Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Architecture and Design
Department of Design

Anna Margrét Gunnarsdóttir

Co-designing Interactive Digital Platforms for Promoting Physical Health in Older Adults

Master's thesis in Interaction Design
Supervisor: Marikken Høiseth
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A master thesis by Anna Margrét Gunnarsdóttir
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Preface

This master thesis is the final project for a master degree in Interaction Design with NTNU (Norges teknisk-naturvitenskapelige universitetet) in Gjøvik. The literature research started roughly in autumn 2020 where the focus on this thesis is the importance of physical strength throughout peoples life time. The research continued from January 2021 and was written during the spring semester 2021. The workload corresponds to 30 ECTS.

My interest in the importance of people's physical health has been increasing through the years. In this process I learned many new things that I was not aware of, not being from a health educated related background. I wanted to learn, explore and add to my poor knowledge in this area by asking the question; "Is it possible to use interactive digital platforms to motivate and encourage the older adults to take care of their physical health?"

The aim of this thesis is to show how much it would benefit people and the society to have better physical strength when getting older. The research took place in Iceland where I am originally from and is therefore made with Icelandic market in mind. I also wanted to make a good research and framework for others to adopt or use later.

01.06.2021

Acknowledgment

I feel humble and thankful to have gotten to know a lot of amazing people throughout this research project. People have been so engaged in helping me to get to the finish line.

For and foremost I want to thank my supervisor Marikken Høiseth for patience and support like no other. Without her contribution to the project the experience would not have been the same.

This had also been impossible to finish without my amazing co-designers Bjarnveig, Tinna, Anette, Marte, Birgir, Ingunn and Yngvi. Thank you so much Erling and Stefanía for taking time from your busy schedules and giving me important input, knowledge and advice in the design and report process. Siri thanks for having my back through these two years of study.

Lastly thanks goes to my family, my husband Halli, daughter Sólveig, my mum and dad and my mother in-law, this has taken its toll and time and was possible for me to finish because of your flexibility and support through this master thesis.

A.M.G

Abstract

With every passing day, each one of us is getting older. In Iceland the number of people aged 70 and older is conservatively estimated to double over the next 30 years and rise to become a quarter of the population. Given this information, there is great importance to the task of delaying disability as much as possible and for as long as possible (Samúelsson, 2021).

This study is intended to identify the needs and wants (requirements and wishes) of the target group of older adults when building a digital platform to help them find motivation to increase or maintain their physical strength with customized training programs. Árvakr is a platform created for the older adults that are not sure how to gain or maintain strength, keeping them motivated by responding to their success. A business version of Árvakr can be used by physiotherapists to communicate with their clients, to create personalized exercise programs and to follow up on their clients' progress.

After reviewing the relevant literature, I conducted a series of interviews to collect as much knowledge as possible. Analysis of the interviews helped to better understand behavior, experiences and needs, and to get knowledge and insights from professionals in the healthcare industry. The interviews helped shape the target group and showed how much of an effect a carefully designed digital platform can have. All collected information was mapped with the use of interaction and service design methods and put into a prototype. This was done through workshops with co-designers and tested by the end users.

The final product, having taken into consideration all of the collected input from older adults and physiotherapists, is a design suggestion for the digital platform named Árvakr.

01.06.2021

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Introduction

With every passing day, each one of us is getting older. Passing into our senior years, we see the similarity between us diminish: it is hard to define a typical senior person as they as individuals vary a lot – much more than in earlier stages of life, and this difference does not come entirely by chance. Rather, it comes as a result of social and economic factors, lifestyle, gender and other circumstances which shape the individual. We tend to define people of a certain age group as people requiring resources and demanding time and services of younger people of the workforce. The fact is that senior people have very different needs and abilities and there is nothing preventing them from contributing to society in different ways despite having reached a certain age.

Different stages of life bring different roles and responsibilities, but throughout life we all have the need for a sense of purpose and the need for good health. Increased longevity can still bring an abundance of opportunities to people in good health. However, if seniority is characterized by steep regression, the effects are more notably negative for the individual and society alike (Samúelsson, 2021). Most people are aware of the importance of taking care of their physical health, but not everyone is taking action and actually doing it. Functional decline among older adults, followed by an increasing lack of independence, is commonly the result of a reduction of skeletal muscle tissues - a syndrome known as sarcopenia. It causes the loss of muscle mass and strength, resulting in the decrease of function. To prevent this from happening, clinical methods usually focus on the benefits of regular exercise and balanced nutrition (Walston, 2012).

The majority of people receiving healthcare today are over the age of 65. Many of these people consider themselves happy, having aged successfully although they struggle with various diseases and disabilities (Bowling and Dieppe, 2005). Older adults often accept the fact that old age brings deteriorating health and that it is normal to have decreased physical function. This is a trend that needs to stop.

When training for strength, it is important to take into consideration that everyone has their own fitness level. Everyone benefits from daily exercise of some sort, and a common recommendation for strength training for seniors includes a regimen with 2-3 exercises each week using a training program individually adapted for technique, safety and fitness level (Fragala, 2019).

Recent advances in technology has made it easier for people to work out at home, but is commonly lacking the proper guidance, motivation, personalization and assures people that they are exerting themselves at the proper level of effort. Most people are motivated by seeing progress while training. By having a program that is varied and composed of fundamental movements, more people can exercise and experience well-being as a benefit.
Many older adults don’t know how to start strength training, how to achieve the results they want and how to stay motivated during the process. The results of the

master thesis is **Árvakr**, which is an app designed to help older adults (65 and older) to train at their respective fitness level, using exercises adapted to the individual user after having completed an initial benchmark. The exercise frequency can be adapted and inspiring feedback helps keep people motivated and on track. A business version of the app allows physiotherapists to connect with the users' profiles and customize a program for each individual.

1. Research questions

The leading formulation of research questions and follow up questions for this master thesis:

- How can a digital exercise program help seniors get better physical strength?
  - How can older adults be motivated to keep exercising?
  - How to make a digital solution easily approachable by the target group, minimizing the learning curve and the threshold for starting?

  What components need to be in place so the app meets each individual's needs and expectations?
  - How to allow for individual customization?
  - How to establish a connection between the user and a physiotherapist?
- What requirements are there for the business version of the app?
  - How to meet the physiotherapist's needs in one app?
  - How to connect the two digital solutions (or platforms) together?

2. Motivation and Goals

This project should contribute to the older adults and their families, physiotherapists and the society for better health promotion within older adults. Iceland has a long waiting list of older adults needing to get into nursing homes (150 löggjafarþing, 2019). The solution for those waiting at home is service from the government and help from family members. This is costly for the government and the best possible service is not provided to everyone. The purpose of this master project is to improve the quality of physical health so the older adults can have more independence and stay at home longer and healthy. The goal is divided into two parts, part one is to deliver a valuable service concept for the older adults, a digital solution that motivates them to take care of their physical health. The second part is to give physiotherapists valuable tools to communicate and make a suitable customized training program for their older client group. This will be done by co-designing with the stakeholders using service design methods with the support of qualitative research methods to solve the research questions.

3. Project Limitations

Since the project is focused on Icelandic market the literature research was based on numbers from Iceland. It was a challenge to get a hold on background information and facts on how many people over 65+ are going to physiotherapists each year. These things are not available online and hard to get a hold on. People working in the health sector in covid-19 days are busy and their offices are not open for the public to come in and visit. Emails from a master student were not a priority so the information used in this master thesis all came from the Internet. This limited the access to data I wished to get a hold on for this research. Physiotherapists in Iceland are using

very little digital platforms to support their work when treating their clients. That ment during the interviews there wasn’t a lot to compare to or talk about on what app they were using or what suggestions could be better. Although their wishes about what they wanted in a digital solution were clear and useful.

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Background

This chapter is about the topic choices and is divided into seven sections: Researcher's Background; Health and Community; Training Physical Strength for Quality of Life; Older Adults and Physical Health; Fundamental Movement Skills; Digital Knowledge Among Older Adults; and Older Adults in Iceland: Long-Term Plan for Quality of Life.

1. Researchers background

An important experience and information background for this thesis is derived from my decade long experience playing professional soccer and working as an Operations Manager and coach at a CrossFit affiliate. I have acquired a wealth of knowledge about the importance of physical strength and regular exercise to maintain well-being and, speaking from personal experience, good mental health. I also appreciate the feeling of a good, hard workout (yes, hard is good) and how that benefits other fields in my life, like playing with my children and not hesitating trying new things and sports that require strength or good physical skills. I can honestly admit that I have reacted adversely when I've seen and met people who avoid and won't do things that they know very well will benefit their physical health. That has been hard for me to understand, which is why I actively needed to put myself into other people's shoes to realize that not everyone experiences exercise as a good, rewarding feeling. I also found out that some older adults think it is normal to feel the onset of age with signs like deteriorating range of motion, endurance and strength.

Over the past 5 years I have had the privilege of working with people of all ages, shapes and sizes with different physical conditions, helping them to increase their strength and improve their health. Everyone has had their own reasons for embarking on that journey and from what I've learned in working with them is that everyone has the need for a feeling of mastery of some sort and an important factor for continued motivation is seeing progress in their actions when it comes to physical health.

2. Health and community

The World Health Organization (WHO) in 2013 estimated the global cost caused by physical inactivity to be $54 billion(Global Action Plan on Physical Activity 2018-2030: More Active People for a Healthier World, 2018) but ultimately the number proved to close in on $67 billion. The estimate was based on information from 142 countries, covering 93,2% of the population in the world (Physical inactivity cost the world $67 billion in 2013, says first ever estimate, 2016).
The main goal of a community promoting health is to encourage its members to create conditions and an environment that promotes health and provides alternatives for increased well-being for all residents. Health and well-being should be paramount in all policies and actions taken in all areas. Creating an environment supporting optimal conditions for work, life and play for people at all stages in life is an important factor to allow everyone to shape their way towards good health and well-being. Making healthy choices needs to be made simple and educating children about the importance of health should start in kindergarten and continue throughout elementary school and high schools (Heilsueflandi samfélag, 2018).

WHO has set 17 goals for sustainability that should be achieved by the year 2030 — the third goal on the list is *Good Health and Well-being*. Many of the other 16 goals relate directly to health or, when achieved, will indirectly contribute to health in one way or another (Sustainable Development Goals, no date).
The environment the communities create for the older adults to maintain their physical condition is important. The older adults need to feel safe, which helps them continue doing what is important to them despite some loss in their capacity (Ageing and health, 2018). Helping the older adults to keep their physical health stable and strong is a long term investment for communities and allows people to live longer and healthier lives. Actively participating in the community increases the quality of life of the older adults, while also contributing to society.

3. Training physical strength for quality of life

Physical activity is defined as any physical movement produced by skeletal muscles that requires expenditure. Regular activities have been proven to help to prevent diseases such as stroke, heart disease, several cancers and diabetes as well as maintaining mental health, well-being and quality of life (Physical activity, 2020).
Many tasks people perform every day are related to physical strength. Whether it is picking something up from the floor, putting things in upper closets, sitting down and standing up from a chair and so on. Some actions require more strength like picking up their children or grandchildren, carrying their baggage when traveling or moving furniture into place. A person's muscle mass decreases as they age and to maintain it, an extra work of physical activity or exercise is required to rebuild or maintain it. Building strength throughout a lifetime can increase mobility, flexibility and balance: three things people lack more and more later in life. Nurturing these skills also decreases the risk of injury, falls, arthritis and the risk of fractures (Simon, 2019).
Many people misunderstand what it means to train strength and wrongly believe that the result can lead to them being big, bulky and scary looking. Even runners, known for their lean physique, train strength to strengthen their muscles and joints for better performance and reducing the chance of injuries. Taking a brisk walk or going out for a run is very beneficial, but will never be as good as if followed up by a good strength program. Three ways that benefit runners doing strength training include:

1. Strengthening the muscles and connective tissues, meaning less injuries.
2. Improving neuromuscular coordination and power for the runner to run faster.
3. Encouraging the coordination and stride efficiency that improves running economy (Why You Should Be Strength Training on a Regular Basis, 2018).

Everyone, regardless of their age, gender, social status or race should keep up their physical strength throughout their lifetime and to know that it is never too late to begin.
The World Health Organization has published these key facts about the benefits acquired from performing regular physical activity:

- Physical activity has significant health benefits for hearts, bodies and minds.
- Physical activity contributes to preventing and managing noncommunicable diseases such as cardiovascular diseases, cancer and diabetes.
- Physical activity reduces symptoms of depression and anxiety.
- Physical activity enhances thinking, learning, and judgment skills.

- Physical activity ensures healthy growth and development in young people.
- Physical activity improves overall well-being.
- Globally, 1 in 4 adults do not meet the global recommended levels of physical activity.
- Up to 5 million deaths a year could be averted if the global population was more active.
- People who are insufficiently active have a 20% to 30% increased risk of death compared to people who are sufficiently active.
- More than 80% of the world's adolescent population is insufficiently physically active (Physical activity, 2020).

4. Older adults and Physical health

Most people know the importance of making good, healthy choices for a richer and better life. People that adopt good health choices are more likely to improve their quality of life and age more successfully (Kelly, 2016). Age and physical condition among the older adults can mean different things to different people. A 70-year old may be able to jump out of bed, take a run and even do Olympic weight lifting, while a 60-year old might have difficulty catching their breath after walking up a couple of stairs. Some of the reasons why people lose muscle mass when they get older are: decreased physical activities; decrease in hormones; malnutrition; and chronic diseases (Baumgartner, Waters, Gallagher, Morley and Garry, 1999). Although some health conditions are genetic, much is also due to the environment of the older adults, where younger people more easily survive the negative effect of environmental degradation happening around the world. This aspect can have an important influence on the maintenance of healthy behaviours (Zeng, 2010).

One of the things that may help reduce the risk of diseases affecting people in their senior years is to consistently nurture their physical health. WHO has issued the following recommendations for weekly physical activity:

- 150-300 minutes of moderate-intensity or 75-150 minutes of vigorous-intensity (for all 18+).
- 2+ days a week doing muscle-strengthening activities at moderate or high in tensity (for all 18+).
- Limit sedentary time, replace physical activity at any intensity (for all 18+).
- 3+ days a week doing activities that empathize with enthusiasm, balance and strength training at high or moderate intensity (for all 65+).
- All older adults are recommended to exceed the recommendations above (Pysical activity, 2020).

By maintaining physical strength it is possible to slow down and reduce the changes that occur in the body with increasing age. It is never too late for people to start their training. Possessing adequate physical strength will help the older adults to be more self-sufficient, increase their independence and confidence, and enable them to stay home longer and take care of themselves.

5. Fundamental movement skills

Physical activities can promote health benefits as long as they are done regularly and with intensity and sufficient duration (Global Action Plan on Physical Activity 2018-

2030: More Active People for a Healthier World, 2018). Fundamental movement skills (FMS) are the foundation movements to life that help us to do more complex skills in life, play, games and sports. They can also be described as the ability for a person to control their body accurately and with confidence in action and to do so effectively. Three types of FMS are:

- Body management skills: balancing the body in stillness and inmotion.
- Locomotor skills: transporting the body in any direction from one point to an other.
- Object control skills: controlling implements and objects (Broomfield, 2011).

As we get older, the importance of continuing nurturing our fundamental movement skills becomes more important. To a majority of people, the feeling of being independent is closely tied to being physically capable of doing things without requiring assistance from others.
Loss of strength and balance easily occurs as age sets in, increasing the risk of falls and accidents coupled with the inability to perform basic tasks which contributes to less independence.

6. Digital knowledge among the older adults

When older adults start to acquire new digital skills, they commonly reflect on how they learned things when they were younger, but few of them had any interaction with digital devices at the time. This is the reason why many of them feel like they are outsiders in terms of digital culture and blame themselves for not being good enough (Blažič and Blažič, 2019).
Technology may be used today to improve the quality of life for the older adults where artificial intelligence, among other things, plays an increasingly larger role. With technology it is possible to provide the older adults with better quality of life to support better active aging and maintain frequent social interactions. With the digital divide in generations there is a need for training programs to help the older adults, and designers and developers also need to consider designing aspects when designing for the older adults as the rules might not be the same as for younger audiences. Digital knowledge among the older adults can be different depending on economic wealth and social development within the country they live in (Gongóra, Liria, López, Parra, Munoz, and Perés, 2017). It is both important and wonderful that it is possible to make the elderlies' lives easier with advances in technology, but it is equally necessary to help these users to understand and successfully interact with the things created for them.

7. Planning for the older adults in Iceland

In Iceland, a person's lifetime is commonly divided into four life stages:

- *First stage:* early childhood and the academic years (up to and including university education)
- *Second stage:* people have started their professional careers, building their homes and families, settling into life.
- *Third stage:* retirement age when people are still in good health, fully active in what life has to offer and able to fully take care of themselves.
- *Fourth stage:* the end is near, health is deteriorating fast and some people are admitted to nursing homes.

Measuring age in years is not a definitive measure of whether people are old or not. It is not uncommon to consider other factors when it comes to describing a person's age, factoring in the biological age with the state of physical and mental health, mobility and cognitive functions like memory. Younger people can just as well struggle with some or all of these factors, making the topic of "young or old" even more complicated (Ingólfsson, Jónsson and Harðarson, 2012).

Statistics show that in 2019, 20% of the Icelandic population was made up of people over the age of 60 and projecting into the future, this ratio is only expected to grow. As of this writing, there are approximately 2.700 beds available in the nursing homes in Iceland but on January 1st 2021, a total of 453 people were on a waiting list to get into a nursing home. This number is also growing quickly. (Hjúkrunar- og dvalarrými - tölur, no date). Research done among the older adults in 2016 showed that 13% of those 67 years and older considered themselves to have bad or very bad health conditions — an increase of 2% since 2012. According to the same research, 24% of the participants said they were doing some strength training — an increase by 1% since 2012. The Icelandic government has created a long-term plan that should be fully realized before the year 2030, starting in 2021. Among the goals set forward in this future vision is that the older adults in Iceland should be able to feel safe, live independently and get the chance to pursue a healthy lifestyle that focuses on each individual's interests, health and skills. More importantly the older adults should receive education on how to live and start their healthy lifestyle. Many stakeholders are involved in the project: home nursing services, doctors, families, different therapists, the government and other stakeholders educated and invested in this field. The final word of this report describes how there will be focus on preventing people's health from declining with emphasis on systemic health promotions for all age groups with the hope of reducing lifestyle related diseases and delaying age-related degeneration to improve quality of life. To invest in this kind of action plan now, there lies an opportunity to reduce future needs for different health services (Heilsuefling aldraðra, 2021).

In summary, the importance of older adults taking good care of their physical health as age sets in has a multitude of benefits including their prolonged personal independence, improved quality of life and less demand for health care which would positively affect waiting lists for nursing homes and the level of care required once admitted. This thesis centers around how older adults can be motivated and encouraged to perform physical exercise to maintain fundamental movement skills and improve strength, using a digital platform to guide them – either on their own or working with a physiotherapist. Let's get started.

