, the user would at no point clearly understand what the neurofeedback means.
- The sounds of the neurofeedback come from a predefined list and a risk still remains of none of them having an affective connection with users.
- If the participant knows what the feedback means, it could also lead to an evaluative state of mind during the session rather than one that is open and self exploratory as outlined by the interaction vision.

5.1.2 Spiritus: Experience the Breath | A one time experience to guide students to Breathwork

'Spiritus: Experience the Breath' is an exhibit set at the TU Delft and specifically at the Faculty of Industrial Design Engineering (IDE). The exhibit is set in a soundproof room with little to no distractions. The participant is asked to wear the EEG headset which would be used to provide neurofeedback. The installation provides an audio-visual and olfactory experience which would initiate students into practising Breathwork. After the session, students would be given resources to further understand what Breathwork entails.

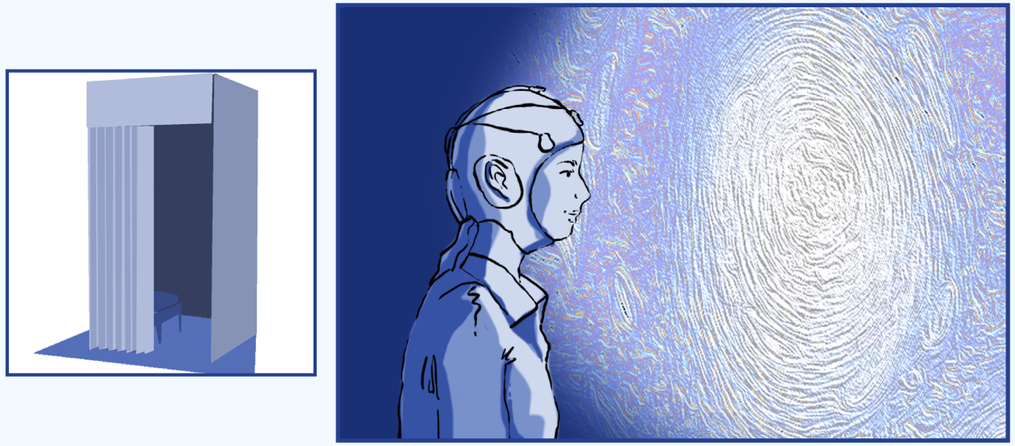


Figure 26 a & b (left to right): a) Enclosure at IDE. b) Participant in the immersive neurofeedback enabled exhibit

Benefits of the concept

- Users receive a powerful introduction to Breathwork and the exhibition modality also attracts those who do not seek the experience out. This could lead to more people knowing about Breathwork.
- There is no need to have a predefined automated neurofeedback protocol. Due to this, the facilitator can creatively provide the feedback based on the response from the participant.
- As seen in practice oriented design theory, enlisting an individual is important. This experience facilitates precisely that.

Weaknesses of the concept

- Being a one time experience, while a lot more participants could be enlisted, there is a significant chance for people to not stick to the practice

5.1.3 Spiritus Online | A web page that introduces the Spiritus practice

'Spiritus Online' would be a web page that presents the Spiritus practice (figure 27). It would include information regarding how this practice came about such as the science behind Resonant breathing and how the brain is influenced. Also, information regarding how the practice could be improved would be provided. To increase credibility, testimonials from past users would be shared as well.

Figure 27: The Spiritus webpage and the mentioned sections

Benefits of the concept

- This concept can be readily implemented given that there are no loose ends. By consistently conducting the experiment with the same setup, the final decisions can be made in terms of what should be part of the instructions pertaining to the practice.
- This page can also act as a pathway to other projects on similar lines that are researched at TU Delft.

Weaknesses of the concept

- Due to the lack of feedback, people might not know how this benefits them. Research activities do show that people have different experiences at every moment; some powerful and some ineffective. This might lead to a high drop off rate.
- Since there is no extrinsic motivating factor, people might not feel compelled to stay long enough in the practice to experience the benefits.

5.2 Project Vital presents *Spiritus: a Data Supported Breathing Practice*

5.2.1 Concept Definition

After analysing the results and the potential concept directions, I inclined towards a concept that integrates the two goals that I had started the project with and further refined.

Addressing the second goal, "Create a system that designers can use to explore bio-sensor data and qualitative data in tandem so as to characterize and design for breath-enabled spiritual experiences.", I define Project Vital.

Through the course of the research process, I have been defining a "set of online and offline research practices that could aid researchers in collaboratively working with local participants" to generate knowledge. These practices come together and fit within the framework of a research platform (Kanngieser et al., 2014).

To bring both the practice and the research platform together, the process requires both the introduction of the practice and that of the data collection as a single collaborative

process. The practice as mentioned before addresses the first goal, "to make the journey towards acquiring inner peace accessible for TU Delft students through a desirable breath-enabled experience they can practice.".

The final concept is a research platform - Project Vital, that enables design researchers to design and explore breath enabled experiences in collaboration with participants. Each practice that is designed is available to participants from which they can receive personalized insights about their own experience. In this collaborative process, the design researchers can collect data from participants to further the research.

The breathing practice - Spiritus, that was developed during the course of this project would be made available to participants. Their participation would lead to the above mentioned collaboration for researching the experiences of the practice and providing them with a deeper insight about their own experience using the physiological data generated during the session.

This concept, aimed at both the user and the design researcher, is formulated with the intention of addressing the personal motivation of laying the groundwork for a PhD in this area. The intention hence is also to ensure that the system designed is sensitive to breath enabled experiences and would enable design researchers to identify the subjective qualities that are associated with the data collected.

5.2.2 Concept Components

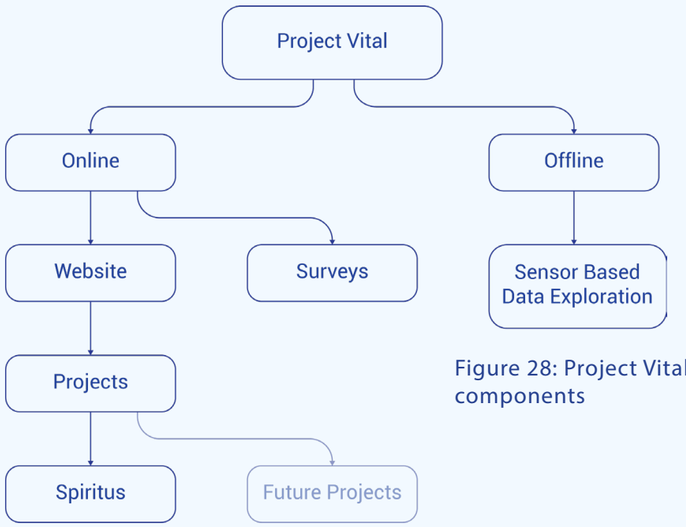


Figure 28: Project Vital and its components

Online Ecosystem

Website

The website for Project Vital is aimed towards design researchers and users alike. Users or those interested in Breathwork can find practices and experiences that are designed based on both quantitative and qualitative research methods of which Spiritus is the pilot project. Other than this it provides insight into breathwork in general and its effect on the body. For those interested in pursuing breathwork further, the website directs them to facilitators and resources that participants can use to explore more.

Surveys

On developing the practice and collecting data, it was possible to collect data from literature research and the qualitative research to identify aspects that could be quantitatively explored. Surveys also enable getting responses from participants when they are in an environment where they are comfortable. This was made clear in the 4th iteration of Design Cycle 1. The ability to look at a large number of participants also helps how the effects of the created experience vary across different demographic groups.

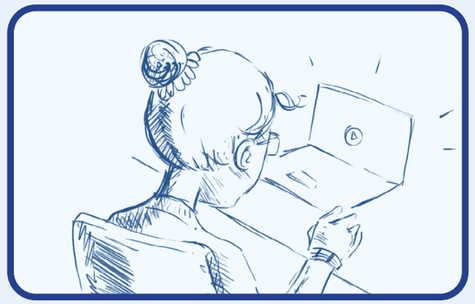
Questionnaire builders like Qualtrics also allow for setting up questionnaires that can randomly assign questions and experiments to participants. This would allow for comparing different videos/experiences.

Sensor Ecosystem

From the onset, thoracic data and the EEG data had been chosen as data features to explore. Both these features have proven to be valuable throughout the research activities. Additionally, since some of the participant responses exhibit a potential change in blood oxygen levels or the pulse rate, a pulse oximeter is further added to the setup to gain more clarity of these aspects.

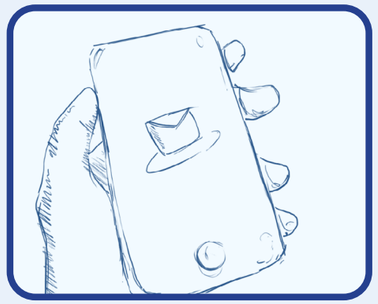
5.2.3 Crafting the Journey

As mentioned previously, practices or experiences designed by Project Vital are aimed at a collaborative effort between researcher and participant. Adhering to the first design goal, research was conducted with this target group and based on the experiences shared by these students has led to the creation of Spiritus, a practice aimed at "making the journey towards acquiring inner peace accessible for TU Delft students through a desirable breath-enabled experience they can practice.". The following visual illustrates the same (figure 29).



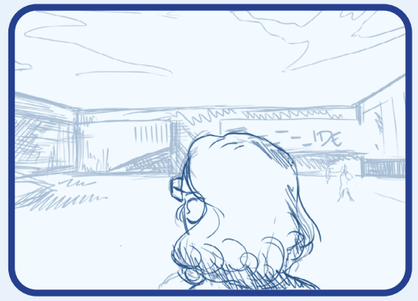
1. Call to join through Online Channels

The student facing stress finds Spritus (through a communication channel they use), a breathing practice that promises to guide them through the journey towards inner peace by support of their own physiological data, on one of the online channels they use.



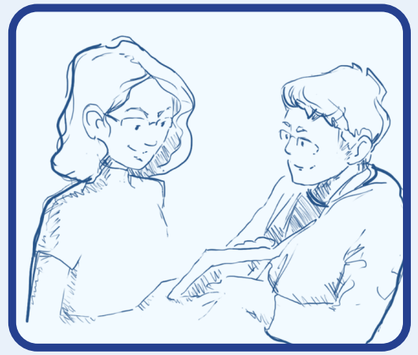
2. Initiation through the Project Vital Website

The student gets to know more about breathwork and about Spiritus on a dedicated webpage. They see that they can book an appoinment to meet a design researcher who will guide help them start the practice. They receive an invitation with details such as location and time.



3. Immersion and Reflection

The student visists the lab, is greeted by the design researcher and then starts a breathing session (Spiritus Video Guide designed during the iteration phase) during which their data is collected. The design ressearcher and the student together reflect on the session with the support of the data. The student here identifies the effect following the session had on their body.



4. Enlisting

The student is given a booklet that has pages that structures the reflection process when the student practices the Spiritus video session at home; this time without the data. However, this time, they reflect with the understanding of how breathing affects their mind and body.

5. See Progress

The student, being interested in data and progress tracking like Tresa, would like to know how the practice has changed their mind and body. They book another appoinment to figure this out.

6. Sharing the experience

The student, seeing that they benefitted from the practice, share the Project Vital page with their friends and family.

Figure 29: The Student's Journey of Spiritus

5.3 Bio-Feedback Training Organisations Focused on Positive Well-being

Project Vital has conceptual intersections with other biofeedback and training organisations. Two of the most prominent organisations that focus on meditation specifically are HeartMath and the NeuroMeditation Institute. A brief overview of the two is provided.

5.3.1 NeuroMeditation Institute

The NeuroMeditation Institute has created a platform around techniques they have validated using neural imaging (EEG) with each of these techniques addressing various needs. They provide these techniques online and offline at a cost. At a premium, they also provide neuromeditation sessions by providing real time feedback based on the technique that was identified as being the best for the participant.

The team running the programme has their expertise in psychology and cognitive neuroscience. They have also developed questionnaires to identify the nature of the technique that might most benefit a particular participant.