Methods

This chapter describes the choice of methods and how they were applied in this project. Also, the method tools used are explained along with a description of how they were used during the process. Lastly, this chapter shows how the design came to fruition with the important help of co-designers, prototypes and user tests.

1. Insights

This thesis will focus on the maintenance and improvement of the physical strength of seniors by connecting digital platforms with their interests, motivations and needs identified by the use of co-design methods for collaboration and creativity. These methods can generate more relevant idea construction with high originality and user value and help get a better understanding in regards to the users' needs and their decision making. The end goal is to help seniors participate in more activities with the help of digital platforms. If senior members of the community are able to get physically stronger, that may allow them to stay at home longer and be more independent. Improved strength may also contribute to faster recovery after getting sick or injured.

2. Design methods

The methods used for this project were service design methods paired with and supported by qualitative research methods. Some examples of the activities carried out during the course of the project were: co-designer choices, literature research, snowball sampling, interview analyses, Mendelow's Matrix tool, mapping, personas, scenarios, co-designers workshops, prototypes and usability tests.

For the purposes of co-designing, I asked seven people to participate: three older adults and four healthcare professionals.

1. *Anette Henriksen* is a physiotherapist in Norway with two years of experience specifically focusing on children and as we would find out, some design considerations are mutual when designing for children on one hand, and older generations on the other. Anette has years of experience in diving, having been on the national team for 8 years and subsequently coached young divers. She is also currently a Crossfit L1 Coach.

2. *Birgir Úlfsson* is 74 years old and retired. He is very active and tries to take care of his physical health. He worked within the technology sector before retiring 5 years ago but is still interested in all kinds of technology and new advancements in the field.

3. *Bjarnveig Birgisdóttir* is a nurse with 14 years of experience working at The National University Hospital of Iceland, most recently as a surgical nurse. She is specialized in patience recovery following neurological surgical procedures. Bjarnveig played soccer and handball on an elite level for 23 years and as such, she has also competed on a national level.

4. *Ingunn Bjarnadóttir* is 63 years old and is still employed as a medical secretary where she's garnered 26 years of experience in the field. The majority of her daily work is done on a computer using a handful of specialized computer programs for documenting patient journals, medical history and more. Ingunn likes to walk to and from work as often as possible.

5. *Marte Sofie Wang-Hansen* has been a doctor for 17 years and six years ago she completed her specialization within geriatric medicine. Marthe is physically active and has a wealth of knowledge in how to interact with older adults, specifically when it comes to matters of their physical health.

6. *Tinna Mark Duffield* has been working as a physiotherapist for 16 years in Iceland, Germany and Sweden. She works with clients of all age groups and has a broad knowledge in the field. Tinna is an experienced athlete in many sports and has played soccer both domestically and on a national level, competing for Iceland.

7. *Yngvi Hagalinsson* is 71 years old and retired. Starting out as a teacher, he ended his employment career after serving more than 20 years as a principal. Yngvi occasionally takes walks but otherwise his general interest in physical exercise and strength isn't reflected in his own actions.

2.1 Mapping stakeholders and collecting samples

For this project I identified an initial group of stakeholders and then used the *Snowball sampling method*, asking the stakeholders to recommend others that could be suitable for the task. Questions that were asked to find the right samples were:

- Who will benefit from participating in this project?
- Who is in a position to lend their support to the project?
- Who is educated in this field?

After conducting a series of interviews, it turned out that the stakeholders (samples) chosen for participation weren't as relevant as initially intended. Most of the samples originally chosen were over 80 years old and dependent on help from others in their daily lives, with few of them having mobiles or pads or the knowledge how to use them. It became clear that this age group would have considerable problems from the outset using a digital platform for regular exercise due to them having missed out on much of the recent developments in personal digital technology. This meant we would have to start by bridging a wide knowledge gap to get them acquainted with today's technology, before we would even get to the core objective: how to motivate and encourage them to take care of their physical health.

This changed the emphasis of the research somewhat in terms of the target group combination. I needed to go with younger adults who had a fundamental knowledge about personal digital technology, and I ended up interviewing older adults still living at home (and not in nursing homes) but with a wide range of routinely performing little or no physical activity, to being very active - and everything in between.

After having conducted 19 interviews, little new information of value was emerging and my seven co-designers and I had enough material to carry on. I would continue collaboration with 7 samples who would contribute to the co-design and user testing

throughout the research process. These consisted of two physiotherapists, a surgical nurse, one geriatrician and three senior adults between 63-74 years old.

The purpose of **Stakeholder Maps** is to illustrate the most important aspects to design for. At any time, it is important to know which stakeholders are involved and for the purposes of this project, these are the senior adults and the physiotherapists, ultimately being the end-users of the finished product. However, they would not be the only benefactors - here are some examples of others who might benefit from a successful implementation:

- *Older adults (65+)* — improved strength, better physical and mental health, well-being and prolonged independence.
- *Physiotherapists* — the ability to treat more patients as a result of having fewer physical meetings which in turn allows for improved time management taking factoring in frequent delays and cancellations. A better overview of client progress and the ability to easily communicate.
- *Society* — improved physical health among seniors contributes to less money being spent on healthcare (resources, staff, hospitals, offices etc).
- *Immediate families* — more time spent with their senior relatives in good health, less worries, the ability to enjoy more activities together, fewer doctors appointments and more confidence in their relatives maintaining their independence longer.
- *Nurses* (hospital staff, nursing homes and those in home nursing) — the ability to recommend the application to a patient as a preventative treatment and using it with them.
- *Doctors* — the ability to recommend the application to a patient as a preventative treatment.
- *Personal trainers* — the ability to recommend the application to a patient and using it, having the option of customizing a set of exercises tailored to treat a specific ailment of a patient.

To analyse the stakeholders and their personal attitude towards the project, Mendelow's Matrix tool was used (figure 1). This helped identify the level of interest and power the different stakeholders had in the project. Each stakeholder is placed within one of the four category boxes in Mendelow's Matrix:

- *High power and high interest* - represents the key players that have a big in fluence on the project and can use their power to change or stop a strategy they don't like.
- *High power and low interest* - represent the group that should be kept satisfied since they might move up to high interest as well.
- *High interest and low power* - represents the ones that are very interested in the project but don't have the power to influence changes in the process if they are unsatisfied.
- *Low interest and low power* - uninterested probably because of lack of power they have on the project (Mendlow's Matrix, 2016).

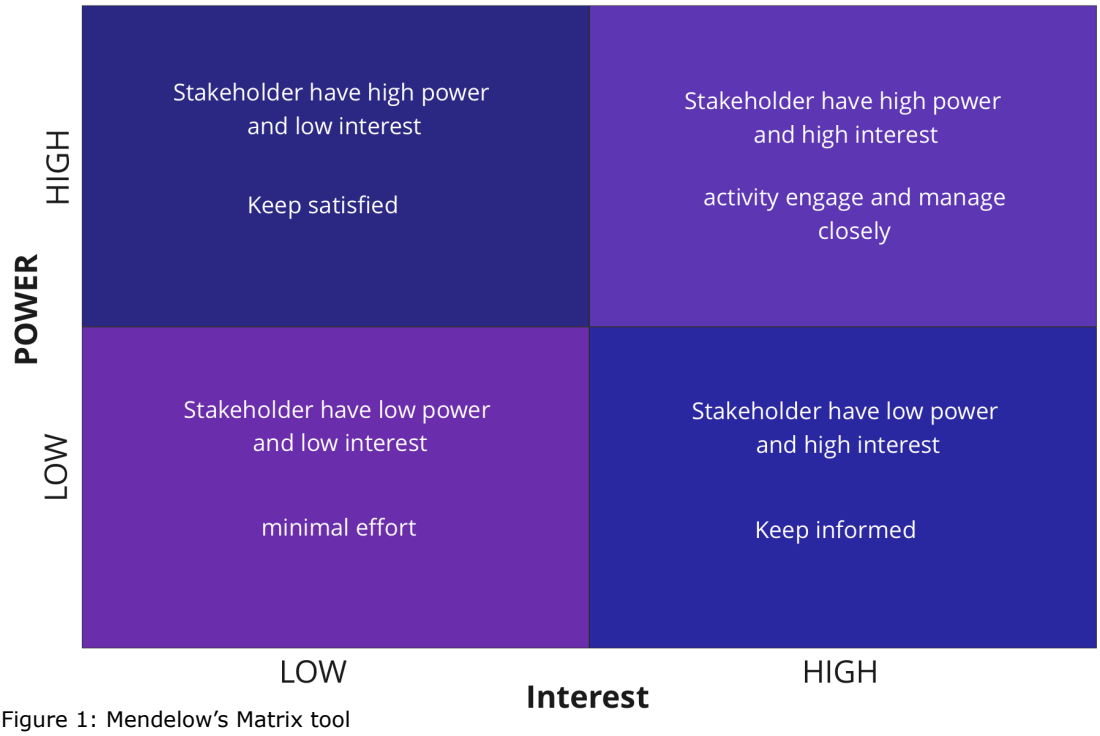


Figure 1: Mendelow's Matrix tool

2.2 Interviews and data analysis

To deepen the relationship with the stakeholders, gather rich data and meaningful insights, a total of 19 interviews were conducted. Rich data is a leading symbol of qualitative research. Rich is a reference to value as much as a mark of distinction (Brekhus, Galliher and Gubrium, 2005). Gathering rich data information from the interviews is important to get an exchange of views between two people – one of whom is in the role of researcher – who are talking about a topic of common interest (Kvale, 2007). The interview's focus in this project was to have a conversation with the interviewees so they would tell their story instead of answering interviewers' questions. The interviews were semi-structured where the aim was to investigate four main topics:

- How can a digital platform motivate older adults to move?
- Technical skills and understanding among seniors: what are their obstacles?
- How can using a digital platform benefit physiotherapists?
- What tools are physiotherapists using today to help their clients?

The participants consisted of the following:

- Six physiotherapists
- Eight older adults between the age of 65-75 years old (four women and four men)
- One geriatric doctor
- One surgical nurse
- One occupational Trainer
- One professor in sports science
- One sports science specialist and trainer

The interviews were conducted in either Norwegian or Icelandic and most of them needed to be done through Zoom due to long distance or COVID-19 circumstances. No personal information was collected during the interviews, I only took notes during and

after the interview. All interviewees got the same introduction and information before the interview was conducted (Appendix A).

2.3 Analysis and personas

The raw data from the interviews was analyzed to transform them into more general insights. Analysis in one go (Figure 2) was the approach used in this research, meaning that analysis took place after all the interviews were completed – that was done to make it easier to acknowledge patterns and help to see more of relevant evidence (User interview analysis – turning raw data into insights effectively, no date).

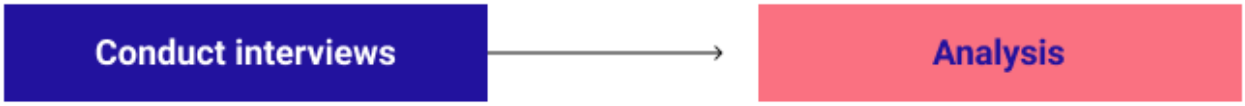


Figure 2: Analysis in one go

By dividing into three categories; Older adults, physiotherapists and other professionals, important information was extracted from each interview, this was done to remove unnecessary information and focus on the core elements that surfaced during the interviews. I conducted a workshop with the co-designers team. By sharing thoughts and information with the team a better understanding of the concept was formed. There were visible patterns in the answers from the stakeholders that would help understand the users needs and wants.

Based on the combination of interviewees, their characteristics, personal situations, common traits and the aggregated results of the interview analysis, three personas were created and meant to represent a group of users. With the use of these fictional characters it was easier to understand which behavior patterns the end-users would follow (Stickdorn, 2018). In this research the three personas: Silja, Halldór and Ragna, represent the whole user group, their goals, frustrations, personalities and technical skills.

Silja is 68 years old and has one daughter and two grandchildren (Appendix B). Silja lives alone and retired one year ago after a successful career as a nurse for over 40 years. Working as a nurse requires a degree of physical strength so Silja was in good physical condition before retiring, after which she has noticed considerable changes in her physical abilities. Silja likes going out for a walk but only if the weather is good and living in Iceland that can be a challenge. Silja uses Facebook on her smartphone or iPad to communicate with friends and family, and to keep up with news and current events.

Goals:

- Feel stronger and regain her good physical condition to have better life quality.
- Find the motivation to exercise.
- Find the right level of exercise and exertion for her level of fitness.

Frustrations:

- The feeling of weakness.
- Not sure where to start or what to do to improve her physical condition.
- Weather in Iceland is cold, which she feels limits her options.

Halldór is a 72-year old retiree who has three children and ten grandchildren (Appendix C). Halldór is married and used to work as a computer engineer in his earlier days. Halldór is very active and meets his swimming group twice a week and goes for a walk with his wife as often as possible, granted he is not in the pool. Halldór loves playing with his grandchildren and reading about new technology. Halldór injured his shoulder a couple of years ago and has been trying to protect and rest that area as much as possible in hopes of recovering and getting rid of the pain. But it still hurts picking up his grandchildren and performing other basic activities in his daily life. Halldór has Facebook and Snapchat but uses them exclusively to follow up on his family.

Goals:

- Gain general physical strength.
- Exercise in a group, or together with his wife.
- Get a feeling of mastery.

Frustrations:

- Shoulder stiffness and pain.
- Not being able to play with grandchildren without physical restriction.
- Not getting better on his shoulder on his own.

Ragna Sif has been working as a physiotherapist for 11 years (Appendix D). She is married with two children. Ragna works long hours every day and wishes she could contribute even more time to her patients. In her pastime she skis in the wintertime and in the summer she spends a lot of time in her cabin with family and friends, a two-hour drive from her hometown Reykjavík. Ragna also likes cooking and often invites her friends to dinner parties. Ragna has Facebook, Snapchat and Instagram and uses them to keep in touch with her friends everyday.

Goals:

- Spend more time with her family.
- Get faster results when helping clients.
- Easy communication with clients.

Frustrations:

- Time management.
- Hard to follow up on clients outside of the office.
- Her professional needs aren’t met by the digital solutions she’s currently using.

The personas helped to understand the users’ needs, goals and frustrations. When questions and design issues arose during the design process, they could be answered by using the presumptions set by the personas: “What would Silja experience, feel or need in these circumstances?”. Using the personas methods makes the ideation stage easier, and the personas could be used as a guide in the process that helps to achieve good user experience for the target group (Dam and Siang, 2021).

2.4 Mapping and scenarios

Based on the personas, three journey maps were created (Appendices E), each laying out its own scenario. The journey maps helped to identify gaps in the user experiences and to explore potential solutions. The journey maps were used to visualize existing

and possible future experiences the personas could have (Stickdorn, 2018).
To make the journey maps come to life, different scenarios were created for each of them. The scenarios describe possible events or circumstances that the personas could come across in their life and therefore was it important to make them realistic and different:

- Two scenarios where the app is needed to reach a certain goal:
  - Downloading the app for the first time, completing the registration and introduction.
  - Having the client receive a personalized program from a physiotherapist and completing the task given.
- One scenario where a persona is using the app:
  - Performs today's training and, by looking at the information in the app, is able to keep track of how it has been going.

The app has three separate patterns of use which needed to be realized and mapped out:

- A person who downloads the app on her own for personal use.
- A person who intends to use the app with the help of a physiotherapist to get customized exercise programs, but also has the possibility to use it on her own.
- A physiotherapist making customized programs for clients, keeping a journal about clients' progress and communicating with them via a messaging function in the app.

To get a better overview over the stakeholders' needs, I created a system map (figure 3) that framed the four most important stakeholders and how they could influence the design results.

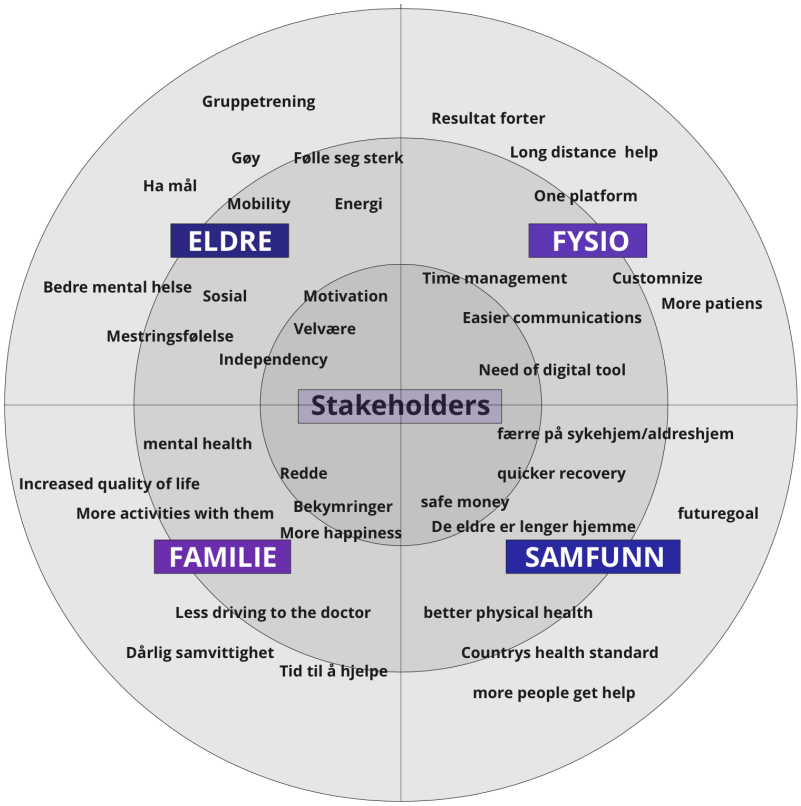


Figure 3: System map made from the interview analyses for different stakeholders

2.5 Co-designing workshops

For this research, four different workshops with different co-codesigners where conducted with the following topics:

- Workshop with two physiotherapists and a surgical nurse. Two questions were asked:
  - Why would we want this type of app?
  - What are the possible uses for an app like this?
- Workshop with two physiotherapists, a surgical nurse and two older adults. Four question were asked:
  - What features are essential (required) to the app?
  - What features would we want to have to enhance or enrich the app?
  - Which non-essential features would be nice to have in the app?
  - What possible name to give the app?
- Workshop with two physiotherapists, a geriatric doctor and two older adults with two topics:
  - Performance of a physical condition test.
  - Literature review.
- Workshop with two physiotherapists and a surgical nurse, introducing results of previous workshops:
  - Personas and scenarios.
  - Mapps.
  - Paper Prototype.

To be able to create a personalized, training program, the app needed to have the individual perform a test to evaluate the individual's physical condition. I created the test in cooperation with four co-designers and in order to come up with a reliable test, it had to fulfill the following five requirements:

1. The results should be measurable.
2. It should be accessible to everyone to perform alone, without external assistance.
3. It should target different muscle groups.
4. It should not take a long time to complete.
5. It should be simple to execute.

After the test is completed, the participants are ranked on a level from 1-10 but the ranking is not visibly displayed to them. However, the ranking is used to select workout activities and to adapt these to the correct level of effort, given their physical condition. The test was performed on eight older adults: four women and four men between 63-74 years old and who all had varying fitness levels.

2.6 Prototyping process

The *Design thinking methodology* is a five-stage, solution-based approach to solving problems. The first three stages are *Empathise, Define* and *Ideate* with the fourth being Prototype (Dam and Siang, 2021). To generate problem solutions and make the ideawork come alive I created prototypes together with the co-designers and ultimately ended up with three different prototypes:

- A paper prototype which included only the main elements required for the design.

- A lo-fi prototype where the app became more visual and tangible, eligible for the first round of user testing.
- A hi-fi prototype that represents the final product, with some elements added, others removed along with some corrections and additions made after having completed the user testing.

2.7 User tests

The fifth and final stage in *Design thinking methodology* is Testing, although I found myself going back and forth between stage four (Prototyping) and five (Testing) as I continuously received and collected feedback from the user tests. User tests are performed to see how users behave, feel, think and empathise with the design and also to see if the design helps to support and guide them through the task at hand at any given time. I made several alterations and refinements at this stage to improve the areas where users had problems and struggled with using the design. After usertest the design team makes new strategies for the same problem and finds a solution that doesn't make the user experience difficult (Dam and Siang, 2021).
In this thesis design the prototypes were tested by the three co-designers, and two end users. Later in the prototyping process three new end users tested the design for the first time to see if all functions and meanings worked like they should.
Contextual inquiry is an interview/observation method I used when conducting the usability tests. This method requires the researcher to ask users questions about the design while the researcher observes, also asking any questions that may arise while the users are actually interacting with the product. Ideally and whenever possible, user testing should take place in the user's own environment (e.g. home or workplace) since these are the locations where the final product will actually be put to use (Babich, 2019). Following the methods of Contextual inquiry, I was able to obtain rich information about the users' workspaces, personal preferences and habits, all of which contributed to improvements of the design. However, I did not pose many questions as the user interacted with the product - rather, I observed and noted the users' actions and answered any questions they had.

Results

This chapter summarizes the qualitative results of the research. The results are described in eight different chapters: Target Groups and Stakeholders; Interview Results; Workshops; Design Briefing; Design Concept; Prototyping; and Árvakr: the Concept and Challenges.

1. Target Groups and Stakeholders

In the very beginning of the research, the target group for the project was intended to be older adults (65+) and the plan was to work with the residents and staff members of the nursing home Skjól in Iceland. I soon found out during my research that even if my target group had no upper age limits, I still required a somewhat younger co-designer group that could participate in designing the solution and testing it. That would require a certain set of knowledge and experience interacting with digital media, a skill that is lacking on today's older members of the senior community.

Taking into account the aforementioned, I defined my two target groups:

1. Older adults 65+ living in Iceland – this group would use the product by themselves and optionally connect with their physiotherapist for better results.
2. Physiotherapists in Iceland – use the business version of the product to customize exercise programs and communicate with clients.

As previously discussed in this thesis, age in numbers is not an exact measure of the physical strength and form that people possess, and findings show that adults as young as 60 years old could also benefit from using the product.

The main internal and external stakeholders in this research were identified as follows:

- Internal stakeholders:
  - Researcher/designer
  - Co-designers (older adults and health employees)
  - Usability testers
- External stakeholders:
  - Older adults
  - Health employees
  - Families of the older adults
  - Society
  - Government

The internal stakeholders participate in building the product, their input varies but they all have the opportunity to influence the end results. The external stakeholders are those who will be impacted by the design although they are not working on it directly (Savina, no date).

A matrix map (figure 4) was created to lay out a communication plan to see when and if different stakeholders needed to be contacted during the research stage. The

map shows that *co-designers, physiotherapists* and *older adults* are the ones that are actively engaged in the project and have high power and interest in the end results; they are also the ones that will end up using the product. The *usability testers* have high power in how the design can be modified and improved after the first prototypes are created and tested, but will not need to be contacted or updated at all times. The *government* and *society* have low power and interest at this stage, but need to be contacted when the product is ready to be presented and subsequently to assess and understand how it could benefit the society. The *families* might need to help the users get started using the product and should therefore be kept informed but will not have power to engage in the design process. In this analysis *coaches, nurses* and *doctors* (as medical professionals) were also identified as having potential interest in the research.

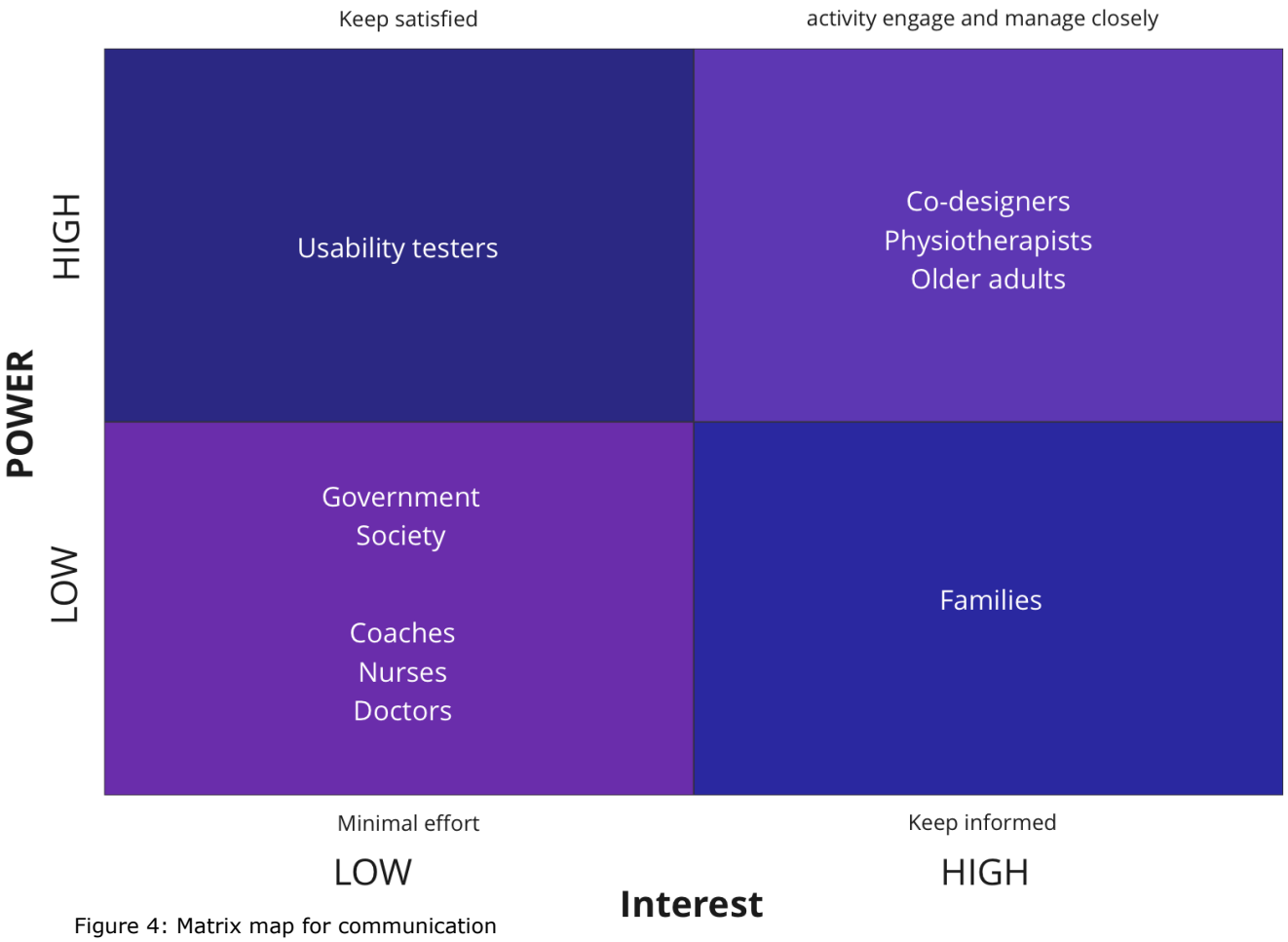


Figure 4: Matrix map for communication

2. Interview Results

I conducted a total of 19 interviews, done one-on-one with each participant using a semi-structured interview technique. I had a list of questions to guide the interview but the focus was to make conversation, establish a personal connection and gain the trust of interviewees talking about a matter where participants had varying confidence when talking about the topic.

The interviews gave me inspiration and insight into behavior patterns and the mental approach participants have towards exercising. We also uncovered the needs

(requirements) and wishes (requests) which would contribute to building a fully featured product, increasing the chances of a successful implementation and gaining general user acceptance.

Clear patterns had already emerged before the last couple of interviews, information and answers were being repeated and little new information was being offered. This gave me confidence in having gathered enough information so that I wasn't missing anything before going forward.

3. The Interviews

3.1 Older Adults

Out of the internal, I conducted interviews with eight older adults between 63-74 years old, split evenly between genders: four women and four men. The interviewees all lived at home and didn't need any help with their daily activities or work. Six out of the eight interviewees had retired while two of them were still actively employed. In the early stages of the research period I was living in Norway and with the target group being in Iceland, I conducted six out of the eight interviews remotely using Apple Facetime or Facebook Messenger Video Chat.
A majority of the older adults interviewed were found to routinely perform some sort of physical exercise to increase or maintain the feeling of well-being. Only one of the older adults performed some mobility exercises, during swimming lessons twice a week. They also see their form of exercise as a pastime: to stay engaged and active, help keep a regular routine and keep themselves occupied after having retired from regular employment. When asked about their knowledge of the importance of keeping the body physically strong, most of them were aware of this need but not everyone was sure of what level they should be exerting themselves at, at what frequency or which exercises in particular they should perform to achieve the results that would help them. Rather, their exercising efforts were performed out of common sense and without a particular target goal in mind.

I also asked about their interpretation of the concept of strength training, and almost all of them felt that taking a brisk walk on a straight asphalt road is equivalent to exercising strength.

Motivation was a topic I wanted to investigate and unsurprisingly found that all interviewees agreed that seeing visible results of their efforts is a big factor in their motivation. They all wanted to feel strong and to be able to enjoy their personal independence for as long as possible. Having a regular routine was important as well, and a common topic brought up by the interviewees was their interpretations of the term 'well-being'. Some of the interviewees said that well-being was being free from taking any medication on a regular basis while others said it was the feeling when waking up, feeling fresh and strong, being able to play with grandchildren or go for long walks.

Another factor in motivation is the social aspect: while some people prefer to exercise by themselves, other people feel that meeting other people is an essential part of exercising and a big factor in motivation.

All of the older adults participating in this research had a smartphone, pad or both. Two of them had smart watches as well. They all knew exactly who they would reach out to if they needed technical assistance and none of them were hesitant of trying new technology but they preferred to use what they already knew. It was obvious that they were confident to try and solve digital problems by themselves, before asking for help. None of the participants were using any kind of digital solution to help with regular exercise.

All of this information was very important for me as this information would influence the design.

3.2 Physiotherapists

I interviewed six physiotherapists: four were located in Iceland, one in Norway and one in Sweden. This range of physiotherapists was intended to get more dynamic feedback and shed light on any differences in practices between the countries.

Five of the physiotherapists traditionally worked at their offices meeting clients in person, while one physiotherapist worked exclusively online using Zoom and e-mail to communicate with her clients. The challenges that come with online work are that it could be hard to explain to the client in writing how to perform particular exercises, and general correspondence could take up time on both sides. This physiotherapist had previously worked at a traditional office for years and offered a valuable insight: clients coming into the office felt it was the therapist's responsibility to make them get better, while online therapy puts the responsibility of performing exercises in the clients' hands, inducing another type of commitment to the process.

A definite benefit of online therapy is the opportunity to serve more clients since they do the exercises at home rather than occupying time and resources at the physiotherapist's office. There is always a degree of uncertainty if the clients are indeed doing all the work requested of them, countered by the fact that older adults do have more spare time and (given the experience of this physiotherapist) are generally more diligent and as such more likely to follow specific instructions. All of the interviewees working in Iceland agreed that clients often didn't seek assistance until they had severe injuries or damages.

The physiotherapist in Sweden used a digital solution helpful for having an overview of the clients and to create exercise programs, but it didn't provide any methods of communication with clients. Instead, phone calls and emails had to supplement the digital solution.

Other physiotherapists talked about how a digital solution would need to be simple, have good quality information right from the start not to deter clients from getting started using it and avoiding irritation. All of the interviewees expressed interest in a single platform to serve all their needs, because most of them were using many different solutions to perform their services. Time management was a challenge for all of the interviewees working in Iceland, coupled with the fact that waiting lists for physical therapy are getting longer by the day.

I did a small survey on what digital tools the physiotherapists were using and collected some of the pros and cons from the interviewees. I did this to see what I needed to focus on in my own solution:

- First, there is a need for knowledge of the importance of keeping your physical condition as good as possible when getting older. Essentially, this falls out side the feature scope for an app as it's rather an educational moment better suited to happen under other circumstances such as conversational therapy or following up on a regular physical check-up.
- Some of the existing tools help people get in shape at home, adapting programs built on facts about a person's age, height and weight coupled with their goal: gaining or losing weight, increasing muscle mass etc.
- Physiotherapists are using different tools to manage their time, clients, progress and frequency.
- One program, Exorlife, shows an overview of upcoming activities, a history of completed activities, program playback with video and the client's summary of a session; how it went for them, coupled with free-text comments. Exorlife then follows progress with some statistics.
- A myriad of other tools can help plan peoples exercise routines in situations like these: books, daily planners, calendar apps and Facebook groups to name a few.

It is worth mentioning that not many solutions – if any – are exclusively focused on older adults' needs, motivation and independence. A majority of the solutions I looked at had confusing structure prone to irritate users in the long run and not meeting their needs, with minimal options for personal customization given client's physical condition. Also, all of the solutions I looked at were in the English language, intended for a younger audience than 65 and older. Although there may be some tools that are focused on an older target group, I didn't manage to find them during this research.

3.3. Other Professionals in the Field

In this round of interviews, I met with five interviewees: a geriatric doctor, a surgical nurse, a personal trainer, a professor in sports science and a trainer specialized in sports science.

The focus areas in this round were society, older adults and their families. The key takeaways from these interviews were that people in bad physical shape require a much longer period to recover, should they end up in a hospital for some reason. Nursing homes are full and at the same time, more and more people need home service coming at a high cost for society and still providing less than ideal quality of care. At the same time, family members — more often than not worried about their loved ones — want to see their relatives happy, thriving and participating in different activities in their retirement years.

The important thing is giving older adults tools and knowledge about the importance of physical and mental health. As we slowly but surely pass the digital divide between generations, a digital approach to the problem could possibly be one aspect to help shape a brighter future for societies, older adults and their families.

Everyone I interviewed agreed that it is never too late to start minding your physical health and there is a need to communicate that out in the society.

4. Workshops

I had four workshops with the co-designers between February 24th and March 20th of 2021.

Depending on the workshop topic, different co-designers were asked to participate so not everyone was present for all of the sessions. Workshops attended by the health-care professionals were performed remotely using Facebook video messenger and the program Miro: a collaboration tool allowing everyone to access and interact with the same document which helps a lot when everyone has the same visuals during the meeting and are able to make (and see) changes done in real-time. COVID-19 prevented me from assembling all of the older adults in a group at the same time so I needed to consult with them remotely in group or individually and in person. This wasn't exactly ideal as I had hoped for more interaction between the participants during mutual workshops, but the results were nevertheless very useful. I also got valuable support and input on the design from family and friends.

First Workshop
Participants: Anette Henriksen (physiotherapist), Bjarnveig Birgisdóttir (nurse) and Tinna Mark Duffield (physiotherapist).

Workshop focus: The needs and requirements of the user group. Introduction and analysis of tools designed for a similar purpose, their pros and cons.

The workshop started with me explaining who the stakeholders for the project are, a summary of the interview analysis and what products I had found that already exist in the market for a similar purpose. The two physiotherapists presented the tools they use in their work and what they felt was lacking for them to be able to fully embrace digital technology in working with their clients. The surgical nurse explained, based on her experience, how the bad physical condition of patients adversely affects recovery time, making it much longer than for people suffering from the same ailments but are in better physical health.

I had categorized the interviewee into three groups: Older adults, physiotherapists and other professionals so we could do the interview analyses together. I also asked the co-designers two questions: 1. Why would we want this type of digital solution? 2. What are the possible uses for a digital solution like this?

The key takeaways from this workshop – which would later prove important – were the following:

- This solution should help people to become healthier on their own, but would need to be simple to use. This would mean that the solution would have to present a clear objective for the user on each screen, with little or no distractions. While this would help users follow and fulfill the tasks, it would probably also limit the dynamics of the interface as shortcuts to other parts of the solution could prove distracting, making the process flow more linear than it would need to be, with a more sophisticated audience.

- The target group needs a digital solution with correspondence features, including the option for clients to exchange video and voice messages with the healthcare professional who's treating them. Using video or voice messages in particular could help the communication between the client and physiotherapist since many factors can impact the ability for clients to express themselves in writing (lacking experience using digital platforms for communication, diminished motor skills or cognitive abilities).

- Everything in one place, a one-stop-shop: this solution would need to cover most, if not all of the identified needs of healthcare professionals for them to be able to use it successfully. Healthcare professionals are already using fragmented platforms to solve different parts of their service, so providing them with just another "one-trick pony" isn't likely to gain traction among professionals.

- Participants expressed certain reservations and doubts about how well older adults would appreciate and adopt this kind of service if not easily understandable and easy to use. Physiotherapists would still be able to teach clients and help them out if it became too complicated, at the risk of causing irritation which would negatively affect the adoption rate and chances of success.

Second workshop
Participants: Anette Henriksen (physiotherapist), Bjarnveig Birgisdóttir (nurse), Tinna Mark Duffield (physiotherapist) and Yngvi Hagalínsson (older adult).

Workshop focus: Ideation work. Done on two separate occasions: first with two physiotherapists and a surgical nurse, and a second meeting with an older adult.

This workshop helped the team understand the usefulness of the solution and set focus on who the users of the product would be. We agreed on having a clean, simple and satisfying solution for the older adult version. Given the target audience of older adults with varying experience of using digital platforms, it was hard to know exactly how intrinsic a design could be before it would start getting in the way more than helping them achieve their goals. When do we cross the line between simple and too complicated? User testing would be a key activity in the prototyping stage to get a better understanding of this.

Four focus topics of the workshop:
1. What are essential features for the app?
2. Beyond that, which features would enhance or enrich the app?
3. Which non-essentials features would be nice to have?
4. Naming the app.