Figure 30: Dr Jeff Tarrant providing a neurofeedback session

5.3.2 HeartMath

HeartMath has based their technology and technique based on heart rhythm coherence. Their technique 'Quick Coherence' is based on breathing in addition with a focus on positive emotion. Based on this technique they also have an app supported devices for mobile - 'Inner Balance' (figure 31 a) and PC - 'EmWave' (figure 31 b).

HeartMath has defined the user journey as one with 3 steps (figure 32). The first being a 90 minute video session that explains the science and ethos behind HearthMath. Second is the user procuring the Inner Balance or EmWave device to get more clarity on their personal practice. Finally, HeartMath implores users to become trainers or mentors as they gain expertise. The application and the device on being used during personal sessions provide the user with encouraging prompts as they achieve the state HeartMath has defined as ideal. HeartMath too hence focuses on live feedback.

5.3.3 How is Project Vital (and Spiritus) Different?

Figure 31 a & b (left to right): a) Inner Balance b) EmWave

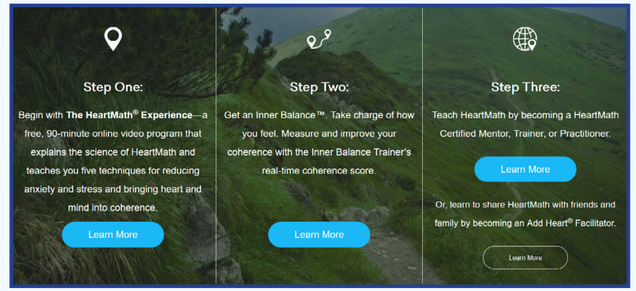


Figure 32: Users Journey through HeartMath

Project Vital is envisioned as a research platform run and curated by design researchers. Due to this, unlike the previously mentioned organisations, it considers the experience and interactions of the user with the artefact (in this case Spiritus) *in detail* rather than just the outcome of the session, along with the data. As seen in and would be seen in the development of Spiritus, iterative prototyping along with literature research leads to what constitutes the experience and what establishes what data features are important and conducive to co-exploration and reflection.

Project Vital as its ethos holds co-exploration of the experience with the participant rather than one that is purely prescriptive. The act of providing participants with an experience that contributes to their well-being and the act of conducting research go hand in hand. This also seems unlike what is seen in the organisations mentioned above. After conducting research, they tend to later provide to users the outcome of their research. The process of co-exploration aims to look at the experience with a lot more granularity,

identifying the nuance even within general outcomes such as a sense of calm. This process is aimed at the characterisation of what constitutes experiences that are associated with altered states of consciousness.

As for the experience provided by Spiritus, the focus is as much on the journey through the session as much as the outcome. The internal state of mind is also not one that is prescribed (such as to focus on positive emotion, or a certain mindset) but is one where participants are encouraged to discover for themselves both for the practice and when they encounter their data.

In the upcoming parts of the report, the process of discovering the appropriate data features and the nature of the experience and co-exploration will be elaborated.

5.4 A TU Delft Student's First Encounter with Spiritus

As shown in the 'Crafting the Journey' section, the TU Delft student encounters Spiritus and through Spiritus, Project Vital. The experience associated with Spiritus is not one that is conceptualized to be one that captures immediate visual attention but is one that focuses more on the subtle experience that follows after one chooses to experience it after engaging with the information and finding what it promises beneficial to them. Due to this, *a digital online medium that is perceived as credible and reaches more students* was more appropriate and offers more value as a first point of contact than an exhibit or an installation that would reach few. The online medium should also hence be one that supports long-form content to provide the information and has an audience that is interested in reading long-form content.

5.4.1 Identifying the Appropriate Communication Channel

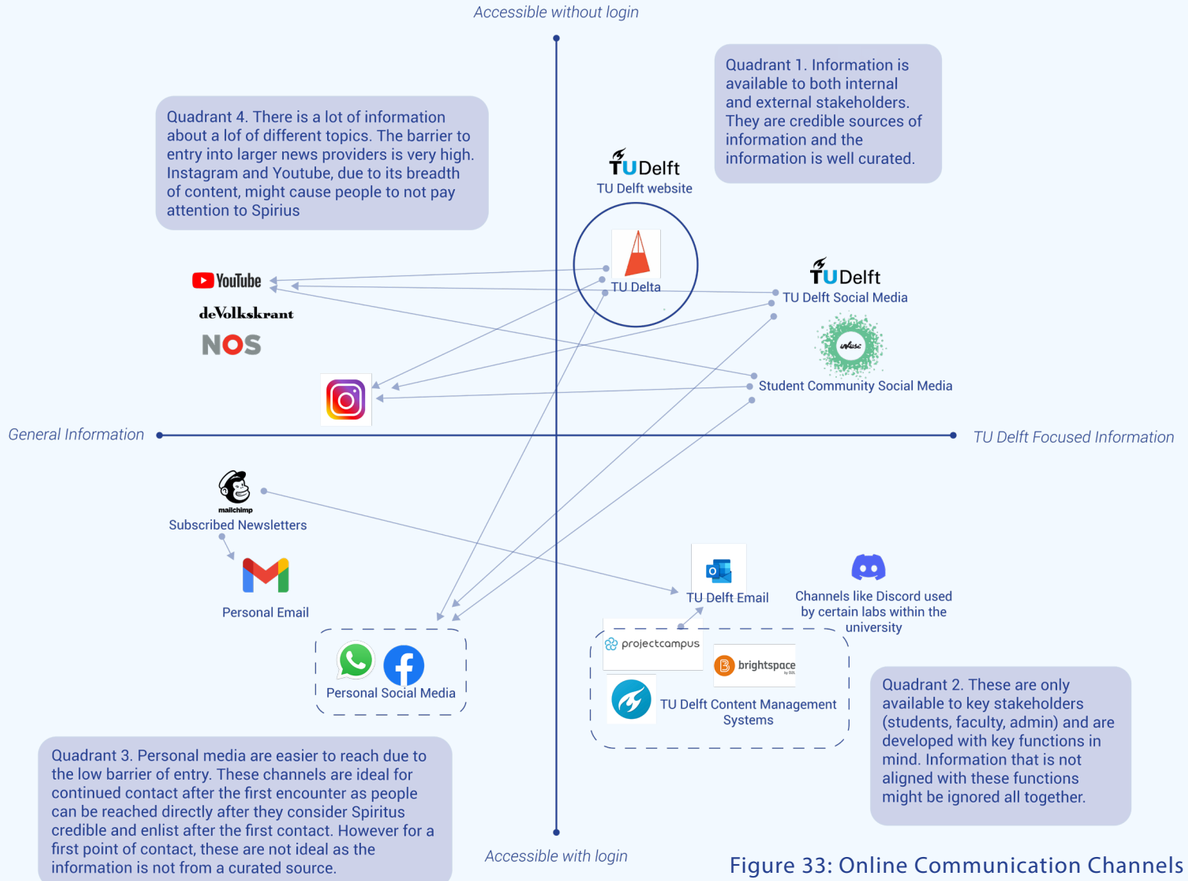


Figure 33: Online Communication Channels frequently used by TU Delft students

As shown in the figure above (figure 33), the first quadrant is seen as most appropriate given the perceived credibility of the media and the focus on TU Delft. Both TU Delta, an 'independent journalistic platform' by TU Delft and the TU Delft social media also share their content on their own social media channels providing more reach (the light blue lines in the figure indicate information being shared). TU Delta, is potentially the better channel given how it features long-form articles and in terms of how it categorises them on its page. This ensures better visibility as well when compared to the TU Delft website,

where the category (Science, campus news etc.) of the content is not as defined. The combination of reasons above has led to a TU Delta article on Spiritus being the first contact point for a TU Delft student.

5.5 Redesign of the Data Dashboard for the Live Data Stream

The data dashboard was redesigned based on the insights from the iteration phase (figure 34). The redesign of the dashboard is done with the intention of increasing the clarity and interpretability of the live data stream as well as to ensure that the same dashboard can be used in the future for neurofeedback applications given that while a consistent neurofeedback method could not be defined, it was possible to identify with the dashboard the effect auditory stimuli had on participants. This dashboard intended for the design researcher to view live stream bio-sensor data would be used for the upcoming sections.

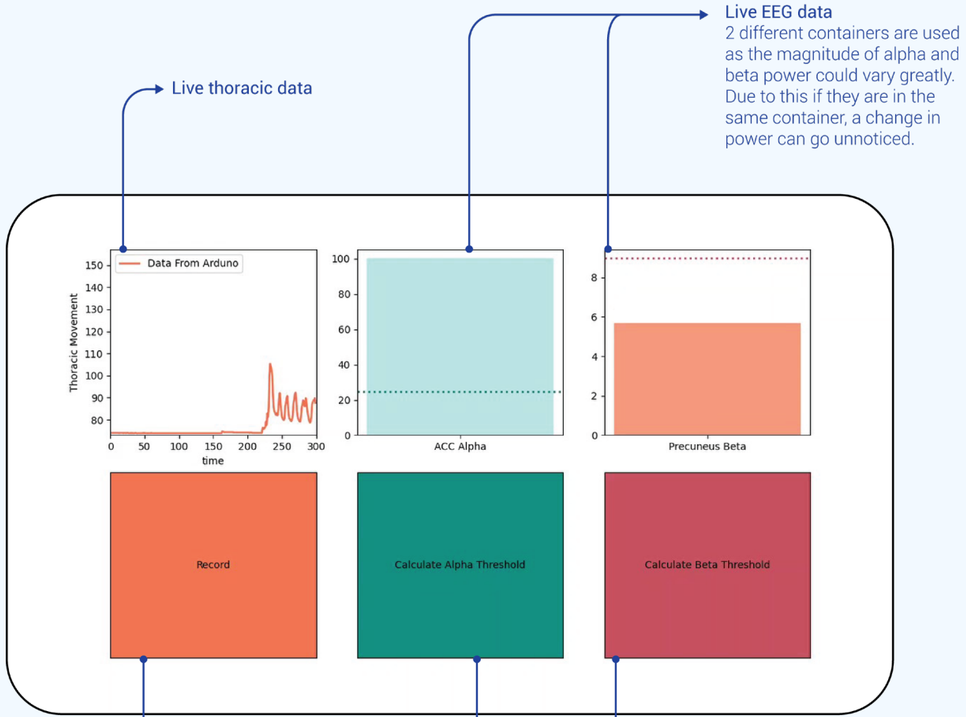


Figure 34: Second iteration of the data dashboard for live streaming data

5.6 Evaluation of Elements to Crystalize Spiritus

Until now, the iteration process in the first design cycle went through various stimuli and conditions to assess which would be most conducive to supporting the practice. While the concept has been defined, more light has to be shed on certain aspects to make thorough design decisions and to move towards the final design. In order to move forward to the final design, it was important to identify *across participants* with the same setup:

- The effect of following the video created during the first iteration cycle.
- Nature and relevance of the data that is collected for Spiritus for the design researcher.
- The appropriate data features for the participant and design researcher to co-explore and for the participant to reflect on. These include potential features that were identified in the iteration cycle other than EEG and thoracic data are blood oxygen level and pulse rate.
- The survey questions that are most appropriate for Spiritus.
- Based on the clarifications on the aspects mentioned above, the information that would be most appropriate in the article, reflection booklet and on the website.

In this phase, the dashboard used by the design researcher to monitor the live data would be shown to the participant as a screen recording to understand the effect seeing their own data has on participants.

5.6.1 Evaluation of Aspects of the Data Supported Session

This section of the evaluation aimed at *evaluating and defining the experience that participants have on following the video and understanding with more clarity what data-enabled discussion could entail.* The insights from this would be used to decide the form of the first onsite breath session as indicated in the student journey. This information would also be used to justify and decide the informative content on the website and the booklet.

This approach would look at quantitative and qualitative aspects such as the sensor data, the survey responses and the discussion after the session. The experiment conducted would also enable the reflective evaluation of the research platform such as the type of survey questions used and how the interpreted data is presented to the participant.

Participant Characteristics

There were a total of 5 participants (3 Female, 2 Male). All of them were TU Delft students. Their level of experience with breathwork varied and this was taken into consideration during the analysis phase.

Experimental Setup

- Laptop running the python script and for viewing the data dashboard
- Laptop running the video for the participant to follow
- Enobio 8 EEG cap
- Arduino based breath strap
- Beurer P0-80 pulse oximeter

Specialized Survey

Based on the qualitative results of the interviews and literature, a specific set of question items were curated for evaluating Spiritus. This included items from the AttrakDiff (Hassenzahl, M., Burmester, M., Koller, F., 2003) scale to measure the pragmatic and hedonic quality of the video session and the Feeling Consciousness Scale (FCS) (Lindhard, 2018) which is used to measure the experiential qualities of calm, focused breathing practices. This questionnaire is longer and has more items which would be filtered on observing how participants respond.

Procedure

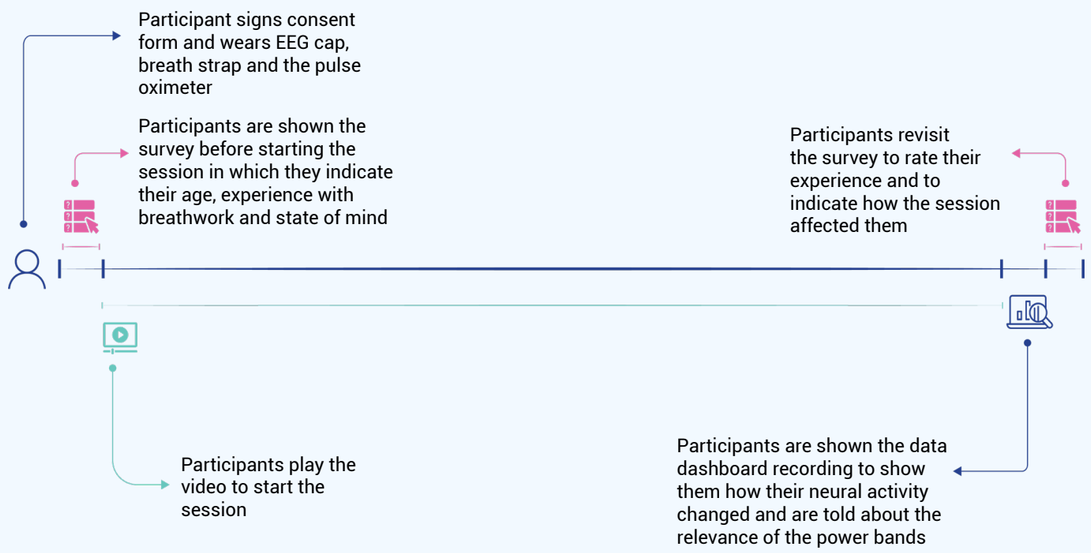


Figure 35: Procedure for testing the elements of Spiritus and Project Vital

Results & Insights

- All participants mentioned that they felt peace/calm and noted that they felt more pleasant compared to how they started off. Other than this, the session contributed to their well-being in terms of improving their mental clarity and motivation to work on ahead.
  - » "I feel uplifted. I had a very long day and I was not looking forward to going back and preparing for the exam..but now I do feel motivated."
  - » "I feel less anxious and more focused than before."
- The normalization of such topics is important as expressed by a participant. People should find it normal to talk about such practices freely.
  - » "It would be cool if topics like these are normalized. It would be nice to 'take 10' during work to practice this for instance."
- The neutral tone of the video and the text based medium allowed for focusing purely on oneself.

  - » "In some videos they sit and talk..that usually does not work for me. This was not the case here.."
- The data based reflection was helpful as it increased awareness about their own internal states. For participants curious about the data, it convinced them about the efficacy of the practice.
  - » "I wanted to know how this helps me. It was good to see how my body responds to the breathing."
- On observing how participants responded to various aspects of the questionnaire, certain items from the AttrakDiff and FCS scales were removed as they were not relevant to the experience. This resulted in a shorter, streamlined questionnaire.
- During the breathing session, participants do not find themselves comfortable thinking that they are looked at when their eyes are closed.
- Participants could feel uncomfortable as they feel observed while following the session with her eyes closed.
  - » "Could you turn away when I'm following the video? It is making me nervous."

Insights from the Bio-sensor Data

The data dashboard proved its efficacy in terms of being a collaborative reflective tool as I, as a researcher, could ask the participants questions based on their brain or breathing activity.

- Those who were more experienced showed a stronger and quicker ability to quiet down their brains. Further, participants who when asked mentioned to have been consciously paying attention to how they breathe with respect to the guidance were seen to have an increase in alpha power (figure 36 a).
- All participants saw a decrease in beta band power over time (figure 36 b).
- The pulse oximeter data and the oxygen levels did not seem to correspond to any particular experiences. There was However the head movement that was identified in the first iteration cycle was seen here as well for some participants.
  - » "My head was going backwards and I felt like I needed support."
- There is a need for a clearer way of looking at the data for reflection rather than a recording of the live data stream. This would enable the participant to look at the entire session duration in one go.

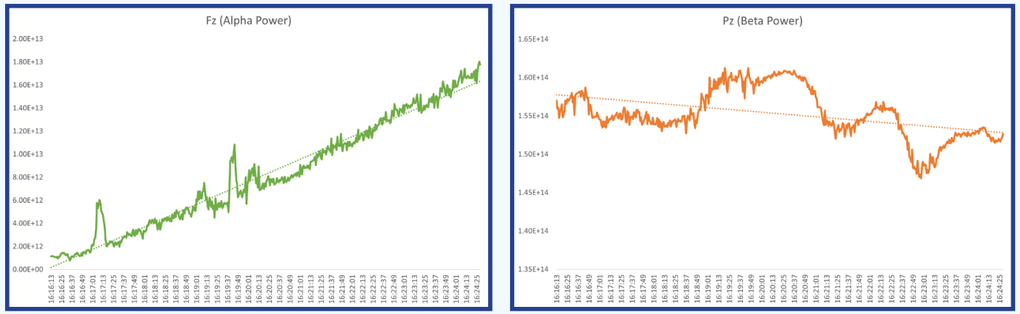


Figure 36 a & b (left to right): a) Increasing alpha power seen in a participant who paid close attention to the guidance b) general trend of the change in beta power across participants

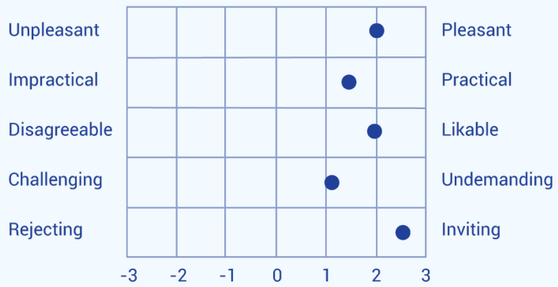


Figure 37: Averaged results indicating the pragmatic and hedonic quality of the experience the video provided

Figure 38: Averaged results of the FCS scale indicating the experiental qualities of the breathing session

6 *Final Design:* Project Vital presents Spiritus

This chapter presents the detailed design as a culmination of a research process guided by exploring both the subjective and objective aspects of the experience of the breath.

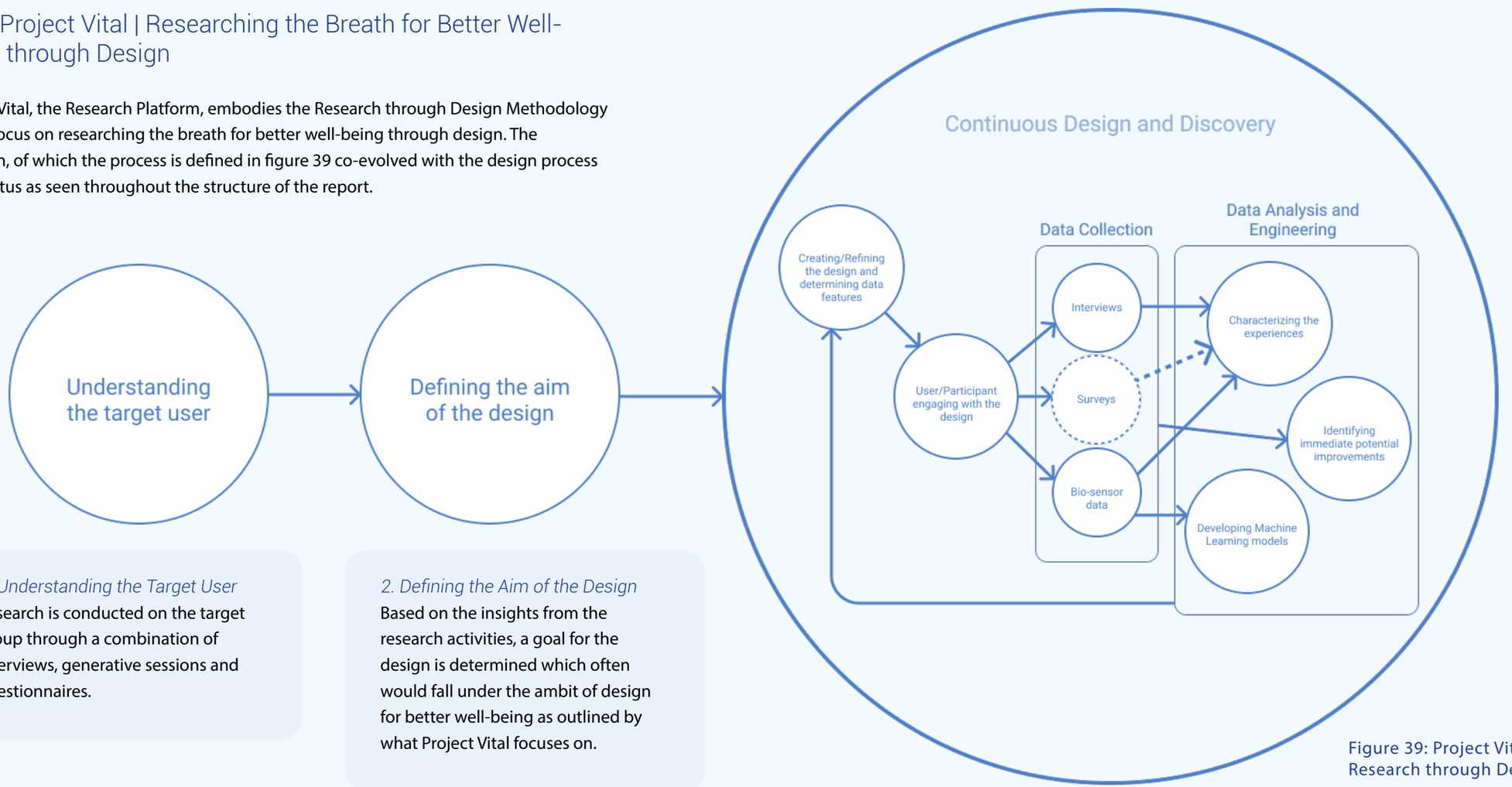
The chapter presents Project Vital, the research platform and Spiritus, a data supported breath practice that stems out of Project Vital. The chapter presents the journey and experience of a student coming across Spiritus and how Project Vital contributes to the work of design researchers. This is also followed by the evaluation and validation of the design and what the future of Project Vital could potentially entail.

6.1 Project Vital

After the evaluation of the individual elements as defined in the concept, the aspects that required clarity were addressed. The following section presents an overview of how Project Vital is structured following which a service blueprint indicates how Spiritus is structured as well as a project stemming out of Project Vital.

6.1.1 Project Vital | Researching the Breath for Better Well-being through Design

Project Vital, the Research Platform, embodies the Research through Design Methodology with a focus on researching the breath for better well-being through design. The platform, of which the process is defined in figure 39 co-evolved with the design process for Spiritus as seen throughout the structure of the report.



1. Understanding the Target User
Research is conducted on the target group through a combination of interviews, generative sessions and questionnaires.

2. Defining the Aim of the Design
Based on the insights from the research activities, a goal for the design is determined which often would fall under the ambit of design for better well-being as outlined by what Project Vital focuses on.