The key takeaways from this workshop were the following:

- Prioritization of the essential requirements.
- The importance of easily being able to understand how to connect with a physiotherapist.
- Anyone should be able to perform the physical condition test without help.

- Never use or display the word “test” when it comes to the physical condition test.
- Don’t let the users know that they are ranked at a certain level.
- Nice to have, but not essential: an option for group exercises.
- Nice to have, but not essential: an option for connecting with friends in the app to share the experience and exercise together.
- The name of the app was decided.

Third workshop
Participants: Bjarnveig Birgisdóttir (nurse) and Tinna Mark Duffield (physiotherapist).

Workshop focus: Show how the paper prototype works, taking into account the findings from the past workshops.

This workshop, collecting feedback and iterating the design before user testing, focused on how the design could be structured, a general layout idea and where to place different elements in the design.

Two focus topics of the workshop:
1. How would the personas interact with the paper prototype?
2. Are the components in the design correctly placed on each page (screen)?

The key takeaways from this workshop were the following:

- Having a limited number of actions available on each page (screen).
- Limiting the amount of interactions required on each page, as to keep each step short and concise. User testing would be required to know more about where the boundaries for this lie.
- Reducing the amount of clicks required.
- Having a way for the user to always know where in the app they are located.
- Simplifying the registration process as much as possible to minimize the threshold for getting started.
- Nice to have, but not essential: we decided to eliminate the “Favorites” area, which would have allowed users to save (or “bookmark”) workouts they enjoyed performing. At this stage in the design it was decided that this was not a key factor to include.

Fourth workshop
Participants: Anette Henriksen (physiotherapist), Birgir Úlfsson (older adult), Ingunn Bjarnadóttir (older adult), Marte Sofie Wang-Hansen (doctor) and Tinna Mark Duffield (physiotherapist).

Workshop focus: How to measure the physical condition with a test that suits most individuals 65+ and reviewing literature findings in that same field.

This workshop was done to investigate how we could create a test to evaluate the physical condition of a person, where the person would perform the test on their own. This would have to take into account a very wide range of people taking the test, usually older adults, so it would have to be inclusive so as not to eliminate any people despite being in bad physical condition.

The workshop participants couldn't all meet at the same time so the workshop was split into two occasions where I was thoroughly impressed by the wealth of experience and knowledge my co-designers brought to the table, making the workshop a great success.

Three focus topics of the workshop:
1. Review existing literature available in the matter.
2. How to structure a physical condition test with measurable results.
3. Performing the test on older adults for quality assurance.

The key takeaways from this workshop were the following:

- We would use video with subtitles and audio narration to explain the test and the tasks.
- Four basic movements would be used to measure the overall physical condition of a person (testing lower body, upper body, core and balance).
- Each of the four exercises would be timed for duration.
- The person would register their results and the system would use that to award points for each exercise, ultimately ranking users on a certain level.
- When older adults are performing the test, always think about safety first.

5. Design Brief

I created the design brief from my pre-existing knowledge coupled with the findings from the workshops. I defined what I was going to create, who the target audience is and why the solution would be relevant for the target group. This also gave me good focus and an overview of what I wanted the end results to be.

What:
A digital solution that focuses on how to maintain or increase physical strength and range of motion.

Who:
Older adults (aged 65 and up) and physiotherapists working with their clients.

How:
This digital solution has two purposes. First, it should give older adults the opportunity to maintain or increase their physical strength by performing exercises adapted to their personal physical level. Also, it should be a tool for physiotherapists to be able to treat more clients (older adults) where the client accepts a larger role and takes more responsibility for their recovery. This would be achieved by co-designing with the future users, physiotherapists and older adults. The design will allow older adults to measure their physical condition and with the help of customized exercise programs (created either automatically or customized by their physiotherapist) help them maintain or increase their strength and mobility which will have positive effects on their quality of life when growing older. The physiotherapist will have tools to help communicate easily with their clients, as well as having access to a video library of exercises to help them create customized programs for their clients.

Why:
Lack of space in Icelandic nursing homes is a societal problem. The homes have long waiting lists and older adults are waiting in lines to get admitted. While they wait, the government provides them with residential services at home. There is a need for older adults to be able to maintain their independence longer and to stay at home as long as possible without being dependent on help. On April 30th 2021, an article from the Icelandic Physiotherapists Association appeared in newspapers stating that at the time, the waiting time to get an appointment with a physiotherapist was about three months. The physiotherapists were getting anxious and concerned about the situation because of how many people were waiting for their service and having to prioritize who needs the help most, which means others who are waiting are getting worse (Bjarnason, 2021).
This digital solution could help physiotherapists treat more clients and for clients to get assistance sooner. Reducing the need for visiting a physiotherapist at their office, they're given the opportunity to perform exercises on their own which could contribute to a quicker recovery. This could have a preventive effect for society in the future.

Requirements for the solution:

- Simple and easy to use with focus on older adults on one hand and physiotherapists on the other.
- Take into consideration the needs of older adults and physiotherapists, their wants and wishes.
- Give motivation when needed, both in scenarios when the progress of users is good or suboptimal.
- Give older adults tools to exercise strength on their own level.
- Give physiotherapists a tool that allows clients to take more responsibility for their recovery.

6. Design Concept

This chapter describes the concept development. Following the workshops I had identified the needs for the design. I started by lo-fi prototyping a solution with the concept that I had created with the co-designers during the different workshops. I put together a scenario for each of the personas taking into account their frustrations and goals. The first scenario describes Silja (68), a retired older adult who doesn't feel as strong as she used to compared to when she was working every day. She is going to download the app by herself. The second scenario describes Halldór (72) who is very active but hurt his shoulder. He meets with a physiotherapist that will help him download the app to treat his injury both meeting up physically and digitally.

The design put forward here is the one made for the older adults and not the physiotherapist version.

An older adult may download the app by themselves and start using it independently, without the assistance of a physiotherapist. They will get an introduction on how to perform an easy physical condition test so the app can assemble the right kind of combination of exercises given their physical condition. A person can also get paired with a physiotherapist through the app if ever there is a need for that.

The other option is that a physiotherapist tells the client about the app and will instruct the client on how to start using it, perhaps even performing the initial physical test together with the client. The client would subsequently be paired with the physiotherapist in the app, allowing them to share the client's exercise diary, access the exercise video library, messaging features to exchange video messages, and a place for the physiotherapist to create customized exercise routines and strength programs for the client. This will reduce the need for the client to regularly meet with the physiotherapist, but will allow them to communicate using the app after their initial appointment.

I would need to use a mapping tool to help me visually line up the ideas from the workshops. The solution should be simple with few components. My idea was that the design should be represented in the same way with few exceptions, whether or not the user was paired with a physiotherapist.

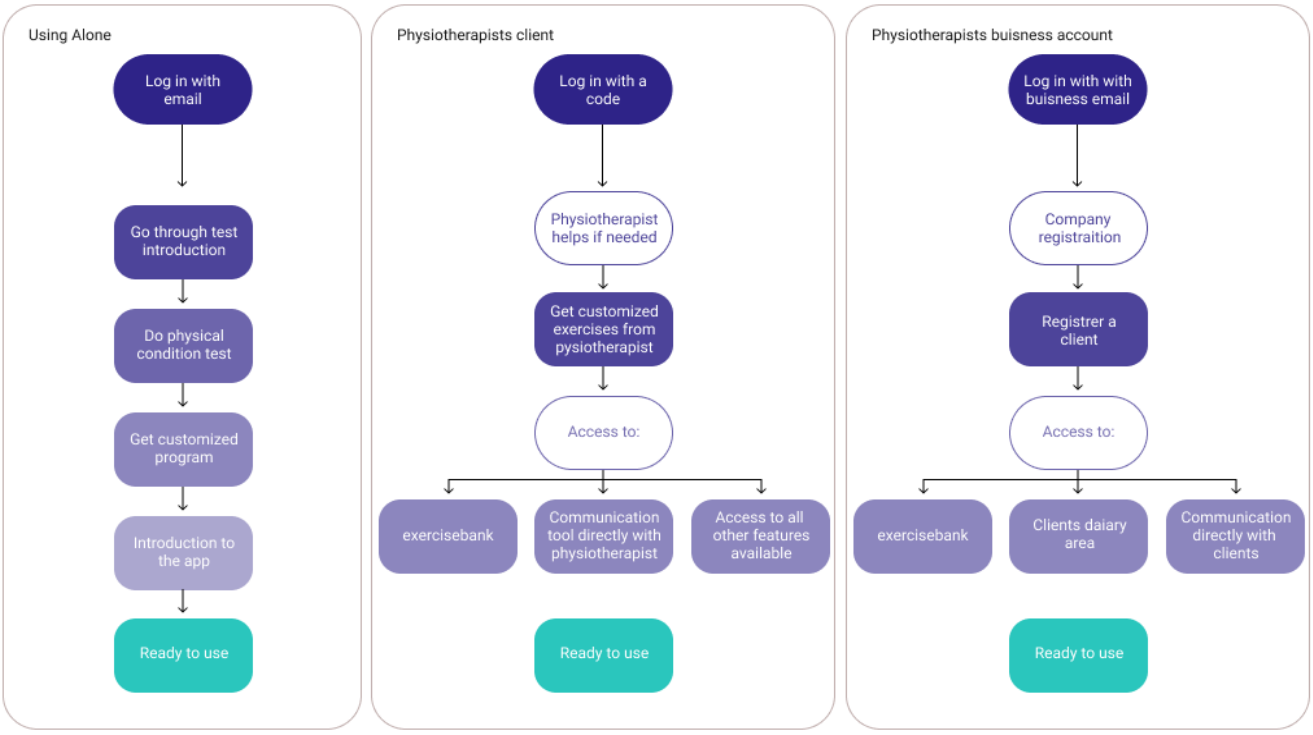


Figure 5: System map for different users

The system map (figure 5) shows roughly how the design would work for different users. The main goal of this digital solution is twofold: to allow everyone to use it, no matter what physical condition people are in and regardless of whether they regularly see a physiotherapist or not. Everyone should get equal opportunity to get help to become physically stronger. The other aspect of the app is to create a digital solution to help physiotherapists to effectively work with clients in a way that works for both of them. In the long-term, this could save money for the government in reduced cost for nursing facilities and residential services. It could also reduce stress in families where senior family members are in better shape to stay home longer and be independent, requiring less assistance from family members and are more able to participate in social activities despite growing older.

The app does encourage contacting physiotherapists if the person requires special treatment or information pertaining to their condition.

The app has gotten the name Árvakr, named after one of two horses that pull the sun (or the sun chariot) across the sky each day in Nordic mythology. Horses are strong animals and the name goes perfectly with a digital solution that is about getting physically stronger.
The app is primarily made for running on a mobile platform while keeping the option open for adapting it to a larger platform although the need for that is unclear at this stage. All of the research work led to the conclusion that future users will have smart devices (phones and pads) and compared to today's older adults, are likely to be more used to operating them and lowering the threshold for getting started.

When launching the app the user is presented with two options: registering as an independent user or using a code from a physiotherapist. If registering as an independent user, the user supplies her email address and after typing in a confirmation code, an introduction chapter explains how they can start their journey by performing four physical condition exercises for the app to create a workout program for their needs. The test takes approximately 15-20 minutes to complete and concludes with one final question asking how many times a week the user is going to exercise with Árvakr so they commit to the program.

At all times, the user has a menu at the bottom of their screen, showing the following four icons:

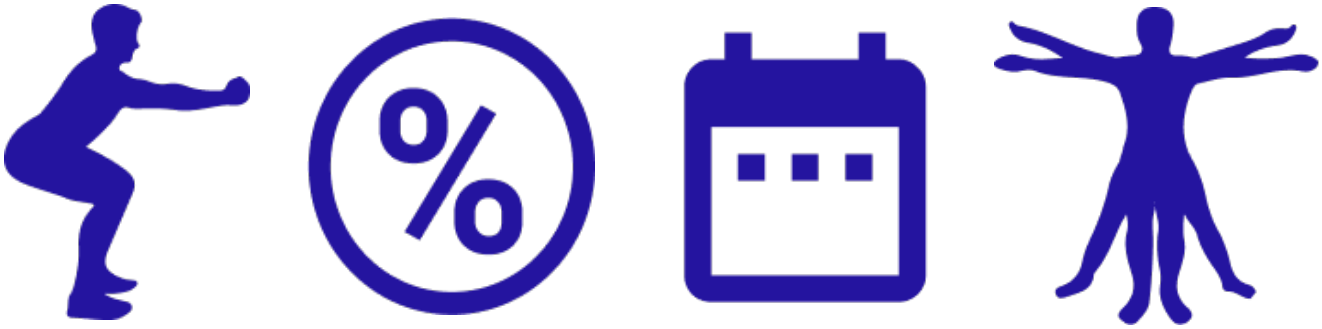


Figure 6: Today´s workout - Statistics - Calendar - Physiotherapist

The only time the menu bar is not visible is when a video (instructional or a video message from a physiotherapist) is playing in full screen.

The icon on the far right, inspired by Da Vinci's Vitruvian Man, leads the user to a page intended for those who are paired with a physiotherapist, where the therapist has already provided the client with a code that connects them together. In doing so, the user can get a customized workout program from the physiotherapist, access an exercise library with instructional videos and use a messaging system that allows the exchange of video, audio or written messages.

The language choice for the final solution was Icelandic, primarily because the solution is intended for the Icelandic market where the majority of users (older adults) speak

Icelandic and have limited proficiency in other languages. Having the app in Icelandic also made it possible to usertest the product with real future users. All text, terminology and interface messages were carefully written by myself and Erling Vignisson, who is a digital solutions development manager with many years of experience in the effect of terminology in digital solutions.

7. Prototyping

The prototyping stages were threefold with the first prototype being made after the last workshop with the co-designers. I designed a wireframe to place the contents in the app. A second prototype was a lo-fi version which I evaluated and iterated in co-operation with the co-designers. The third prototype was a hi-fi version used in testing with real users, being a strong candidate for the actual final product.

7.1 Wireframe and Digital Paper Prototype

The first thing I did was to create a wireframe. I used the workshop information (appendix F) that I had done with the co-designers in Miro to make these sketches and to get an overview over the contents required. Due to an ongoing lockdown caused by COVID-19 in Iceland, this wireframe didn't get tested separately. Instead, it was shown to the older adult co-designers remotely and a discussion took place about the wireframe in broad terms.

Observations from co-designers:

- Don't have too many things going on on the same page, that confuses users.
- Video needs to be large with narration and subtitles.
- Good to incorporate a timer in the design and an important factor is always knowing where they are located in the app so they won't get lost.

After the wireframe I created a digital paper prototype (Figure 7) because it was important for me to get an overview of the whole interface and what it could possibly look like. I made sketches with the collaborative interface design tool Figma so I could easily access it later in the process, since the final prototype would also be made in Figma. After careful consideration I designed the solution for mobile so it could be easily scaled to pad and desktop. I kept my research questions and design brief close so I wouldn't disconnect from the important goals I had made for the design.

The biggest challenge at this stage was the need for simple interaction when performing the physical condition test. I was careful not to use the term "test" in the interface, as users could easily get deterred by it, and also it isn't as much a *test* as it is a *measurement* of what stage people are on. The focus should be that in return for doing these four movements, users would get a program customized for them.
When usertesting this version I wanted to get feedback on the contents. I briefly explained what the app was about, but wanted the users to navigate on their own as much as possible. Due to the COVID-19 lockdown, this was also done remotely where I would share my screen with the participants and have a conversation about the design and their expectations.

Questions asked during the process:

1. What do you see on this page? *Are they understanding the content as it is meant to be understood?*
2. What do you think this page is about? *What is their understanding of the use of the page?*
3. Where do you think the different content will take you next? *When interacting with content, where do they think they will end up?*
4. Do you know where you are located? *I wanted to know if the users had an understanding of where they were while navigating in the app.*

I also wanted to know if the users understood how the physical condition test worked without actually performing the movements.

Results from user testing:

- Tests showed that users forgot everything about the introduction text in the beginning, if they had even bothered to read it before proceeding to the next step.
- On other pages, the content was easily understood but I got feedback that the dates on the top of the screen weren't particularly useful.
- They all felt motivated by seeing their progress for the week and also how many exercises they had done since they started using the app.
- On the first page with video, the participants did not read the text above but instead played the video right away. There were probably too many interactions on the same page and they didn't know where to start, but playing the video seemed like the most important thing to do on that page. The video caught their attention right away, which is why they clicked on that before anything else.
- The users always knew where they were located when navigating through different pages, granted that this version didn't have that many pages yet.

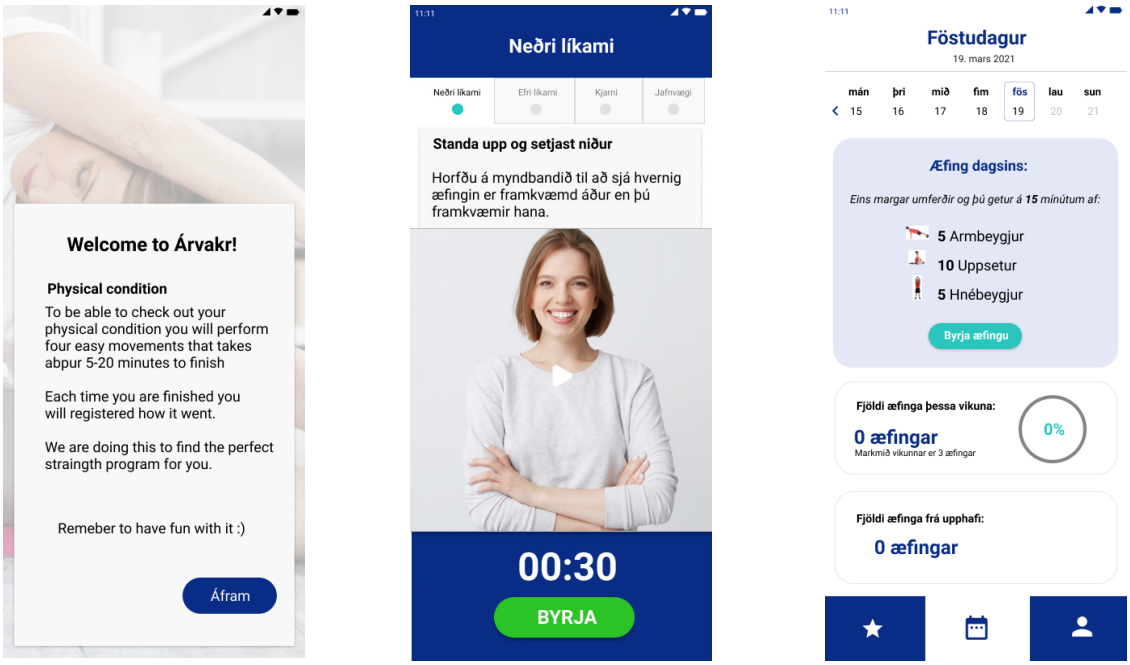


Figure 7: Digital paper prototype - Welcome page, physical condition test page, first page

7.2 Lo-fi Prototype

Moving on to a lo-fi prototype version, I thought carefully about the importance of consistency. I used the system map I had made to help me remember the steps I needed to take. I made this prototype clickable with Figma to see how the participants would interact with the design on mobile. In this round (and for the remainder of the user tests) I had the pleasure of being able to meet the participants face to face and observe them using an actual mobile device for the user test. The physical condition test would be an important aspect of the design since the users would be using the product on their own at that stage. The initial startup page was also important, giving the first impression of the product and all navigation should be as clean and easy as possible. At this stage my knowledge had gotten broader as to what requirements the end users had for the design.