3. Process of Continuous Design and Discovery
This is based on the Research through Design methodology which is focused on producing knowledge through the design/prototype. A prototype is created based on the design goal which is tested with participants. The prototype here is often the design itself which is aimed at improving the well-being of the participants, in this case, the user through the breath. The *data collected* through various streams is *analyzed* and the insights are utilized for *generating new knowledge as well as continuously improving the design.*

Figure 39: Project Vital embodying Research through Design

Data Collection

The data collection as mentioned above is done via a combination of interviewing and bio-sensors. While for each design (or practice as in the case of Spiritus) the individual data features would vary, through the project, I have been able to outline the primary sensors from which the data would be collected (figure 40).



Figure 40 a, b & c (left to right): a) Enobio 8 EEG headset b) Beurer PO-80 pulse oximeter and c) Vernier GoDirect chest strap

The sensors shown above have been chosen due to indications during the project that parameters such as EEG, pulse rate and blood oxygen levels, and thoracic activity are relevant data streams associated with breathing and show significant, observable variation. The Enobio 8 also has an in-built accelerometer that can capture head movement. Pragmatically, the specific devices are chosen as their resolution and compatibility with Python also allows for the detailed processing and analysis of data. Once a significant amount of qualitative data has been collected through interviews, surveys are also developed based on this for experiences that can be shared online to gain an understanding of how a larger sample and different demographics would respond to the experience.

Data Analysis and Engineering

Looking at the subjective experiences that people have and the bio-sensor data collected, it would be possible to characterize these breath enabled experiences. This is in accordance with one of the questions the project started with:
'What data might characterize spiritual or transcendental experiences?'.

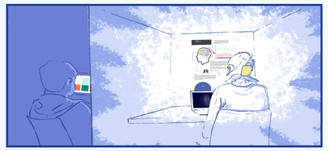
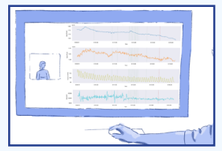
One of the participants had expressed that he would want the stimulus to adapt to how he is breathing. The possibility of this being implemented can also be explored from the data collected and by identifying the right data features that could be used to train machine learning models that could create such experiences.
An important aspect that follows this data collection and analysis is also the continuous improvement of the design itself.

6.2 Spiritus as a Data Supported Breath Practice

Spiritus is the pilot project that is to come out of Project Vital. It has been developed as a data supported breath practice aimed at guiding students on their journey towards inner peace. In this case, the students who start this practice are users of the developed design who would take a step towards inner peace and are participants whose data is collected and analyzed which leads to the production of new knowledge.

The upcoming service blueprint and user journey show (figure 41) an overview of how Spiritus is structured. The subsequent sections dive deeper into each touchpoint of the service which guides people through Spiritus and elaborates on the user experience.




STAGES

Initiation | Immersion | Reflection | Enlisting | Share | See Progress

PHYSICAL EVIDENCE

Social Information Channel | Project Vital Homepage | Spiritus Page | Invitation Email | IDE Lab | Sensor and experience setup video | Data Dashboard | Booklet | Spiritus Page | Spiritus Page

STUDENT ACTIONS

Comes across Spiritus as an article | Reads more about breathwork and the platform | Reads about the practice and books an appoinment | Identifies the location and chooses a timeslot from the email and replies | Visits the lab and meets the design researcher | Participate in the session | Co-exploration of data with the design researcher | Collects the booklet | Share the link with like minded people | Makes another appoinment to see progress

LINE OF INTERACTION

DESIGN RESEARCHER ACTIONS

Greet, obtain consent and guide the student | Monitor the data and note down noticable events | Show the data dashboard and co-reflect on the data | Explain the role of the booklet and hands it over

LINE OF VISIBILITY

BACKSTAGE ACTIONS

Available timeslots are identified and is sent as an email to the student with possible meeting times and location | An appoinment is made | Securely save the anonymized data | Makes appoinment and retrives student file

LINE OF INTERNAL INTERACTION

SUPPORT PROCESSES

Appoinment software system | Data management sortware writes a file | Data management sortware sends stored file | Appoinment software system

Figure 41: User Journey and Service Blueprint for Spiritus

The phases of the student's journey are based on the phases as depicted in the service blueprint. The following subsections elaborate on each phase and touchpoint in detail. The journey here is one that is undertaken by the persona Tresa who was previously introduced in the report. The lettering in italics indicates Tresa's point of view and experience which would also be how I present the final design.

6.2.1 Initiation

The TU Delta Article

As Tresa was already battling stress and an impending possible burnout, as mentioned before had realized that breathwork might be the solution but was overwhelmed by the large amount of information online. She had almost given up on pursuing a practice.

This was when she chanced upon a TU Delta article on her feed which said mentioned that Design Researchers at IDE (Industrial Design Engineering) had developed a data supported breath practice to aid her on her journey towards...'Inner Peace'.

The full article copy can be found in appendix 4.

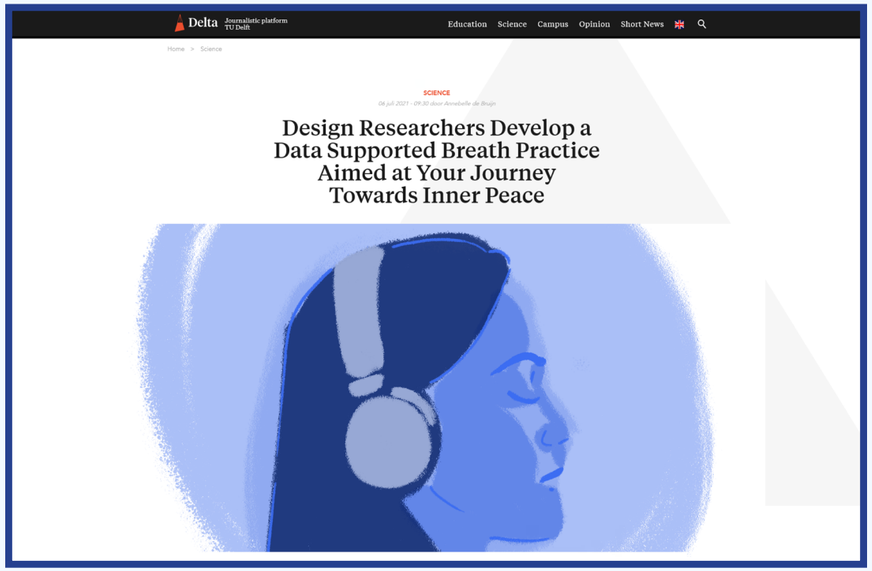


Figure 42: A visual mock-up of how the article would appear on TU Delta

The article also featured a link that called for students interested in participating. Tresa, on the lookout for a solution and interested in physiological data, decided to follow the link hoping to know more.

The Project Vital Website (full website viewable at www.project-vital.org)

The landing section indicating the raison d'etre. The top menu provides links to the other pages as well such as the about page and a page that introduces breathwork

Section Indicating the aim and imploring those who are interested to participate in projects

An animated call to action to try out Spiritus: A Data Supported Breath Practice that links to the Spiritus page

Link to the about section that elaborates on the process followed by Project Vital

Figure 43: Homepage of the Project Vital website

Tresa decides to browse the website to know what Project Vital does and what they mean by Breathwork.

Figure 44: The About page elaborating on the process followed by Project Vital

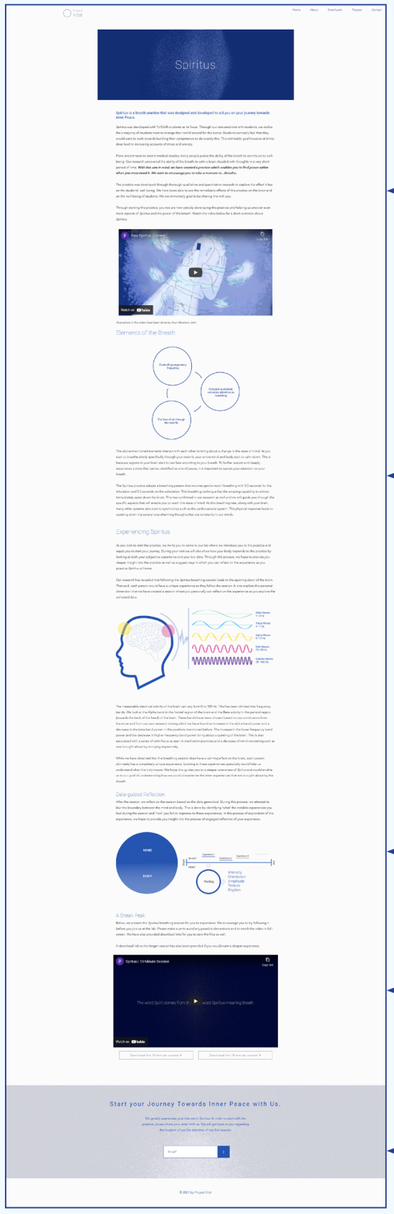
Figure 45: A page on Breathwork explaining its relevance both historically and in the present day

Tresa finds that Project Vital is approaching breath in a very different manner unlike the sources that she has come across before. On the about page she sees a video that elaborates how Project Vital follows a data supported approach to understanding the breath and how the benefits to well-being are scientifically approached. She is intrigued by the fact that through participating in the practice, she is contributing to producing new knowledge about how the breath can aid in bettering well-being.

The Breathwork page on the website, also gave her a new perspective on how ancient breathwork really is and how different cultures all over the world understood the breath.

With this information, she is all the more curious about what Spiritus would entail. She wonders what a data supported practice really means and how it would help her on the journey towards 'Inner Peace'. With these thoughts, she visits the Spiritus page.

Introduction to Spiritus



A section explaining the role of the breath and Spiritus towars inner peace

Sections elaborating on the science of Spiritus

An short explanation of the data supported reflection process followed

A short version of the breath session video that would be shown during the inperson session

A section to share the email to book the appoinment

Figure 46: The Spiritus project page on the Project Vital website

Improved video

While the effect the breathing pattern on the body was established, the video that was shown until the second design cycle was improved so as to make it more desirable for participants. This improved video would be the one present on the Spiritus webpge and would the one participants would see when they come to the inperson session as shown in the blueprint.

The improved video was created using Touch Designer and is one that is audio-reactive. The particles (as shown in the figure 40) react and move according to the video.

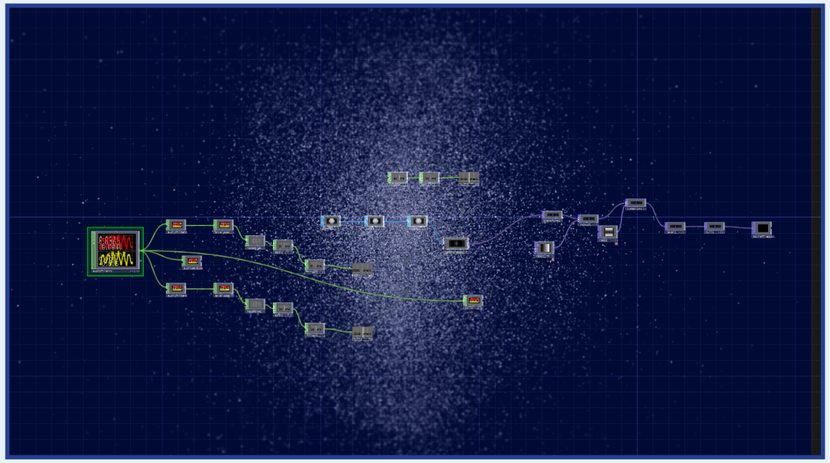


Figure 40: The Touch Designer Pipeline for creating the audio reactive video

The intention behind the audio reactive video is for participants to interpret the forms as they like while still making the video more desirable than the comparatively minimal video as used before.

Tresa tries the video she found on the Spiritus page out and completes the short session. After noticing that it had an immediate calming effect where she felt her thoughts reduce and a sense of calm, she was intrigued by what could be happening to her mind and body. To find this out, she shared her email ID on the website to book an appointment and finds an email in her inbox in a few minutes mentioning the location and the possible timeslots from which she selects one (figure 47).

Figure 47: Student sharing their email and receiving an invite

6.2.2 Immersion

Based on the location mentioned in the email and the timeslot that was decided, Tresa visits the lab. On reaching the lab, she is greeted by the design researcher who explains to her what the session entails and then with her consent, helps her to wear the bio-sensors. They start the session during which Tresa follows the guiding video.