Guidelines

Colors

When designing for the older adult the two most important words from my experience are simple and easy. My mindset was focused on balancing function with aesthetics throughout the design. The color choice (Figure 8) was made so it would have high contrast for good readability, and a soft color blend with gradient use in the back-ground of the app to create a sense of motion and good feeling. I had a discussion with a few of the co-designers about the color choices, some possible options and after everyone had justified their choice, we each voted and together came up with two main colors to use.

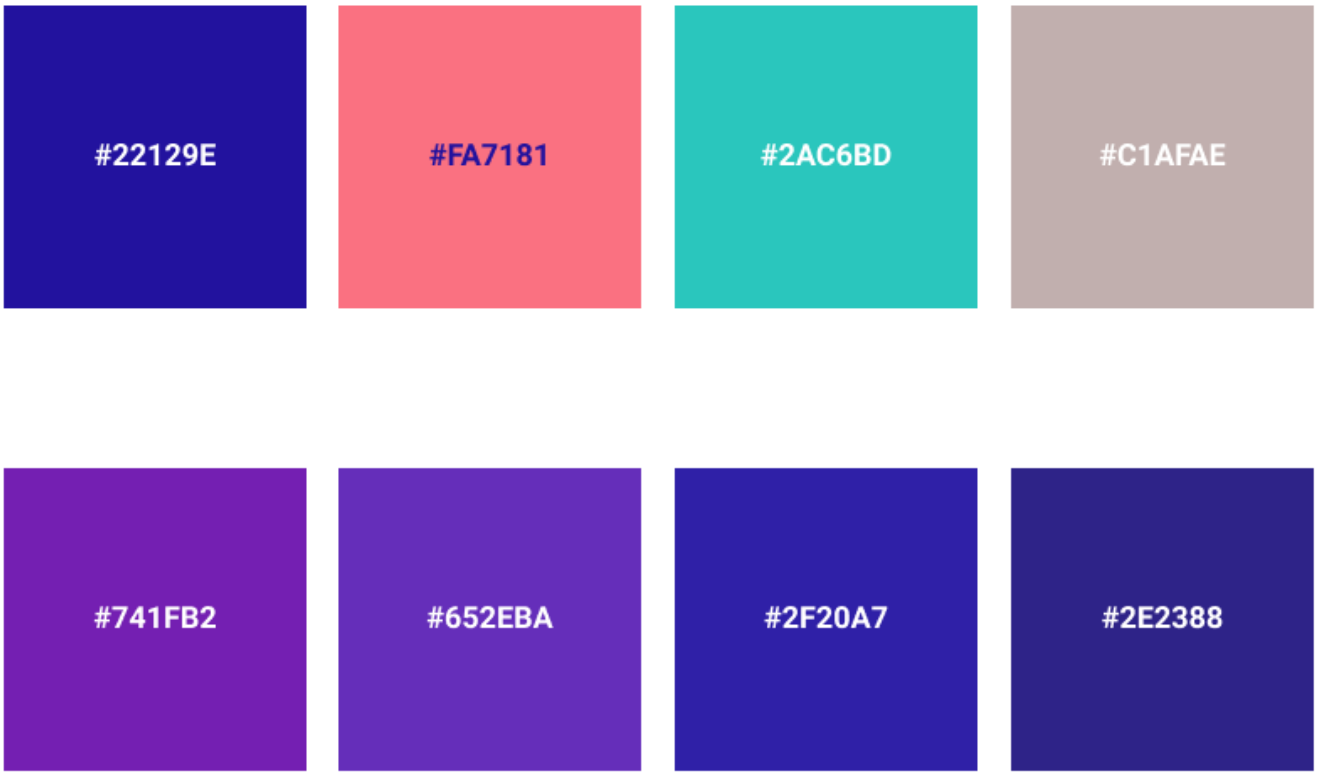


Figure 8: Color palettes for Árvakr

Typeface
The typeface choice for headlines was PT Serif and Robot for main text (Figure 9). These choices were made to have good contrast between headlines and main text. Robot is a sans-serif font where the forms are mostly geometric, the font is open and easy to read. PT Serif harmonizes very well with a sans-serif typeface and is used for headlines because of its good proportion in design. The plan was not to have long text anywhere in the design but messages can get long and that's why Robot suits well.

Figure 9: Two typefaces used in the design

Calculation of Physical Condition Test
The physical condition test consists of having the user perform four basic movements given a certain amount of time for each one. This is used to measure the overall physical condition of a person by testing lower body strength, upper body strength, core and balance. After performing each basic movement, the user can choose between a few options to rate their performance. Each option carries a certain number of points: getting less points means the user is in better condition. Getting zero points means that the user is in great physical condition and will be ranked on level 10. Users that get the maximum of 27 points will be ranked on level one.

It is important to note that the user's level and point score are never displayed in the app, as we did not want users to feel discouraged by a disappointing score.

However, the levels are used to adapt exercises to the fitness level of the user, making sure that they are doing exercises at the appropriate pace and exertion level (Figure 10). The exercises can either be task based (the user performs a task, progress is measured by how long it takes to complete the task) or time based (the user repeatedly performs a rapid movement, progress is measured by the number of repetitions completed within a given amount of time).

If they at any time retake the physical condition test and get better results (less points), the app will know to modify the exercises making them harder, longer, with more repetitions or by adding more challenging movements.

Depending on the user's fitness level, the solution can create dozens of different workouts for every level by assembling them from 10-20 different exercise movements, scaled according to the user's fitness level. This prevents workouts from becoming monotonous and eventually wouldn't contribute to progress, risking the user to plateau. As the fitness level increases, more exercise movements become available for workouts, making them more varied.

Figure 10: Calculation of physical condition test

Tasks assigned to users during testing

- Perform the physical condition test.
  - Are the movements too complicated for users to perform on their own?
  - How long does it take to complete the test?
  - What questions arise when performing the test and what challenges are there?
- Log workout results after performance.
  - Do they understand the concept of logging workout results and how it's done?
  - What are the reasons for logging results?
- Examine the statistics page (Tölfræði).
  - Is it clear to the users what is happening on that page?
- Find the workout you did on March 19th to review your old results.
  - Understanding the results and that you can perform the workout again, either to get better results or just for fun.

Results From User Testing

- The introduction page before performing the test wasn't clear enough for the users.
- The timer should have 10 extra seconds for the user to get in position before starting to perform the exercise (they didn't typically manage to press the button and run into position, so they felt they lost some time right at the beginning). This is something I have learned in my previous work as a coach and works really well: to have a countdown before starting the performance.
- The test took 15-20 minutes to complete for different participants. The participants understood everything well but it took them a little bit too long to digest everything and complete the registration of their results after the workout.

Changes Made After User Testing

- After analysing the results, I decided to divide the introduction page for the physical condition test into four sections on four pages instead of one, adding an icon to represent each section to increase the understanding of the approach.
- After the physical condition test was completed, a final question was asked: how many times a week did the user plan to exercise strength? After choosing an answer from a numbered list of options, the user was taken to a four-page sequence explaining the icons and main functions (Today's Exercise, Statistics, Calendar, and the Physiotherapist Page). Before nothing explained the function.
- Two out of the five older adults that performed the physical condition test requested to have the opportunity to do push-ups on their knees, so I added that option to the design with the approval from the co-designers that helped create the test.
- I also modified the result registration page by dividing it into three smaller steps, rather than having the entire registration in one chunk.

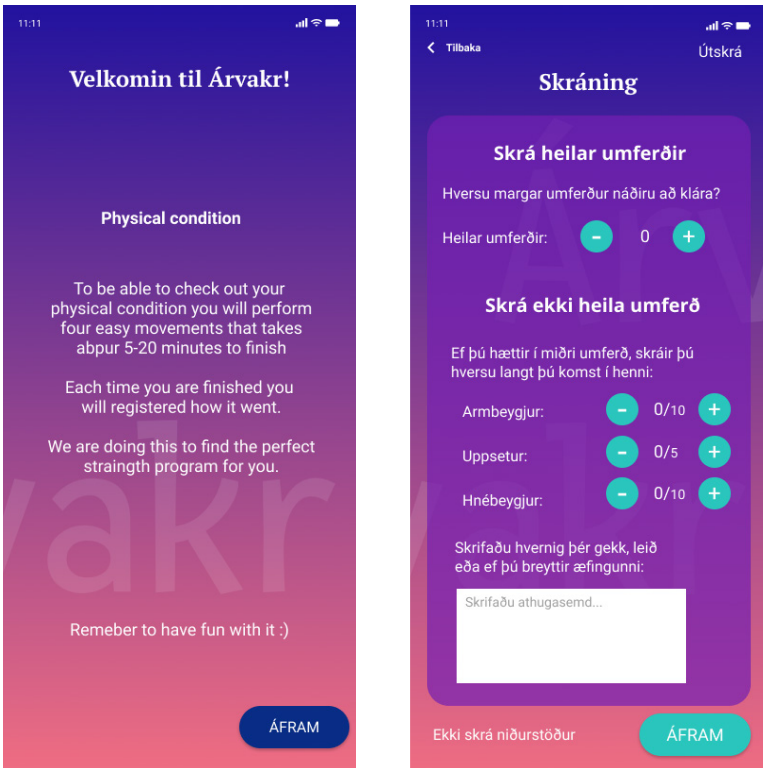


Figure 11: Lo-fi prototype - Introduction page to physical condition test and result registration page tested on users

7.3 Hi-fi Prototype

After receiving and reviewing the feedback on the wireframe, the paper prototype and the results from user testing the lo-fi prototype, I reflected on them with a part of my co-designer team, wanting to take the design further. Using this and all of the input I had collected, I made changes to the design and was able to improve it before getting the app tested for the last time.

With the changes I had made after the lo-fi prototype testing with the older adults, I also wanted to continue with the *Physiotherapist Page* (with the help of two of my co-designers) since there were many functions and categories in that part. I used a female icon for the categories since I had used a male icon in other parts of the design. I also redesigned the menu page since I didn't feel like it was quite working the way I wanted it to. I relocated the menu in the bottom again as I had previously done in the paper prototype with icons. Along with the new menu that would be visible at all times (except when a video plays in full screen), I created a short introduction explaining the use of the icons.

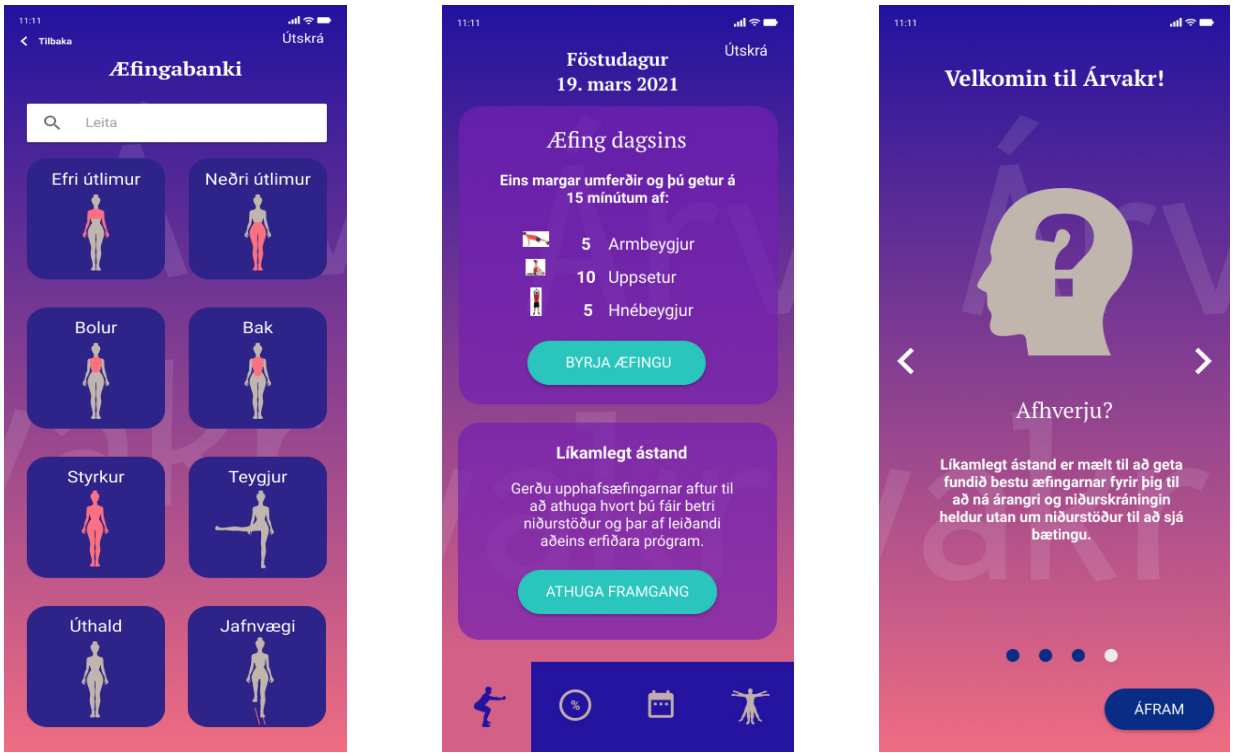


Figure 12: Hi-fi prototype - Physiotherapists page exercisebank categories, the front page with the menu, and introduction to the function of the app tested on users

Tasks assigned to users during testing

- Find exercises for shoulders.
  - See if the navigation system is good enough, easily understood and effective.
- Send a video message.
  - Look at the interaction in the massage part.
- Perform exercises assigned by a physiotherapist.
  - See if the user understands how to perform exercises and report their results to a physiotherapist.
- Examine how users react to the bottom menu.
  - See if a bottom menu works better than a page menu.

Final results from the usertest

Some small changes were made at this final testing stage:

- I removed a button that was visible in the introduction – it seemed redundant since it was already possible for the user to advance to the next page by sliding left and by pressing arrows or circles.
- I had also forgotten to add a button for the user to log out, so I added one in the top right corner visible at all times (except when watching a video or accessing the exercise library).
- I also needed to add text labels to the bottom menu, the icon alone had some users confused. They became uncertain and blamed themselves for making the wrong choice, but the text labels made the design more approachable.
- To make it more obvious what test was already performed I added a checkmark in front of the test when finished.

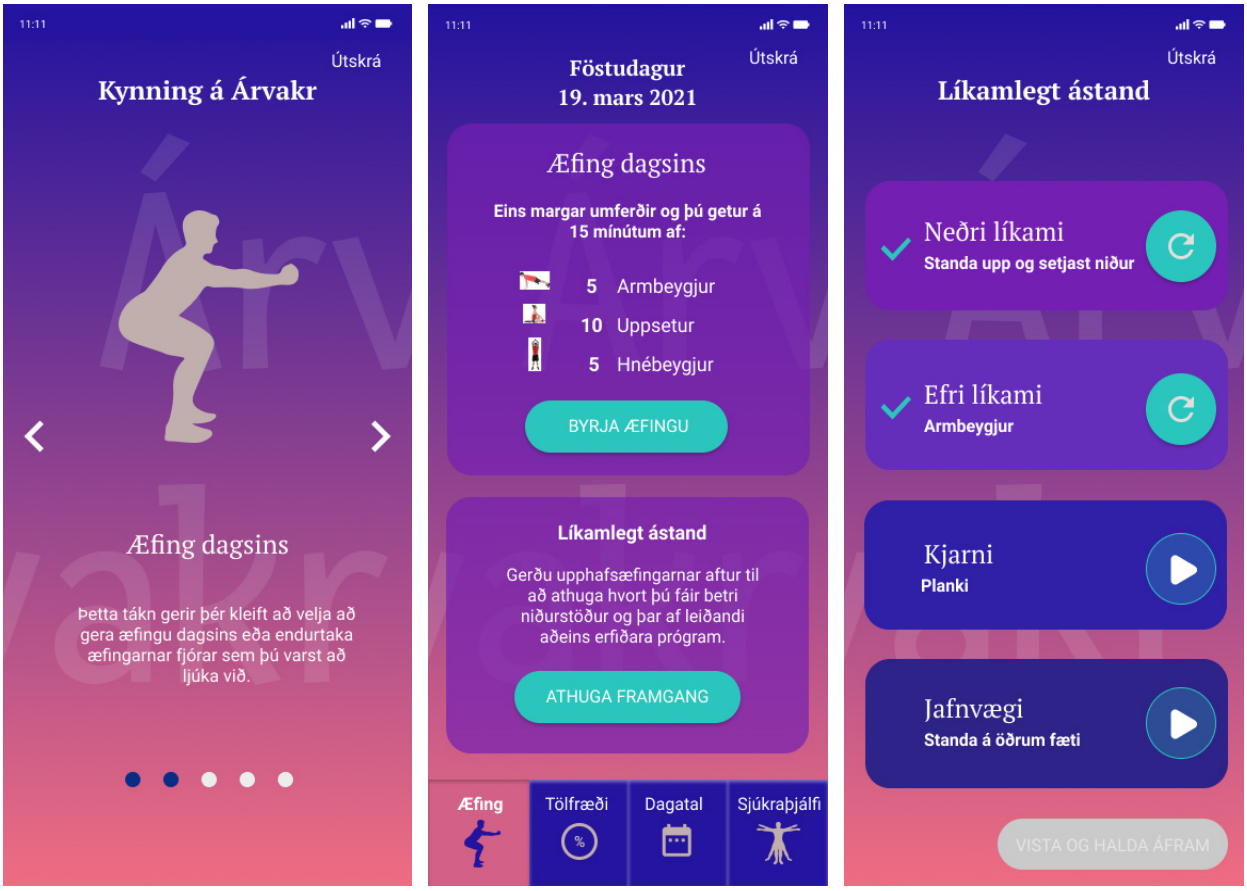


Figure 13: Final version - Introduction to the function of the app, the Front Page (after having seen the Introduction) and the Physical Condition Overview page tested for the last time on users

8. Árvakr: The Concept

This chapter will demonstrate and present the core functions of Árvakr. The content will be introduced, followed by a diagram and screenshots for further explanations. I will make additional suggestions in regards to the user interface based on the research work, as well as presenting the possibility for continued development to complete the physiotherapist's version (referred to as the business version).