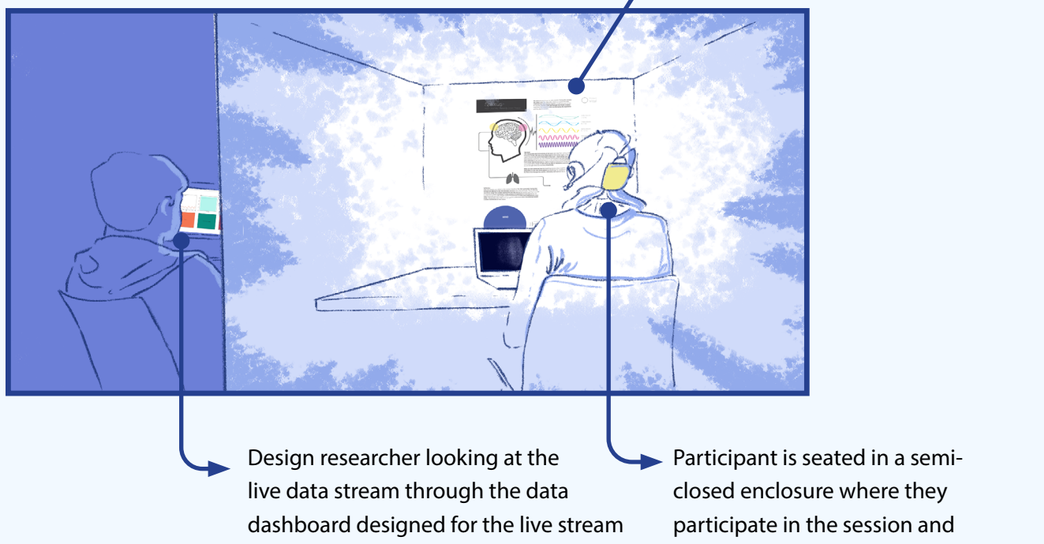


Figure 48: Student participating in the session

During the session, the design researcher monitors the live stream of data to take note of any patterns or events. The enclosure is intended to reduce the feeling of being observed by the design researcher during the session.

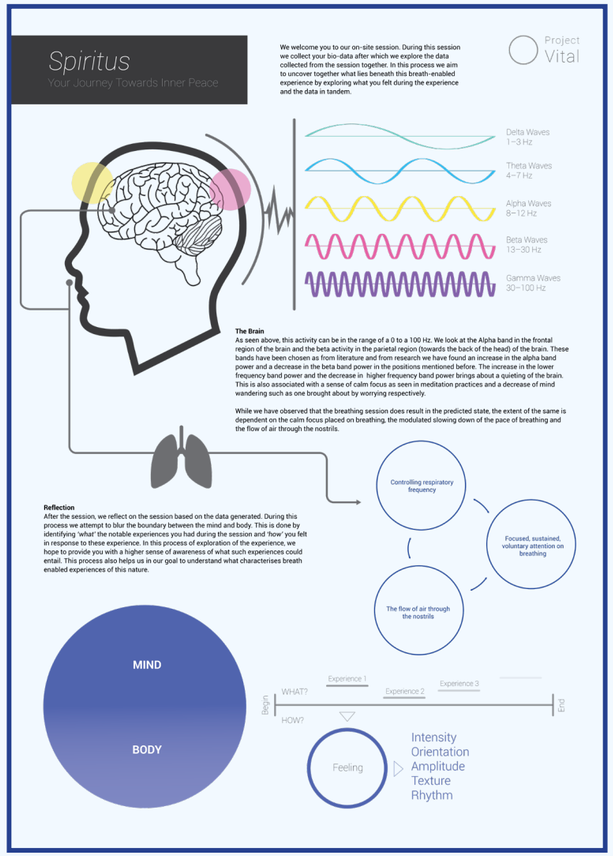


Figure 49: The poster in the lab giving an overview to participants about session

6.2.3 Reflection

Microphenomenology: A framework for Reflection

As the previous evaluation phase shed light on what the data features relevant for reflection and analysis could be, a framework too had to be defined for enabling this reflection. The framework adopted was one that was adopted from the micro phenomenological interview method. This method focuses on having participants reflect on transmodal qualities of the experience such as the intensity, orientation, amplitude, texture or rhythm. This method has been shown to give participants a deep and unique account of their own experience (Claire Petitmengin: "Micro-Phenomenology," 2019) connecting their thoughts and the feelings in their body; the 'What?' and the 'How?'.

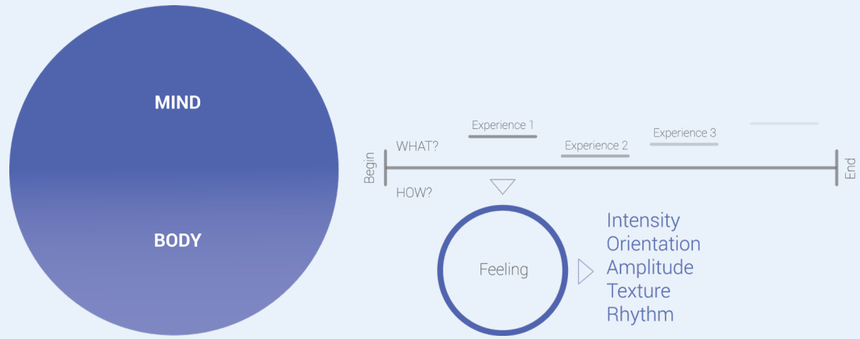


Figure 50: Structure of a microphenomenological reflection process

This reflection process was intended to support the data dashboard that would be presented to the participant with their midline frontal alpha (Fz) and midline parietal beta (Pz) power, chest expansion/contraction and head movement all of which were data features that were identified as having observable changes during the evaluation phase.

After the video guidance is complete and as Tresa opens her eyes, the design researcher asks Tresa to take a look at the data dashboard (now shown on a much larger screen beside her) and her own video on the side and to reflect on the experience. As shown in the poster, he implores her to think of notable experiences she remembers during the session (such as distractions, complete calm etc.) and to think of how these feelings felt in terms of the transmodal qualities such as the intensity, and its location in the body. Tresa is asked to mark the time series data using the mouse cursor.

As she clicks on the dashboard she sees that a line is drawn across the time series data across all the data features. After each mark, she is prompted by the design researcher to reflect on the nature of the experience at that point as mentioned before; to think of 'what' the experience was and 'how' it felt to her.

As she continues she finds herself increasingly being able to identify a correlation between the experience and the data. She comes to know what a feeling of calm truly entails both in terms of her subjective experience and what the bio-sensor data shows.

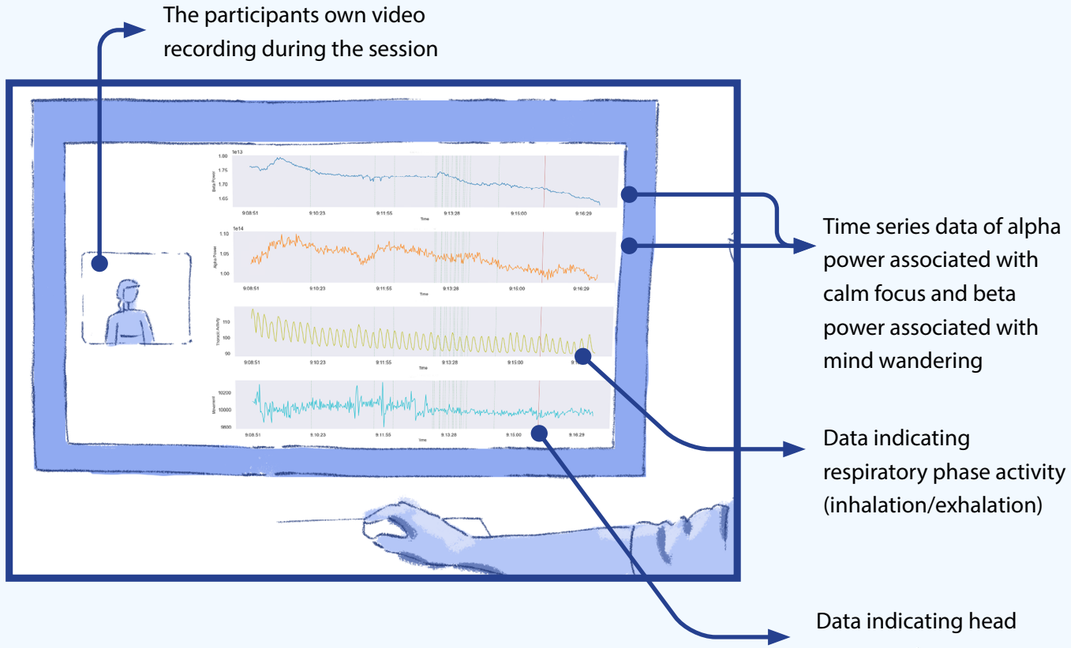


Figure 51: The data dashboard that supports the reflection process

6.2.4 Enlisting

After the reflection session is over, the design researcher, shows Tresa a booklet and explains that she can take this booklet home and write down her reflections after each session she follows at home which of course this time is without any data collection.

Figure 52: The design researcher explaining the role of the booklet

That said the design researcher does implore Tresa to reflect on her experience in a manner they did during the session wherein she reflected on how each sensation identified truly feels during the session.

The booklet can be found in appendix 5.

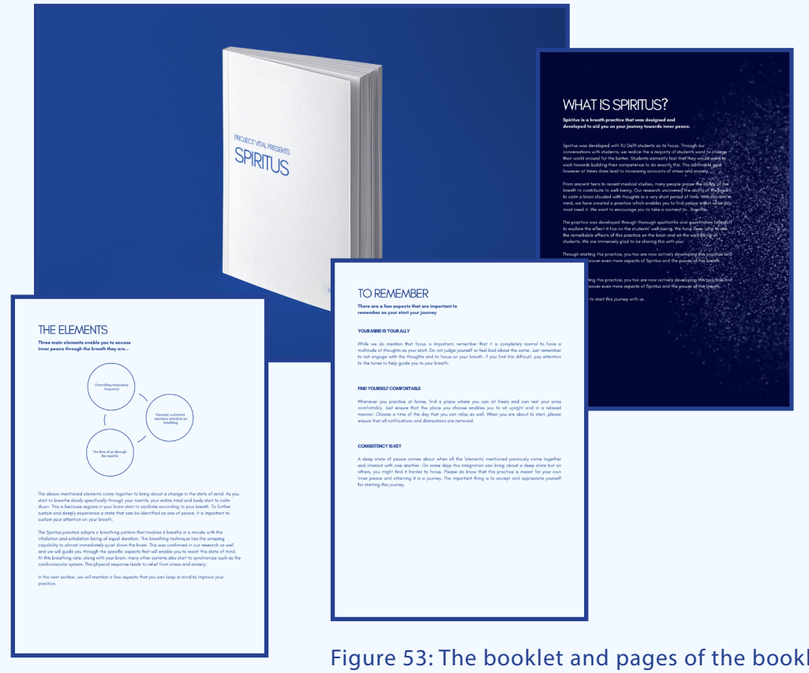


Figure 53: The booklet and pages of the booklet that indicate what the participant has to keep in mind

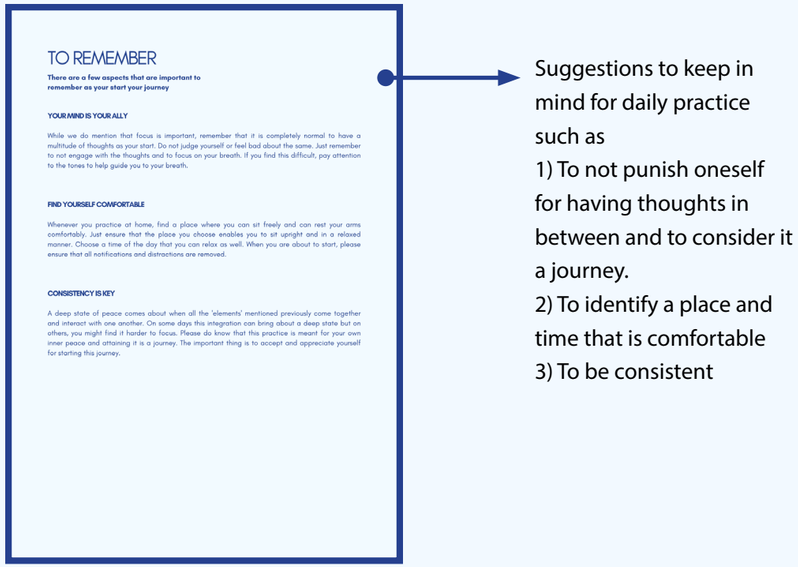


Figure 54: Suggestions provided in the booklet to aid the daily practice

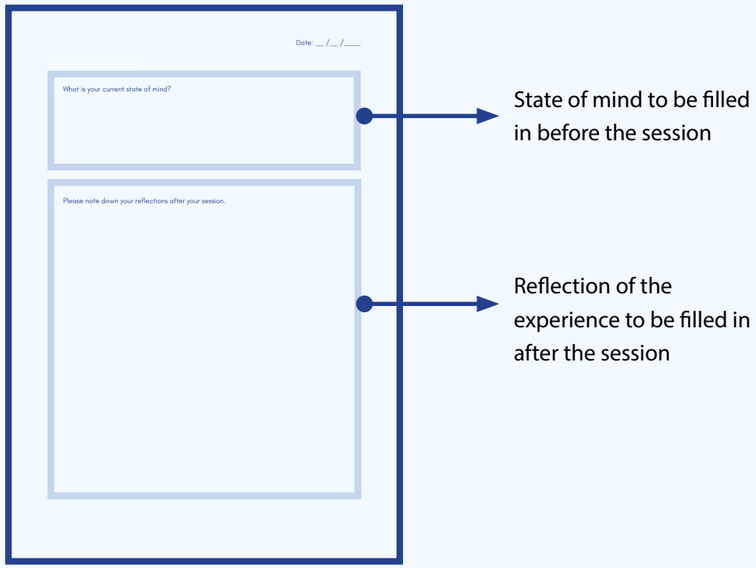


Figure 55: Reflection pages that make the most of the booklet and are those which are to be filled after each session

6.2.5 Sharing and Seeing Progress

Tresa on finding the session insightful leaves with a newfound sense of direction in terms of how she could resort to the breath in order to find a moment of peace. Unlike before where she was just told that the breath contributed to well-being, she saw for herself how her mind and body respond to the breath. She knows how certain thoughts and feelings affect her body as she practices.

She is also keen to share this experience with her friends as well who were on the lookout for a practice to follow. She feels that they could benefit from following the practice as well.

As time passes and as days and months go by, she is curious about how her body and mind might have changed its response to the breath. She finds that she is increasingly more at ease as she practices and wonders what her bio-sensor data would be given that she has been practising for quite some time.

She decides to book another appointment and looks forward to what might be uncovered.

6.3 Spiritus as Implemented as a Research through Design Project

In this section, how Spiritus functions as a design that contributes to new knowledge is elaborated upon. This is done through having the participants annotate their experience as part of the reflection process, the bio-sensor data collected and the surveys that are formulated.

6.3.1 Observing the Live Data Stream for Events

This data dashboard as defined previously is intended for the design researcher to observe the live data stream and to note down observable events. This makes the researcher better prepared to look at the data dashboard intended for the participant to reflect on the experience and to guide the participant.

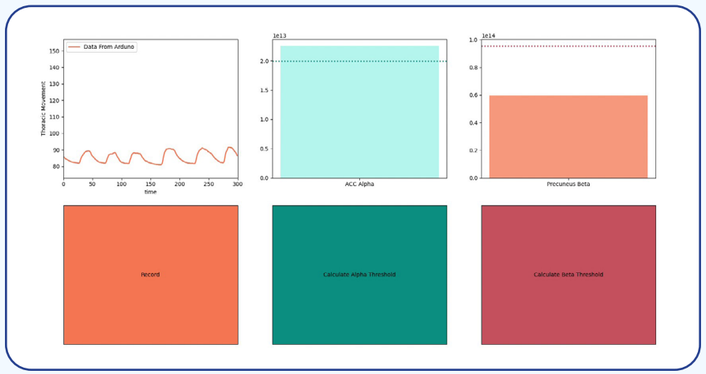


Figure 56: The data dashboard for viewing live data

6.3.2 Annotating the Experience

As shown in figure 57 and as explained before (figure 51), the participant revisits the experience by looking at the time-stamped bio-sensor and their own video side by side with the support of which they reflect on the experience. This reflection process brings about a juxtaposition of the participant's subjective experiences during the session and the bio-sensor data at that point.

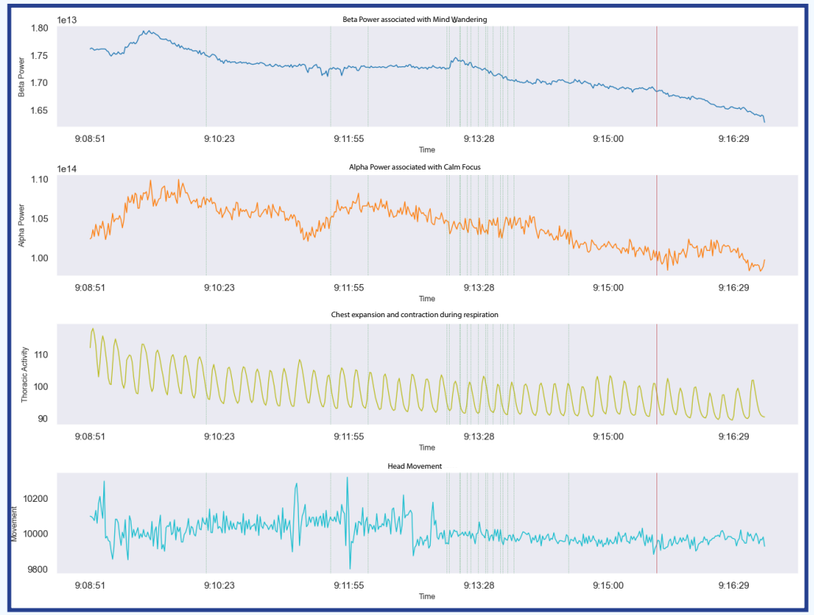


Figure 57: An example of an annotated data dashboard

As mentioned earlier in the report as well, due the difficulties associated with defining the experiences associated with altered states of consciousness given its subjective nature, quantitative means seem to be the way ahead. This is what Project Vital as illustrated by Spiritus attempts to accomplish. While the participant benefits from a detailed reflection, the process provides new insight into what objectivity underlies the person's subjective experience.

6.3.3 Bio-sensor data Based Predictive Modelling

The data that is collected from participants using the Python script is processed and cleaned to an extent as the script exports the data to .csv files. These data features can be used to create machine learning models such as a linear regression where for example we could attempt to predict the breathing rate or a classifier where we would be able to predict whether a person is inhaling or exhaling.

From a product design point of view, this could be incorporated into products that provide adaptive stimuli according to neural activity for instance.

6.3.4 Developing Surveys

Through the qualitative data that is collected for Spiritus, it was possible to refine and formulate a questionnaire that can be used to understand the experiential qualities of the video session that was created. Like shown before, the data shows that different breathing techniques could have different physiological effects. Through surveys it would be possible to identify how a particular breathing technique would be experienced by various demographics. The survey refined and produced through this project can be found in appendix 6. The structure of the survey is shown below (figure 58).

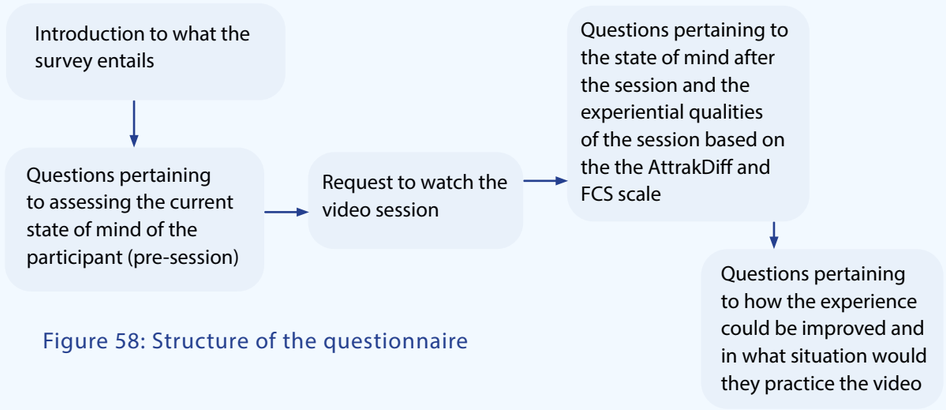


Figure 58: Structure of the questionnaire

7 Evaluation, Validation and Reflection

This chapter presents the evaluation and validation of the design decisions taken as a result of the activities taken during chapter 6 addressing both the research platform and the breath practice. After this, a reflection on the design is also presented.

7.1 Evaluation, Validation and Reflection of Spiritus as a Practice

This section would be focused on evaluating and validating Spiritus as a breath practice. While the efficacy of the breathing pattern was already established, aspects such as the website, data supported reflection and the importance of the booklet are yet to be verified. The intention was to identify how these aspects contribute to their journey towards inner peace.

7.1.1 User Testing

Participant Characteristics

There were a total of 3 participants (1 Female, 2 Male). All of them were TU Delft students. Their level of experience with breathwork varied and this was taken into consideration during the analysis phase.

Test Setup

The test setup was created with the intention of closely simulating the first session participants would have to start their practice. The setup includes an enclosure for the participant which consists of the poster, the laptop to view the website, a mockup of the booklet and the stand to record the participant during the session (figure 59 a). The design researcher is to sit beside the enclosure observing the live data stream during the session (figure 59 b). A large display is also present to facilitate viewing the data dashboard that supports the participant's reflection of the session (figure 59 c).

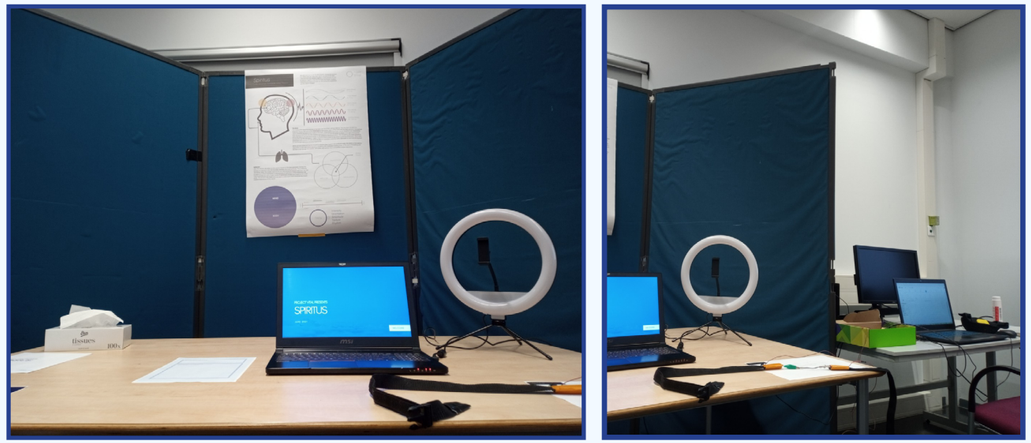


Figure 59 a, b & c (top left, top right and bottom left):
a) The enclosure for the participant for the session
b) the location where the design researcher sits c) A large display to view the data dashboard

Procedure

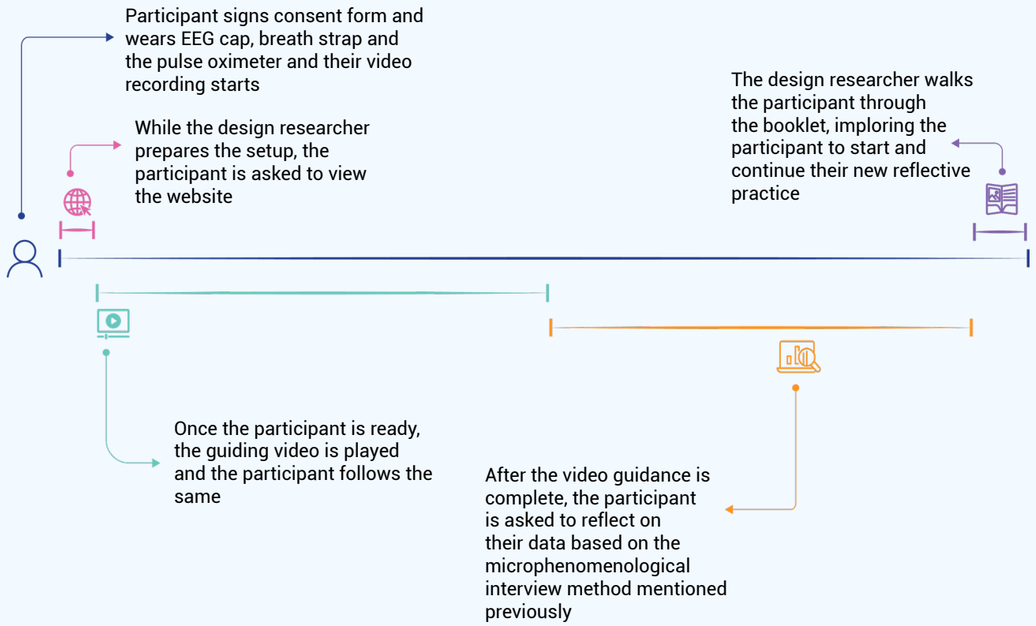


Figure 60: Procedure followed for the user test aimed at validating the practice

This was followed by asking participants about their experience of each touchpoint and how and whether it was conducive to them starting their own practice.