8.1 Contents

Login

The user logs in by registering their email address and accepting the terms and

conditions because of privacy policies. A confirmation code is sent directly to their email address and the code is registered into the app and a new password is chosen. The reason for adding the confirmation code to the registration process it two-fold:

1. It allows us to only ask the user to enter their email address once (and not twice, which is not uncommon but somewhat tedious).
2. By sending a confirmation code to the email address, we know that the supplied email address is indeed correct and truly belongs to the person signing up (otherwise the code can't be obtained).

Physical Condition Test

The physical condition test is introduced so that the user gets an understanding of what is coming and why they are conducting the test. Before starting the test a video shows exactly how the movements should be performed, how the clock timer works and how the users should register their repetitions or level of difficulty. Once the test is completed, the app displays an animated GIF-image with fireworks, celebrating and giving an energy boost for a job well done.

Introduction of Árvakr

The menu icons are explained to the users, so they know their way around while using the app.

Front Page

The Front Page will always appear when registered users launch the app. This page presents two options: "*Exercise*" or "*Check progress*". The exercise part shows today's workout which varies from day to day. The exercises can either be task based-related (the user performs a task, progress is measured by how long it takes to complete the task) or time based-related (the user repeatedly performs a rapid movement, progress is measured by the number of repetitions completed within a given amount of time).

Should the user choose "Exercise", then the next part is in four steps:

1. *Briefing:* The user is met by a 2-5 minute video giving a briefing of the workout and how it is possible to scale it according to their needs.
2. *Warm up:* The user follows a warm up video in the form of mobility exercises.
3. *Start workout:* The user starts the workout, having the opportunity to pause it or stop at any time.
4. *Log workout:* User logs the results of the workout (but not the warm up) and adds comments if needed.

Statistic

The Statistics Page displays an overview of this week's goal and how many exercises the user has done from the very beginning. The user can also change the preferences for their weekly exercise goals as well as settings for notifications.

Calendar

The Calendar Page displays an overview of the number of exercises for the month and allows for the user to see old results and repeat exercises they've already completed (either for fun, to check progress or to challenge themselves).

Physiotherapist
To be able to use the Physiotherapist Page, the user needs to obtain a code from a physiotherapist so that they can be paired in the app. To allow the physiotherapist to view and process personal information about their client, the user would need to agree to a separate Privacy Policy.

This part of the app is divided into three feature categories:
1. *Exercises* - this is where the user can access a customized exercise program created by their physiotherapist. A short message from the physiotherapist explains what the client should do and a short video might follow to demonstrate the exercises. After the client has completed the exercise as prescribed, a confirmation is sent to the physiotherapist so that they can monitor the progress. Physiotherapists will be able to respond to users, leaving short messages or video recordings to show interest, motivate their client and build a relationship with them.
2. *Communication* - this is the communication feature allowing the physiotherapist and client to message back and forth. Both parties can initiate a conversation, send a video message, record a voice message or write in text, depending on what they prefer and what suits their needs at each time.
3. *Exercise Library* - Hundreds of movements where users can look up exercises by searching by keywords or traversing categories. Every movement and exercise is explained with an accompanying video.

There are four ways of using Árvakr:
1. *Registering as a new user* - new users would follow the signup process as described in "Login" (page 42) and conclude the process by having successfully logged in.
2. *Log in as an existing user* - existing users would supply their email address and the password they chose during their initial registration. Note that the app would persist the login, so users would only have to verify their credentials once a year (at most, assuming they are using the same smart device).
3. *Log in using a code from a physiotherapist* - this path assumes that a user has met with a physiotherapist that introduces them to the app and creates their profile using the business version of the app. Clients would most likely go through the physical condition test with their physiotherapist who would register their results and create a customized exercise program. Finally, the physiotherapist would give their client a code to use when logging in for the first time, essentially bypassing the registration process, physical condition test and coming straight to the Menu Page.
4. *Log in to the business version as a physiotherapist* - this part of the app is beyond the scope of this thesis.

The path for the first three methods are visualized and explained in the diagram above (Figure 14).

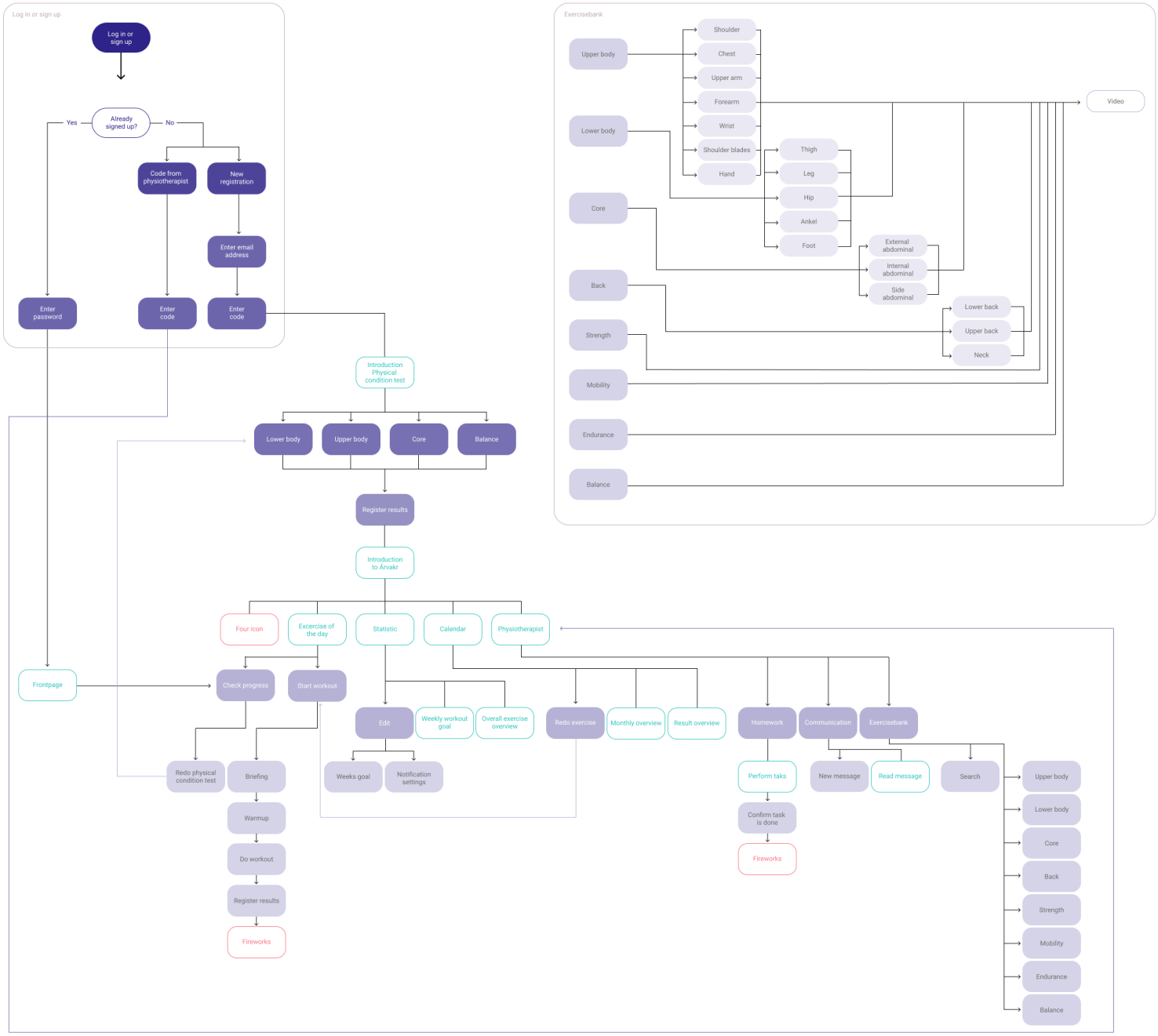
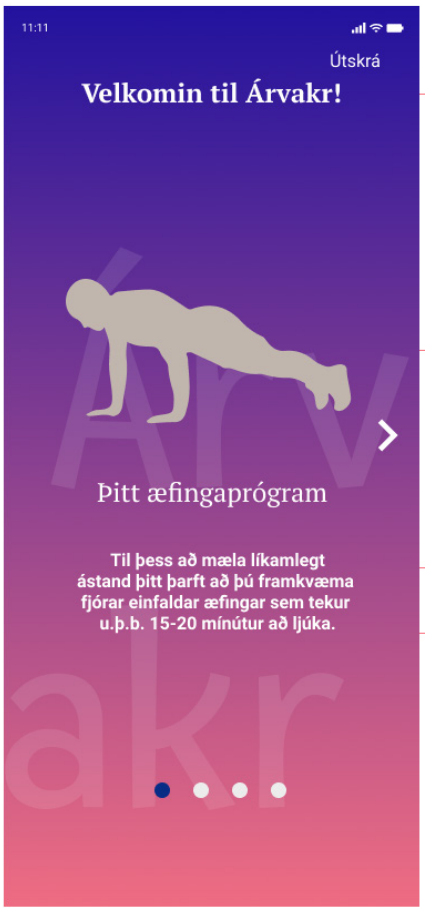


Figure 14: Diagram explaining Árvakrs functions

8.2 Description of Pages

To further explain Árvakrs function (also it being in Icelandic), a set of pages (page 46-54) show how the app works - these are taken from the hi-fi prototype of Árvakr. As previously described, care is taken to limit the functionality of each page to keep the user focused and keep the flow as simple as possible.

It is highly recommended to further test the app and most importantly, the business version needs more work so that the product can reach its full potential.

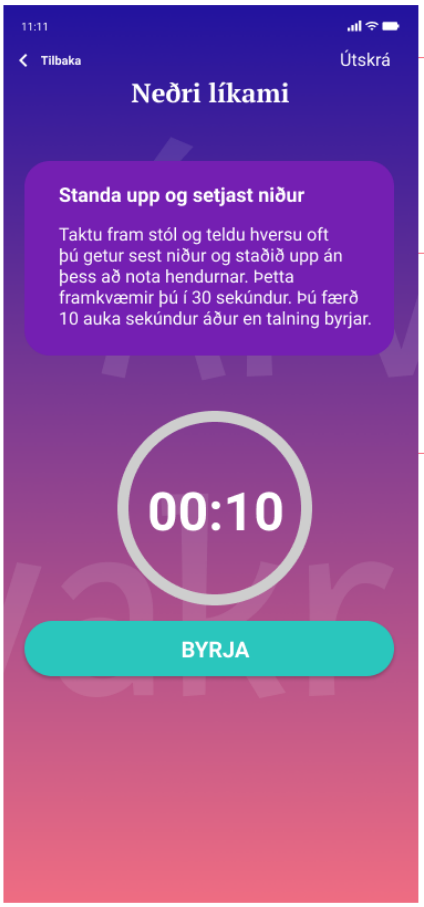


The name Árvakr is from Nordic mythology. Árvakr and Alsviðr are the horses that pull the sun across the sky.

Different icons are used to represent essential content and make functions more clear. This also makes the app more attractive.

All text is in the minimum size of 16pt for good readability for the user.

Before conducting the physical condition test user gets information about what is to come and how the process works.

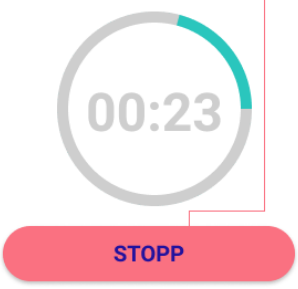


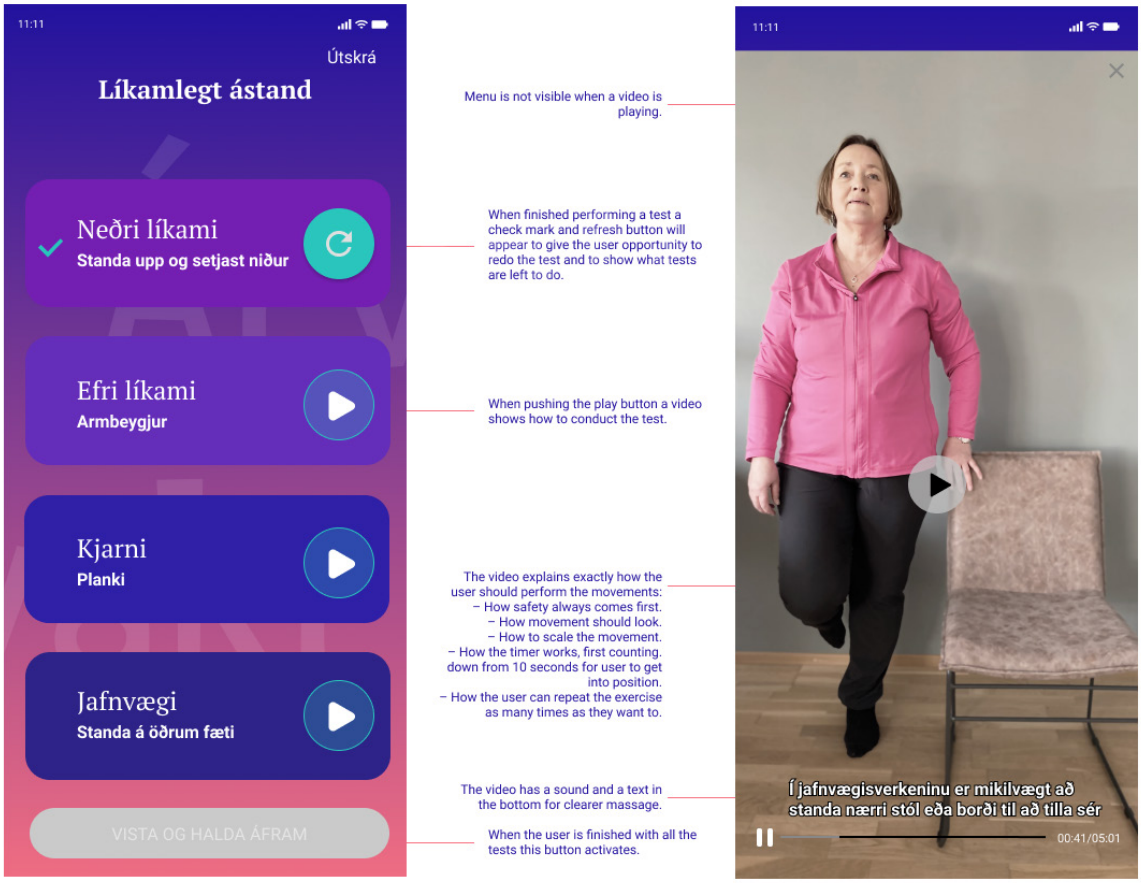
Sign out button is always available except when watching a video. All results are saved if the user decides to sign out before finishing the physical condition test.

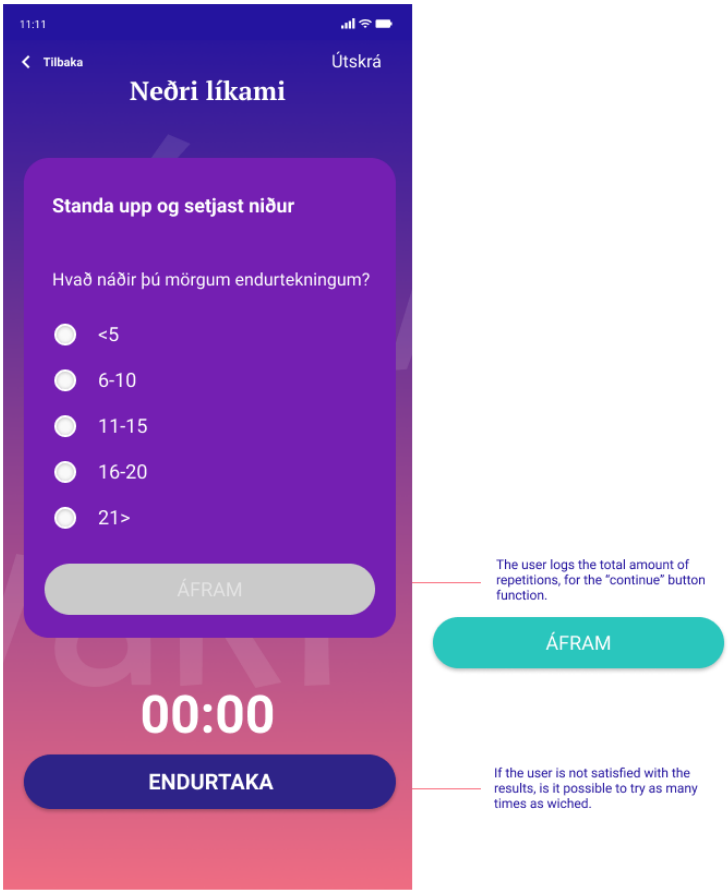
After watching a video a short text of what the user saw in the video and is about to perform is visible.

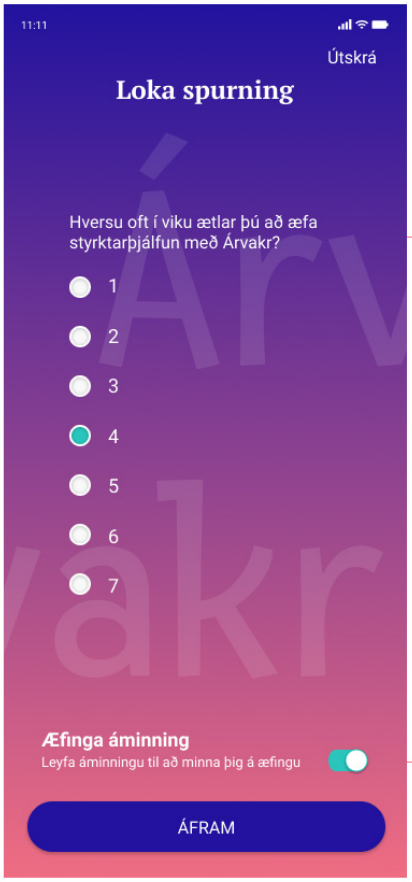
The timer should have 10 extra seconds for the user to get in position before starting to perform the exercise. The last three seconds are with a sound so it is not necessary to see the clock to know when the workout has started.

After the test has startet it is not possible to pause ony stopp so the results are relevant to use.