Observations and Results of Each Phase

The Information

- The information of the website and the poster equipped the participants with the understanding required to interpret the data dashboard during the reflection.

The Video Session

- The improvements made to the video were noted to be positive and were more in line with the interaction which intended for people to make the experience unique for themselves. The improvement was also intended to improve the desirability of the video which was also observed.
  - » "...the thing about particles and their movements is that is very organic and hence can capture attention. You can imagine particles taking a shape, or mirroring your emotion."
  - » "Really liked the particles. At times it felt like air, fish moving and even water reflecting."
- The experience provided by the breathing guidance was similar to that which was reported earlier and expressed using words such as, "mind relaxing", "not having any thoughts", "peaceful" and "calmness".
- The pace of the guidance was perceived differently by those with experience and those without. Those with experience mentioned that they would want the "duration of the exhalation and inhalation to be longer".
- The video played during the meeting was the 10 minute version. Participants expressed that they would want to continue the video for longer. The longer version is made available on the website.

The Reflection

- The presence of the design researcher to guide the participant and prompting them to think of individual experiences they had during the session and identify the feeling specifically with the support of the data dashboard was seen to be conducive to a deeper reflection.
  - » "Having a person to talk to and guide through the reflection is important and necessary. I think it will affect how I will do it in the future as well."
  - » "Having a timeline to guide me and have me identify when I had a sensation helps in a deeper reflection. Just having an open question..I don't think would help."
- Seeing their own data was in itself engaging. To an extent, it convinces the participant of the benefits of the session as well.
  - » "It is fun and engaging to look at the data and try to identify what might have happened. Looking for correlations with the data and the thoughts in my head makes it a lot of fun."
  - » "I think it shows the benefit of the experience."

- The data features, when arranged as time series data and when seen parallelly is seen to aid the participant in identifying what lies beneath their experiences and how their body is affected. Annotation of their experience which otherwise is not easily possible was made easier with the help of the accelerometer data and the video.
  - » "Seeing the accelerometer data helped me identify where exactly I felt or did something...without it I felt like I would have marked my own data incorrectly. It gives me an idea of what exactly is happening other than of course my feeling of being relaxed."
  - » "Seeing the data helps me understand the state of my well-being."
  - » "Talking about the different waves and what they are responsible for helped me relate to how I would feel at those instances."

  An example of an annotated dashboard can be found in appendix 8.

Enlisting

- The booklet seems to be beneficial in nudging those starting off their practice to practice the session more.
  - » "..I think it would nudge me to do it more often."

Sharing the Experience

- Due to the online nature of the experience, a participant remarked, "I would share this with my Mom too. She has been really stressed nowadays.". This inclination is in line with the design intention for the participant to be inclined towards finding the experience one they can share with others.

Seeing Progress

- Due to the nature of the persona defined, one who was inclined towards self-quantification, the expectation of the user to improve their practice and to see if they improved was anticipated. This interest was expressed by the participants as well.
  - » "It is good to know if there is a way to see progress. Seeing the differences for two sessions for instance would be interesting anyway."
  - » "I would be interested in seeing how it changes. I would like to have a second opportunity to see how it changes."

7.1.2 Reflections on Spiritus as a Practice Based on the Hero's Journey

This reflection of the evaluation results of the design is based on the resulting hero's journey that was mapped out after exploring how TU Delft students recount peak experiences they consider spiritual and spiritual experiences in daily life.

Figure 61: Revisiting the steps of the Hero's Journey in the context of Spiritus

I. Call to Adventure

Students who would be interested in pursuing would be those who are looking for a relief from stress and are being overwhelmed by the available options. The call to adventure presented by the article and the website also addresses any reluctance the persona might have as the practice promises a session where they can see their own body's response to the session. As shown through the evaluation, the presence of data is seen as one that piques interest and is engaging. Unlike the reluctance in accepting the word spiritual, students were found to comfortably recount their experiences as ones that brought them a sense of peace. Each person did have slightly different descriptions of what this peace was; ranging to a sense of calm to not having any thoughts at all.

II. Initiation

The information presented beforehand through the website, the poster and by the design researcher, informs the participant about what the in-person session would entail. In this case, the information, the design researcher and the data play key roles in informing and guiding the participant and continue this role. The participant starts the in-person session with the design researcher which is possibly their initiation into Spiritus. Due to the relationship of the design researcher as one who is also collecting the data to further knowledge, the design researcher is as much a guide as he is an ally on the journey.

III. Transformation

All participants recount a point during the session where there was a point of absolute calm. That state was one that was identified as desirable. This conviction is further elaborated on by the support of the data dashboard. The data dashboard presented at the end of the session was seen as interesting and engaging as much as it was insightful. It was seen as an 'aha' moment where participants would see how their thoughts and actions affected the data. While the participant through the information knows what the data collected is, now through the dashboard knows how these data features are affected by their own thoughts. This was also one of the aspects mentioned in the framework identified by practice oriented design (figure 62). Competence is marked by not the ability to do something but also by an understanding of how it is done. The participant who goes through this session is now able to articulate and understand with the help of the dashboard what actually happens compared to an understanding that is impersonal.

IV. The Hero's (The Student's) Return

As the first in-person sitting ends, the participants are now aware of what the breath does to their mind and body. They start their journey through Spiritus. The participants were also keen to see how their bio-sensor data and their understanding of the experience could change and evolve over time and to share the experience with those who might benefit from it.

This manner of approaching an aspect of spiritual well-being is one where participants are oftentimes unaware that they are in fact addressing the same. But that said, Sam Harris, a prominent neuroscientist and philosopher considers the ability to access a state of peace or tranquillity while faced with stress as that which can be achieved through training oneself to do so (Sam Harris: Consciousness, Free Will, Psychedelics, AI, UFOs, and Meaning | Lex Fridman Podcast #185, 2021). To him, this is through meditation. Spiritus posits that this is possible through the breath itself and implores those who would want to know this for themselves to come visit. This manner of coming to terms with and being able to have the means to face life's troubles with a calm demeanour is what according to him is associated with the 'meaning of life itself'.

While I am aware of the hyperbole in this statement, it falls in line with the definitions of inner peace as defined earlier in the report as well.

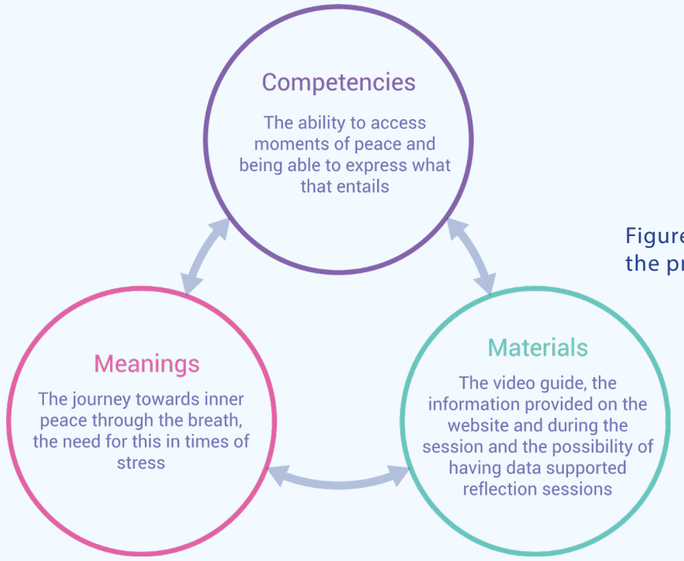


Figure 62: Elements of Spiritus, the practice

7.1.3 On the Future of Spiritus as a Practice

Spiritus would continue as a data supported practice although as time goes on and based on the data gathered, it could potentially evolve. As seen during the evaluation, participants do seem to want to revisit the design researcher for a second time to know how their mind and body would change with time and experience. The possibility for experience to have a measurable effect on the mind and body is one that is already been proven (Powell, 2018) and was also seen during the project for the data collected from experienced participants.

The data collected hence should be managed appropriately and stored securely. While the quantitative data cannot be used to directly identify the person, because of which it is not considered as personal data, it is still prudent to ensure that the data collection and storage is done with the utmost care. The TU Delft supports research data management and has the infrastructure to hence handle the data. In the future, this would be done with a close co-ordination with the data steward of the faculty of Industrial Design Engineering.

As suggested in the process followed by Project Vital, Spiritus is a design as well as an artefact that undergoes continuous improvement while it facilities new discovery. As also seen in the case of the HeartMath Institute and their devices, the potential for producing devices that aid the practice is a possibility. Especially the incorporation of machine learning models developed based on the data collected from participants could lead to devices that can provide personalized guiding feedback.

During the first iteration cycle, we had seen that live neurofeedback could potentially create powerful experiences if the nature of the feedback is one that resonates with theuser. Based on more data gathered, it would also perhaps be possible to determine the qualities of the guiding feedback that would contribute to a strong, memorable experience.

7.2 Evaluation, Validation and Reflection of Spiritus as a Research through Design Artefact

This section would be focused on evaluating and validating the data dashboard and the value of the data collected itself in terms of creating machine learning models i.e., its ability to contribute to knowledge generation. While until now, I had been reflectively improving the data collection based on my own research process and insights, it was important to know and confirm how it aids other design researchers in their process as well.

7.2.1 Evaluation of the Data Dashboard aimed at Design Researchers

The data dashboard was evaluated by having a group of master students (Team Breathe) use the platform for their research project. They had used it to look at the differences in physiological response for resonant breathing and box breathing. Box breathing is a breathing technique where one inhales for 4 seconds, holds the breath, exhales for 4 seconds, holds the breath and then continues this cycle.

Results & Insights

- Visualized data such as the live graph of breath rhythm, the alpha and beta state of the brain, helped them to comprehend the mental state of participants during the experiment. Without those visualizations, they mentioned that they "surely couldn't follow the state of the participant at the same time.". In addition, the data streams indicated a clear difference in how beta power changes as it was generally seen to decrease when following the resonant breathing technique (figure 63 a) and to increase while following box breathing (figure 63 b). Aspects such as these can only be verified with a larger group of participants.
- "The general assumption is designers are not scientists, design floats somewhere between science and art, and we are not trained to conduct purely scientific research. This platform can really ease this process for us to back up our intuition with science." -Team Breathe. This is precisely what the research platform had hoped to do for those who conduct research through design.