11:11
Útskrá
Líkamlegt ástand
Neðri líkami
Standa upp og setjast niður
Efri líkami
Armbeygjur
Kjarni
Planki
Jafnvægi
Standa á öðrum fæti
VISTA OG HALDA ÁFRAM
Menu is not visible when a video is playing.
When finished performing a test a check mark and refresh button will appear to give the user opportunity to redo the test and to show what tests are left to do.
When pushing the play button a video shows how to conduct the test.
The video explains exactly how the user should perform the movements:
– How safety always comes first.
– How movement should look.
– How to scale the movement.
– How the timer works, first counting down from 10 seconds for user to get into position.
– How the user can repeat the exercise as many times as they want to.
The video has a sound and a text in the bottom for clearer massage.
When the user is finished with all the tests this button activates.
11:11
Í jafnvægisverkeninu er mikilvægt að standa nærri stól eða borði til að tilla sér
00:41/05:01

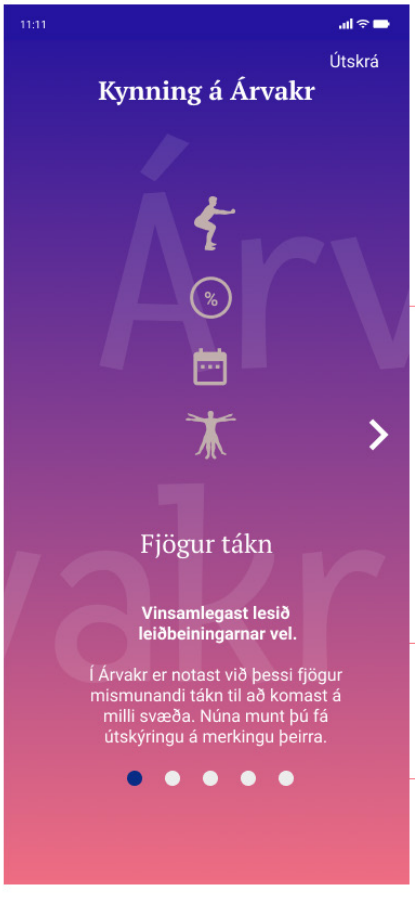

11:11
Tilbaka
Útskrá
Neðri líkami
Standa upp og setjast niður
Hvað náðir þú mörgum endurtekningum?
<5
6-10
11-15
16-20
21>
ÁFRAM
00:00
ENDURTAKA
The user logs the total amount of repetitions, for the "continue" button function.
ÁFRAM
If the user is not satisfied with the results, is it possible to try as many times as wiched.



So the user makes a commitment a question is asked on how many times a week the plan is to exercise strength with the Árvakr.

After finishing the physical condition test and when finishing a workout the user is granted with fireworks and inspiring words.

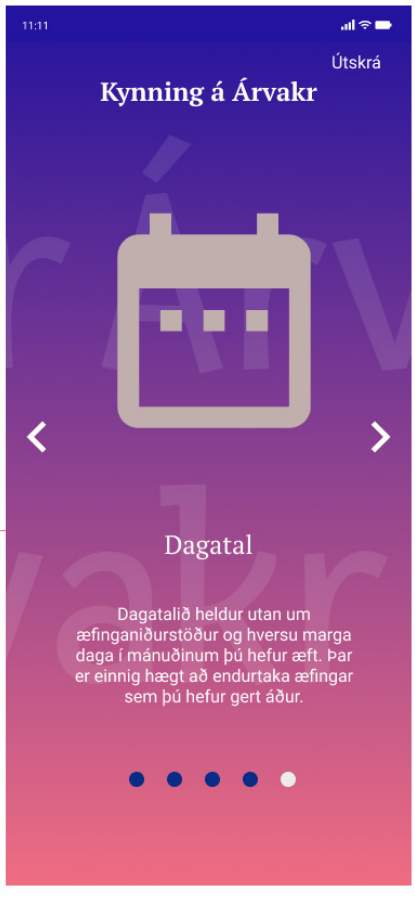
Allow notification that will remind, motivate and give compliments to the user.



The four icons represent the menu of the app. Before the user starts using the Árvakr they go through a short presentation of the functions.

User is asked to please read carefully through the guidelines.

The user can either slide or press the arrow in the middle to go to next. The dots show where the user is located in the introduction and can also be pressed on to go back and forth.



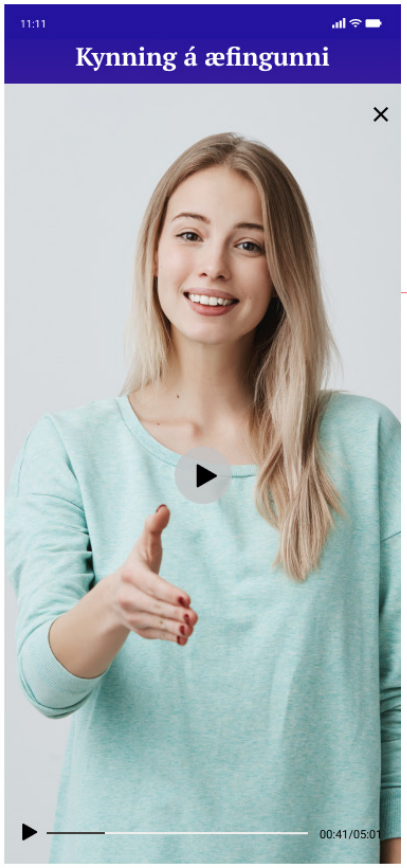
Introduction of the Calendar that explains shortly what is to find in that area.

After the user has registered this page is the one that they will see when opening the app.

A small gif shows the movements at all times. The user can also press on the movements name or the gif and see a full size video on how to perform it.

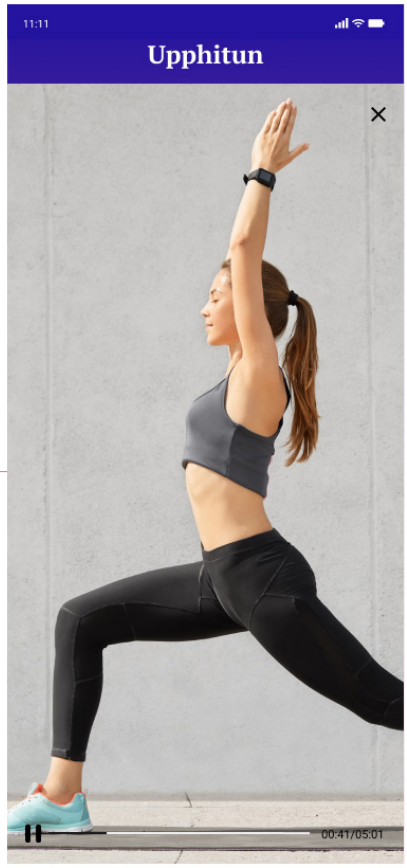
The user can always check progress. If they perform the physical condition test better than before they will level up and get more difficult workouts.

The menu shows icons and names to make it clear for the user what is happening when they press the icons.The menu is always visible except when watching a video.



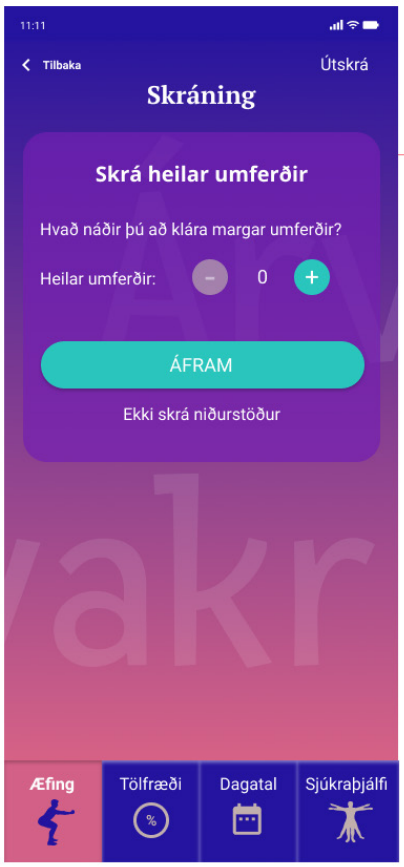
The workouts are always represented with a briefing on how to perform the movements, what to focus on and how it is possible to scale after each individual's needs.

After the briefing a mobility video appears for a warm up of stretching. the user will face similar upwarmings videos each time so they will be familiar with the movements.



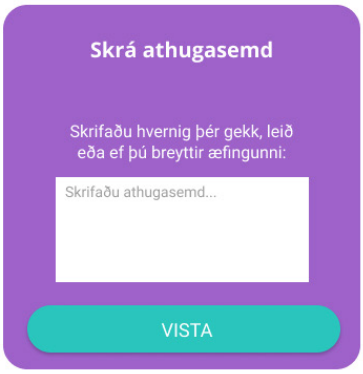
The workout is always visible for the user.

During the workout the user can pause for a brake or stop completely, if that is don the time will start again from the beginning.



After finishing the workout the user logs the results in three steps:

1. How many whole rounds did you finish?
2. How many partial rounds?
3. Comments (Did you scale the workout? Was it a bad day or any other comment).

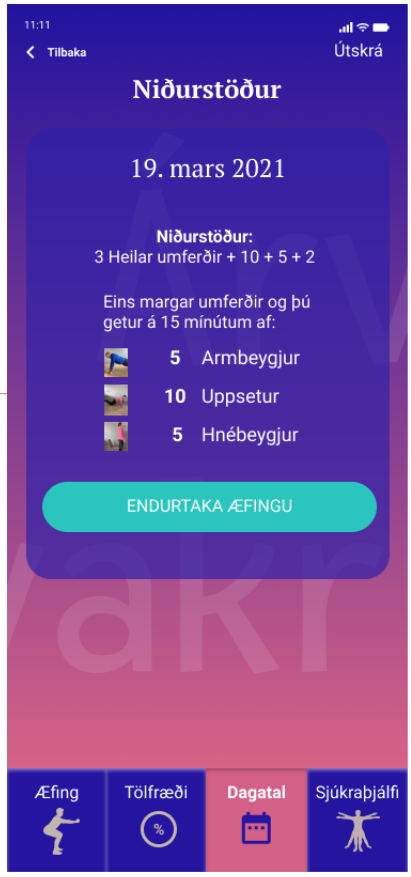


To change the goal of the week or the notification settings the user can press the edit button. For the user to understand better a text is next to the icon.

When the user has successfully finished the week's workout goal the horseshoe gets golden showing 100% finished for the week. The week always starts on Monday and ends on a Sunday.

How many exercises have been done from the start. Every 50 exercises is a milestone. The user gets a compliment for a job well done with fireworks and motivational words.

The Calendar shows how many workouts the user has done in one month. When pressing on a date the workout performed that day shows with results and the opportunity to redo that workout.



The physiotherapist part is divided into three categories.

Exercises sent from the physiotherapist to the client after they have met digitally or physically depending on circumstances.

The physiotherapist and the client communicate directly through the app. A new message is represented with a green dot.

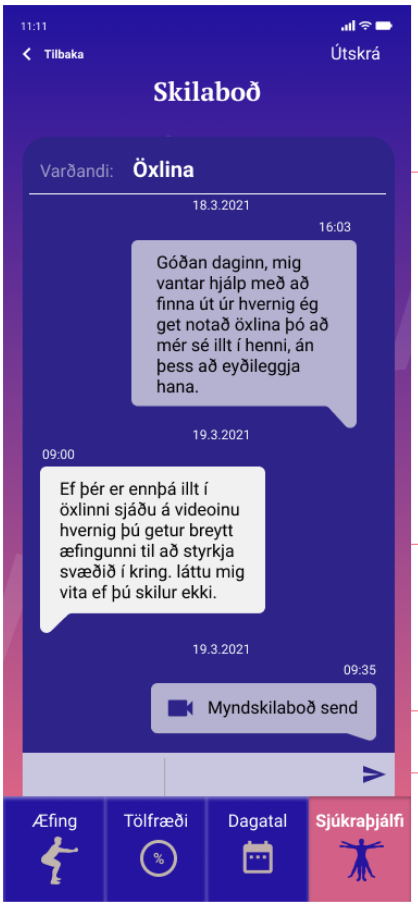
In the exercisebank the client can search for movements in different categories with videos to explain how it should be performed.

Those features are only available for those connecting to Árvakr via physiotherapist.

Short message from the physiotherapist to the client.

Video to explain how to perform movement.

When finished with all the given workouts the client sends a confirmation to the physiotherapist that it is done.

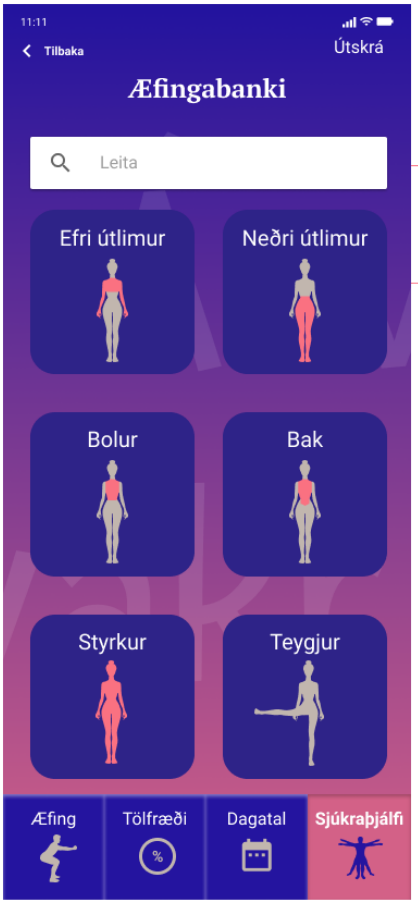


The client can choose a topic for the chat to easily sort out different messages in the inbox area.

Answer from the physiotherapist with a lighter background.

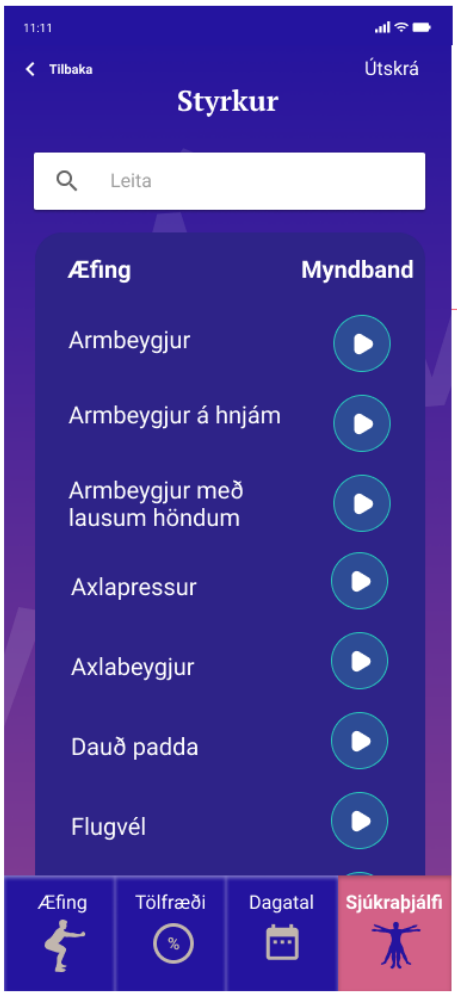
Confirmation that the video message is sent.

The client can choose the type of message from Video, photo, sound or written.



The client can search for specific movements.

The categories are represented with a name and an icon that is marked in red to show the focus area.



The user is located in the category "strength" and can search alphabetically after a certain movement. The movement is then available to look at in a video.

9. Challenges

While Árvakr as a concept is applicable to any audience in any country, I limited my work in this thesis to the Icelandic market. Iceland with its population of 360 000 is by most considered a small market, and rightly so, but there are some benefits to working with a small market: a greater chance for a fast rate of adoption, easier to reach the audience and there are benefits to having a somewhat homogenous market in terms of people and technology. The challenge comes with the target group and the language: today's generations considered to be older adults in Iceland typically aren't fluent in languages other than Icelandic, so I had to take this into account and design Árvakr in Icelandic which negatively impacts how the prototype can be presented and tested in other markets without reviewing it in whole.

My plan was to create a product that could be used by older adults and physiotherapists, but I found out that the scope of creating the entire product for the purpose of this thesis would require more time than I had at my disposal. I had to prioritize and decided to focus on completing Árvakr for older adults and leaving out the business version (where physiotherapists register users, pair themselves with users and create custom workouts). Also, it would be possible to use Árvakr without the business version if one should decide to create a pilot product before investing time and resources in the business version.

I realized during the early stages that Árvakr wouldn't suit as broad an age group as I thought (or hoped) it would: adults in nursing homes or those around or over the age

of 80 had such limited knowledge and experience using digital platforms like smartphones that they weren't viable co-designers or candidates for user testing. With that being said, 80-year olds of the future will have the required skill set so Árvakr might work just fine when current generations grow older.

Also, my cooperation with physiotherapists and older adults was severely affected by COVID-19 restrictions, limiting me from meeting with participants and co-designers as much as I would have liked to. I also had trouble getting feedback from healthcare professionals in the research phase as they were probably working overtime due to COVID-19 and not able to prioritize my questions. This left me with using what information was available online, which is not always current or up to date.

Discussion

This chapter is a discussion of the thesis, divided into the following sections: Research Questions; Interviews; Usability test; and lastly Design Results and Future Work. I will reflect over my own process and evaluate the studies.

1. Research Questions

How can a digital exercise program help older adults get better physical strength?
Through the interviews I found that in some cases older adults had more digital knowledge than I had anticipated, but it's important to note that I had already reduced the age range of the target group somewhat, as previously described in the chapter Challenges. All of the older adults interviewed were between the ages 63 and 74, they all had smartphones and pads and used social media to communicate with friends and family. This made me realize that people that have reached a certain age today sit at the edge of a wide gap, sometimes referred to as the digital divide, where they're far behind in using personal digital technology. The gap may only span a few years but the effects are glaringly obvious.

I learned what obstacles older adults can face when interacting with digital tools and how they react in those situations. All of the interviewees had their go-to person for digital dilemmas, but anyone who doesn't have such a person could run into trouble so that they would abandon the product. These problems could be big and small: everything from how you install an app on a smart device; how you find the confirmation code from the registration process; or why no sound will play in the video message sent by your physiotherapist. Based on my research, it seems unlikely that this would pose a platform abandoning problem in Iceland given the relatively small size of the nation, it's close-knit family circles and geographical density of the population with 2/3 of the nation's population living in the greater capital area. As a last resort, physiotherapists could establish contact between the user and a technical support person for big problems, or solve smaller ones themselves together with their clients.

A principal focus point and an assumption when creating Árvakr, was that people have the need of having mastery on some level. Mastery can come in many shapes and sizes: having a neatly organized home, a spotless car, being the best at Scrabble or never missing a day of work. I found out that older adults are commonly very diligent and could incorporate that into the design by making them responsible for logging their results for each workout and sending a "confirmation" to the physiotherapist when they had completed their workout for the day.

Unlike younger generations, the older adults seem to have more patience (or stubbornness) to understand and study new digital platforms, contradicted by their resentment of constantly trying new things. Árvakr is accessible for everyone but that doesn't mean that it is suitable for everyone. Different people like different things, but Árvakr suits the ones in need of a workout program to maintain or improve their physical strength using fundamental movements adapted to their fitness level. The app needed to be simple to use and by co-designing with the older adults and user testing

throughout the process, my co-designers and I managed to go beyond the threshold and make a solution that can be attractive for older adults.