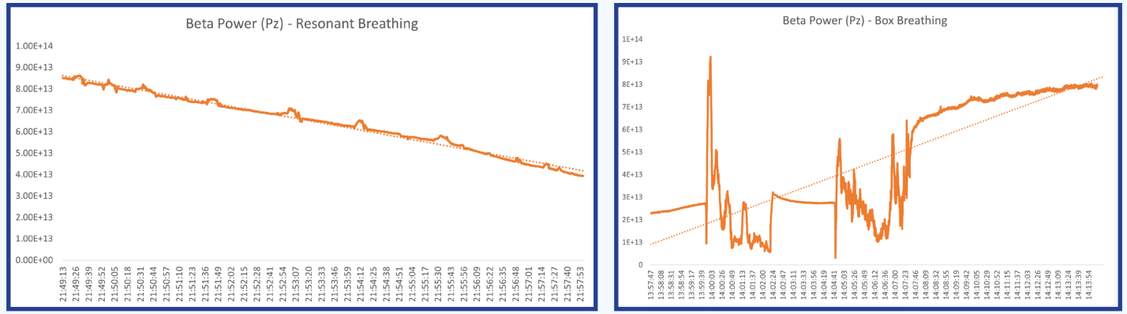


Figure 63 a & b (left to right): a) Decreasing beta power for resonant breathing. b) Increasing beta power for box breathing

7.2.2 Underlining the Potential for the Data Generated for Producing Predictive Models

As previously stated, the cleaned data that was stored as .csv files using the Python script with the intention for further analysis and creation of machine learning/predictive models. To further test this, through consultation with Pankaj Pandey, a PhD student in Computational Neuroscience, the collected data for a short ten minute session from one participant was used to create various machine learning models combining the data features in different ways. The attempt was to predict whether the algorithm can predict whether a person is inhaling or exhaling based on a set of data features. This for instance would be useful in a case where the user is to receive personalized guiding cues based on the data collected from the user. This can lead to a potential product where the rate of the guiding cues changes according to the state of the participant. The type of machine learning model that needs to be created is a *classifier* as we are attempting to classify whether a set of data points correspond to inhalation or exhalation.

Results & Insights

The highest accuracy of prediction was seen when alpha power, beta power and chest expansion/contraction extent values were provided to the model. A comparison of when the same data features were used to produce classifiers based on various algorithms (figure 64). The highest accuracy (70 %) obtained when using various combinations of data features are shown along with the name of the algorithm involved (figure 65). This implies that there are 70 correct predictions of whether the person is inhaling or exhaling out of all predictions.

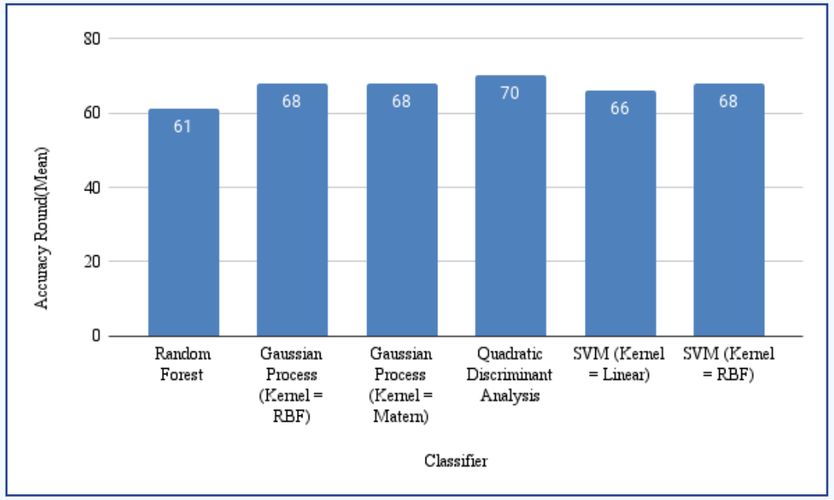


Figure 64: Comparing the accuracy of various methods when alpha power, beta power and chest expansion/contraction values are provided

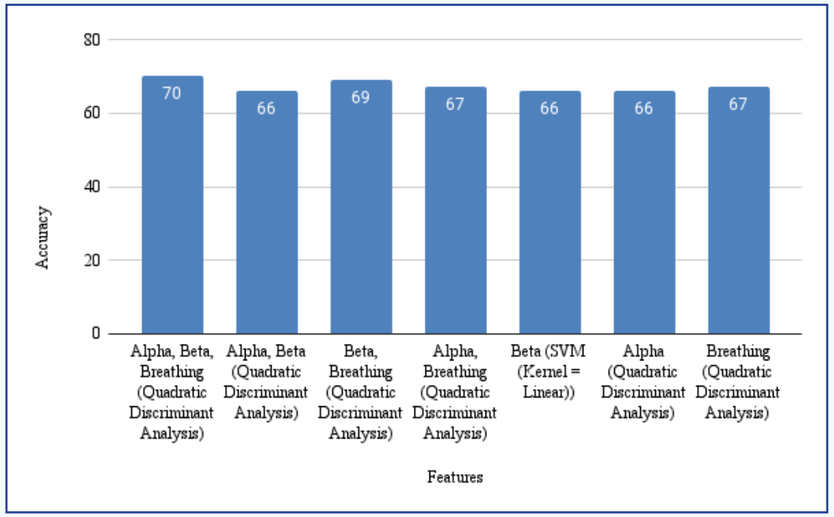


Figure 65: Comparing how the accuracy varries when various combinations of data features are used

These results are promising in that they indicate that it could be possible to create reliable machine learning models. Improving the already seen accuracy could be done by using a larger data set and exploring and including more relevant data features as the research progresses.

7.2.3 Reflections on the Potential New Method Created for Data Supported Enquiry and the Future

As mentioned before, the reflection process involved the participant clicking the cursor to mark the data dashboard intended for reflection with a line. Corresponding to this, as the participant is asked to revisit and recount their experience, participants were able to draw correlations between the data and their specific experience. The combination of the accelerometer and the video also seems to make this annotation process easier than it otherwise would be.

The method of the microphenomenological interview has already been applied to meditation (Petitmengin et al., 2019), where it has been used to uncover what the experience truly entails for the participant. The researchers who conducted the study mention that there is a lack of investigation into what underlies the experience of meditation or any such contemplative practice. While there are first person accounts of what the benefits of meditation offers, there are not many studies that attempt a 'moment to moment' investigation of the experience. Most of the studies that do look at moments in time are those that are based purely on neurological data alone and does not consider the experiences associated with the neurological correlates. While through Spiritus only a simplified version of the same is employed where the participant identifies moments within the session and elaborates on the feelings associated with it, it seems to pave the way forward for researching such experiences. The evaluation of the practice does show that participants were indeed able to identify and effectively reflect on the experience with the support of the data.

What possibly has been identified during the course of this project is a novel method to investigate such experiences by employing a data supported microphenomenological interview process. A collaboration with researchers who have developed these methods and to introduce data into the methodology would be the next step.

Project Vital has been setup to embrace a future where through design develops knowledge and tools that uncover the role of the breath towards better well-being and perhaps, at least to an extent attempts to further our understanding of consciousness.

8 Conclusion

In this chapter, the preliminary questions and the design goals are revisited along with my own reflections of the process followed during the project; both the highs and lows.

8.1 Revisiting the Preliminary Questions and the Design Goals

In this section, I revisit both the design goals and the preliminary research questions and how through the process I have worked to address the same.

8..1.1 Reflections on the Preliminary Questions

How should designers approach the design of spiritual experiences in a secular context?

The use of generative techniques had proven quite effective for me as a designer in aiding people to express experiences that they consider spiritual. This proved to be especially helpful in the fuzzy front end of the design process where an exploration of the context is conducted. Like mentioned before as well, for a designer, focusing on existential aspects of spiritual well-being during interviews made for a more effective session.

Being a Christian myself and coming from India, a country where there are multiple definitions of spirituality co-existing simultaneously, it was important for me to approach this as systematically as possible building knowledge from the ground up to avoid any sort of prejudice as I make decisions.

The designs that are generated as well, as a result of this process should keep these aspects in mind. While it might be difficult to explicitly design for spiritual well-being, it was quite feasible to design for an aspect of spiritual well-being that was discovered to be relatable to the target group which in the case of this project was inner peace.

Especially for breath enabled experiences, it proved beneficial to iteratively test out various factors that could contribute to the experience even before a thorough conceptualisation phase. This was important as, unlike experiences that have a visible interface and are more oriented towards outward interaction, the experience that was to be crafted was one that was internal. This internal experience was of course guided by the external stimuli provided. More detailed conceptualisation could be carried out based on the insights received about which external stimuli were most conducive to the experience.

In approaching such topics, I would implore designers and design researchers to approach them with humility and wonder more than anything. There's a lot of behaviour that at least as a novice designer I could not anticipate given the personal and subjective nature of the topics. That said, each find and discovery was rewarding and also shed light on what spirituality could mean to me personally as well.

How might we design data feedback to assist breath-work? What data might characterize spiritual or transcendental experiences?

This proved to be especially challenging during the project. While commercial products promise data feedback that is meaningful such as the Muse headband for instance, the software they use is proprietary and hence the methods they use are inaccessible. It was also not possible to conclude these commercial technologies involving especially neurofeedback work as suggested as these products do not cover the all the regions of the brain that are significantly and differently affected by breathwork.

Directly prototyping with the live data stream proved to be most effective in helping determine which data visualisation and collection method would be most appropriate. In this sense, throughout the project, I've considered the data as design material as well.

During the course of the project, one of the iterations did cause the participant to have a strong emotional experience for which the behaviour of the data was observed. Other than this during the project, the state of reduction of thoughts, a state that was associated with inner peace by the participants was characterized as well.

While the project focused on only a particular type of experience that could be considered spiritual, the system developed as proven to be robust in terms of being able to characterize the data in a detailed manner.

Can breathwork help TU Delft students achieve greater spiritual well-being?

The evaluation of the practice does support that breathwork could indeed contribute to spiritual well-being. Like mentioned before, in the project, the focus was not on addressing all aspects of spiritual well-being but to improve one aspect of the same to hopefully add to the whole.

8.1.2 Reflections on the Design Goals

The two design goals were:

"Create a system that designers can use to explore bio-sensor data and qualitative data in tandem so as to characterize and design for breath-enabled spiritual experiences."

"My design goal is to make the journey towards acquiring inner peace accessible for TU Delft students through a desirable breath enabled experience they can practice."

Both these design goals were addressed through the final design: Spiritus as a data supported breath practice which also effectively acted as a Research through Design artefact. Both these aspects were validated with TU Delft students and with design researchers. The evaluation results suggest that TU Delft students would indeed be able to successfully embark on their journey towards inner peace with their first step being supported by their own data. The contribution to new knowledge produced through the process of designing Spiritus and through Spiritus itself also validates Project Vital as a research platform for producing knowledge through design.

8.2 Limitations

This project was carried out during the COVID-19 pandemic. As there was a need to have in person sessions to collect data from participants, it was important to manage the time taken for the sessions and to devise the methods accordingly so as to ensure that enough data is gathered while taking the utmost care. This did call for some research activities being carried out in smaller parts. This however in most cases proved to be beneficial as it gave me more space to iterate and improve towards the final design. Most of the participants were also IDE master students which might potentially have an effect on the results.

8.3 Towards Fulfilling Personal Objectives

I had expressed my interest in working on my thesis in such a manner so as to lay the foundations for a PhD that leverages bio-sensor data as design material to design for better well-being. My supervisory team completely supported me in this regard while always reminding me to not lose focus of the immediate goal as well.

At the beginning of the project, I had never dealt with EEG data or any bio-sensor data for that matter and neither was I adept at python enough to do any sort of data engineering. Now at the end of the project, I find myself having processed various kinds of EEG data, performed a fair bit of data engineering and even was able to explore the possibilities of using machine learning methods. All of these activities were done by considering data like any other design material where the methods were tried and tested and iteratively improved upon.

I hope that Project Vital, as formulated through the project, becomes the starting point of my career as a design researcher and also one other design researchers at IDE can use to further knowledge about the breath through design.

To a student who might be reading this report, I implore you to not hesitate if you want to do something or to try something out. As designers, we can make design material out of almost anything that we might come across. All we have to do is to just try it out and learn from each attempt.

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