What components need to be in place so the app meets each individual's needs and expectations?
Age in numbers is not an exact measure of the physical strength and form that people possess and as such, not all older adults are at the same fitness level despite being the same age. Therefore, for Árvakr to be able to scale the exercises to each user's level, I created a physical condition test together with four of my co-designers who are healthcare professionals. Workout programs adapted to the user's abilities, no matter what their shape or size, are more likely to keep the user engaged, allowing them to make small steps of improvement and help them keep with the program.

Starting this thesis I wasn't completely sure what older adults needed when it comes to exercising, but I knew there was a general need for them to exercise strength. After all the conversations, remote meetings, workshops and sessions, here is a summary of what the co-designers and I identified as the most important features to include in the solution:

- Get more older adults to exercise on their own, at their level - Customized workout programs.
- Motivate users to continue - Feed their feeling of mastery.
- Design a solution to suit most people - Provide scalable options.
- Notify users based on their dedication to the program - Don't make them feel guilty for missing out. Celebrate success.
- Exercise diary - Logging results and see progression.
- Simple solution with good user experience - Users should feel confident in navigating the app and recommending it to others.
- Easy for physiotherapists to follow up on clients - Correspondence feature with video and voice messaging.
- Explaining as much as possible with videos - Visual approach promotes better understanding, allows for audio descriptions and subtitles.

The physiotherapists I worked with were less eager to work on the business version of Árvakr, than they were on the version intended for their clients to use. With that being said, they knew very well what features they would like the business version to provide them with, but the first step would be to give the client a tool that they understand and wouldn't give up on.

The older adults can use Árvakr on their own, whether the app has them paired with a physiotherapist or not. The app recommends users that are hurting or are in the need of physical help to contact physiotherapists for better results and to perform movements that are safe given their ailments. The app does not provide a direct method of contacting a physiotherapist: the users will need to contact their doctor like everyone else. Physiotherapists can recommend the app to their clients to reduce the need of recurring physical appointments, and by moving into the digital array, they can follow their clients' exercise activity and communicate with them via the app. As previously mentioned, the co-designers working in healthcare were convinced that clients can take more responsibility of getting better when they exercise at home, rather than counting on the physiotherapist to make them better by visiting them at their office.

What requirements are there for the business version of the app?
Six physiotherapists were interviewed for this thesis and each of them has experience working in the field with different focal points: kids, older adults, athletes et cetera. Two of them were co-designers throughout the project and one was interviewed twice for a second opinion. The physiotherapists all knew exactly what they wanted the app to provide them with, but as I mentioned before, they were mostly concerned with building the app for their clients first. The most important feature for the physiotherapists was an Exercise Library with video, coupled with a video messaging function that could be used to communicate with the clients directly through the app. To connect (pair) the physiotherapist together with the client, the physiotherapist provides the client with a code which the client enters into the app, giving the physiotherapists full access to their workout information. This would require the client to accept a slightly different set of terms and conditions so that the physiotherapists are allowed access to personal information about the client in the app.

1.1 Interviews

Co-designing was key in creating the design for Árvakr. Literature research and interviews gave me knowledge about how physiotherapists work and what tools and methods they feel are missing for them to work more efficiently. I also got knowledge and insights about what tools are already in use to support the new design and needs. To be able to answer the research questions, I needed help from different professionals. The whole design is based on literature research, interviews and user experience and the work done with the co-designers. This part of the process is one of the most important and effective ones because this helped me shape the design and start visualizing the end result, the product and it's scope.

Some of the participants are acquaintances of mine which might have affected the results. Out of 19 interviews, 15 were conducted remotely because of COVID-19 or because of long distance. This could have influenced the interviewees' answers: it can be harder to create the connection between the interviewer and interviewee in the same way as I made with the ones I sat down with in person. Six out of the eight older adults I interviewed were positive in regards to their physical health, which in my opinion also positively affected the process and solution. These participants set a requirement for quality content and features in an app they would possibly come to use along with their existing activities (replace other activities they were participating in).

The interviews took from 20-90 minutes depending on the need for participants to share and talk. The interviews with the older adults were usually longer and many times the discussion got carried away from the project's subject. I didn't strictly moderate the conversation for time or topic, although I was careful to get all the answers I needed even if it took more time. I allowed the conversation to flow, listened actively and felt it was special as I created a connection and a bond with some of the participants (and future co-designers) I barely knew. I am convinced that this also made us all more dedicated to the design process.

I learned that many older adults are accepting of the fact that aging brings medication, deteriorating health and decreased physical function. I was taken aback by the lack of knowledge regarding the importance of physical strength when one of my interviewees said: "No, I'm done with exercising. I did that when I was younger".

Having exercised, trained and competed in sports since I was a kid, I had a hard time wrapping my head around this mentality. While I had to learn to put myself in other people's shoes, one of the healthcare professionals was surprised that I wasn't aware of how common this mindset is among older adults. While I certainly wasn't aware, it's something that needs to change and Árvakr may be a step along the way.

1.2 Usability test

The usability tests were conducted in different ways. In the beginning of the prototyping stage I started testing on my family members and friends, since they were the only people I was allowed to meet in person. The first round of user tests was done with the future users. These tests were done remotely through Teams or Facetime where I would share my screen with the participants and have a conversation about the design and their expectations. This was not as good as a hands-on test, but the users shared their thoughts with me and I clicked on the things they wanted to interact with. Possibly this test round was influenced by me helping the participants on the other side.

The older adults were very verbal about what they were thinking and some of them were unsure about their thoughts in between, since I was on the other side of the screen and operating the mouse and keyboard. During these long distance user tests, some of the older adults had their family members with them during this meeting as a support if something wouldn't work as they liked. In my opinion this part could have produced better results if it had been possible to meet the users and allow them to interact with the product. At this stage COVID-19 restrictions were in full effect so this method of testing was the next best thing.

The rest of the usability tests were conducted by having future users physically interact with the product. This had a much better effect on how the product was actually being used. The only thing I was missing was an extra person to take notes while I was guiding the participants through the process. Since I didn't have the opportunity to create the instructional exercise videos for the app, I was the one playing that role when the participants pressed play on the screen. As an observer, secretary and participant it sometimes became hard for me to notice and remember everything that went on. This too might have affected the end results of the design.

1.3 Design Results and Future Work

Overall the design and concept met the requirements from the design brief, although the concept is not fully matured in this thesis. My goal was to research for and design a digital solution for older adults as well as their physiotherapists. The scope of completing both aspects of the app turned out to be quite a challenge to complete in five months and early in the process I had to reduce the scope and leave out the parts pertaining to the physiotherapists (referred to as the business version).

In the beginning of the project, COVID-19 constantly came in the way and made it hard to conduct proper qualitative research, and social restrictions in Norway and Iceland sometimes changed from day to day. Like everyone else sailing these uncharted waters, I had to come up with a way to host the co-designing sessions, conduct the interviews and design the physical condition test, as well as the user interface. Then I needed to iterate all of this, get more feedback and adjust accordingly, without ever being able to bring everyone together in the same room.

The solution was to use, Microsoft Teams, Facetime and Miro for remote collaboration but honestly it required much more work on my behalf in planning, spending time and patience on technical difficulties among participants (some of which had never used these services for anything but casual conversations), switching between live video and screen sharing and losing out on a lot of the social and conversation dynamics you get when you're in the same room.

Towards the end of the project some of the older adults I worked with got their vaccination and I was fortunate enough to be able to visit some of them in person, if only to wrap things up with them as the project was nearing completion.

This project would have benefited greatly had we been able to do more physical workshops and meetings together, where co-designers could get to know each other better and communicate more rapidly, draw on whiteboards and exchange ideas faster.

The physical condition test was created in cooperation with physiotherapists and a doctor in geriatric medicine, and tested primarily by future users. Designing the test turned out to be more time consuming than designing the actual user interface, partly because the ones designing the test weren't allowed to meet the older adults for conducting tests. This created something of a logistical time management conundrum and became extremely time consuming. Since creating the test took so long, I ended up having to find more participants to user test the physical condition test with fresh eyes to look for any newly created obstacles that needed to be rectified.

The workout program Árvakr uses is based on my experience working as a Crossfit coach and working with people at every fitness level and age, but seldomly injured. Physiotherapists however, primarily treat people that are physically injured or incapable of performing certain movements, hampering them in their daily lives. This contrast among our clients, who all still had the same goal of improving their health, turned out to be a benefit to our team and helped us compare different scenarios.

One factor that may have influenced the end results was how the instructional exercise videos were presented to the users during testing. Since I didn't have the time or place, and lacked the experience of creating such videos, I acted them out for users myself during the user tests. Luckily I have worked as a coach which made it easy for me to make the demonstrations professional, short and accurate.

As I now part ways with Árvakr – for the time being – in its current state, it would benefit from even more user testing: on the physical condition test in particular, to create the instructional exercise videos and getting the timer to work properly in the prototype. This would complete the entire set of required features, allowing users to test the app without external assistance.

Conclusion

As we get older, our physical condition is an important factor when it comes to continued quality of life. Seniority characterized by steep regression and suboptimal physical condition contributes to decreased quality of life, less mobility and independence and even contributes to slower recovery after getting sick or injured, all of which comes at a cost of tens of billions of dollars per year. Despite older adults wanting to stay active and strong and understand the benefits of physical health, many don't know how to start strength training, how to achieve the results they want and how to stay motivated during the process.

The goal of this thesis was to design a digital solution to help adults older than 65, optionally in cooperation with their physiotherapists, to maintain or increase their physical strength by performing fundamental exercises, scaled to their respective fitness level using the results of an initial benchmark test. The final result is *Árvakr*, a platform with one main goal: to improve the physical health of older adults while keeping them motivated and responding to their success.

Árvakr stands out as a product as it's designed in cooperation with older adults and healthcare professionals. Benchmarking users and adapting the difficulty of *fundamental* movements as exercises is unique to Árvakr, as is the language: having it in Icelandic is a huge benefit to the users. So much so, that one of the older adults who participated in the project even wanted to invest in the product. To me, this was a clear sign of the need for a product like this and assured me that I was on the right track.

With that said, a limiting factor for the reach and adoption rate of a product like Árvakr at this time is the individual knowledge and experience among people older than 75 in using personal digital technology such as smartphones. This may not be a problem for future generations.

As for the research question, being able to motivate and encourage older adults to take care of their physical health using an interactive digital platform, then I am convinced that with the help of a product like Árvakr it is possible to engage a large segment of the target group that otherwise would idle. The benefits have been outlined in this thesis: independence, confidence and quicker recovery for the *older adults*. Better communication, time management, customization options and quicker client recovery for the *physiotherapists*. Saving money and raising people's physical health standards for the societies. Less worries and more activities, less caretaking and fewer medical appointments for the *family*.

This thesis gave me the opportunity to use different service and interaction design methods throughout the process and matured me as a designer as I iterated my design more (in closer cooperation with actual users and stakeholders) than I ever have before. I answered the research question to the best of my ability and the project has brought me a new perspective on the subject matter. I truly believe there is a need for Árvakr and hope it will be adopted as a valuable tool for improving the health of older adults, bringing with it the multitude of benefits previously described.

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Appendix

Appendix A

Older adults:

Move/Exercise:

1. What do you usually do to exercise/move?
2. Why do you exercise/move?
3. Do you think it is fun to exercise?
4. What makes it fun?
5. Are you a routine person?
6. What interests do you have?
7. Do you usually train alone or in a group?
8. Do you think it is important to keep up physical strength and why?

Technology:

1. Do you have a smartphone and/or tablet?
2. Which app are your favorites (do you use the most)?
3. Do you think new digital things are scary? Why?
4. If you need help with digital things, do you ask for help?

Physical history:

1. Are you seeing a physiotherapist or have you ever?
2. What was your problem?
3. Did you need the physiotherapists help for a long period?
4. Did you get acceptable results?

Physiotherapists and other professionals:

General

1. For how long have you worked as a ….?
2. What age group is in majority of your patience/client group?
3. How do you communicate with your patience/client?
4. When your client gets homework from you how do you represent it (email, print-out..)?
5. Do you think it is important to keep up physical strength? Why?
6. Approximately how many patience/clients do you treat every day?

Older adults

1. Do you have to treat a lot of older adults at the same time?
2. What motivates older adults in your opinion?
3. What do you have to be aware of when explaining things to older adults?
4. What do you think works best when communicating with older adults?
5. Do you think it is important to have different solutions for the older adults to keep up their physical strength? Why?

Technology

1. Do you use apps or digital platforms when treating your patients/clients?
2. What function in a digital tool would you wish was possible to help make your job easier?
3. Do you treat any patience/clients through digital platforms?
4. What difference do you feel when working digitally vs. physically with patience/ clients?

Appendix B

Silja Gudmundsdóttir

"I want to have fun when I do activities"

ABOUT

Age: 68
Location: Reykjavík

Occupation: pensioner
Status: Single
Children: One
Grandchildren: Two
SoMe: Facebook

GOALS

Feel stronger and in good physical condition to have better life quality.

Do the right thing for her level of fitness.

Motivation to move.

FRUSTRATION

Feel weak.

Don't know what to do to get stronger.

Weather in Iceland is very cold.

BIO

Silja lives alone, she has one child and 2 grandhildren. She stopped working as a nurse one year ago and is now a pensioner.
When she was working she had some physically demanding work where she used her body and muscles. After Silja stopped working she feels that she has gotten weaker.

In Silja's freetime she goes out for a walk if the weather is good. She is alot at home knitting or playing candy crush.

TECHNOLOGY

IT & INTERNET

SOFTWARE

MOBILE APPS

SOCIAL NETWORK

PERSONALITY

Thinking — Feeling

Extrovert — Introvert

Judging — Perceiving

Sensing — Intuition

Appendix C

Halldór Antonsson

"I like feeling strong and be with other people"

ABOUT

Age: 72
Location: Kópavogur

Occupation: pensioner
Status: married
Children: three
Grandchildren: ten
SoMe: Facebook, Snapchat

GOALS

Gain general physical strength.

Exercise in a group, or together with his wife.

Get a feeling of mastery.

FRUSTRATION

Shoulder stiffness and pain.

Wants to play with grandchildren without feeling weak.

Not sure what to do to get better.

BIO

Halldór is married and has 3 children and 10 grandchildren. He used to work as a computer engineer before he became a pensioner 5 years ago.

Mondays and Wednesdays Halldór goes to the swimming pool with his wife where they meet up with a group of pensioners and Tuesdays and Thursdays, he goes for a walk preferable with his wife.

In Halldór's free time he plays with his grandchildren. He also like technical things so he sits and reads updates on new technology on his iPad.

TECHNOLOGY

IT & INTERNET

SOFTWARE

MOBILE APPS

SOCIAL NETWORK

PERSONALITY

Thinking — Feeling

Extrovert — Introvert

Judging — Perceiving

Sensing — Intuition

Appendix D

Ragna Sif Rúnarsdóttir

"I need my patience to want to get better and time for me to help them do it"

ABOUT

Age: 34
Location: Reykjavík
Occupation: physiotherapist
Status: married
Children: two
SoMe: Facebook, Snapchat, Instagram

GOALS

More family-time.

Faster results for her clients.

Better communications with clients.

FRUSTRATION

Time management.

Not good enough follow ups on clients.

Hasn't found a digital solution that covers all of her needs at work.

BIO

Ragna Sif is married and has 2 children. She has worked as a physiotherapist for 11 years and loves dedicating her life to help others with their physical health.

She works every day from 9am - 17pm and feels she needs more time to get through with all the work she wants to do with her patience.

In Ragna Sif's free time she skis with her family or in the summertime the family goes to their cabin 2 hours outside of Reykjavík. She loves having dinner parties for her friends and is very interested in making good food.

TECHNOLOGY

IT & INTERNET

SOFTWARE

MOBILE APPS

SOCIAL NETWORK

PERSONALITY

Thinking — Feeling

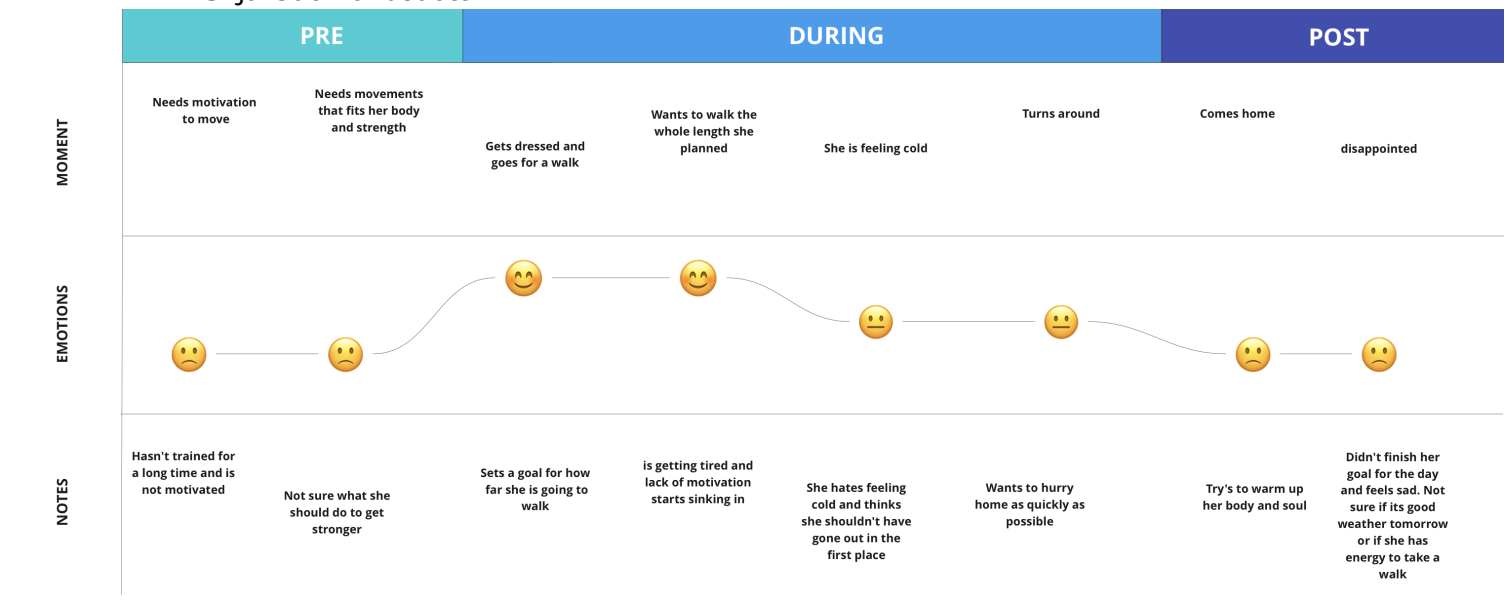
Extrovert — Introvert

Judging — Perceiving

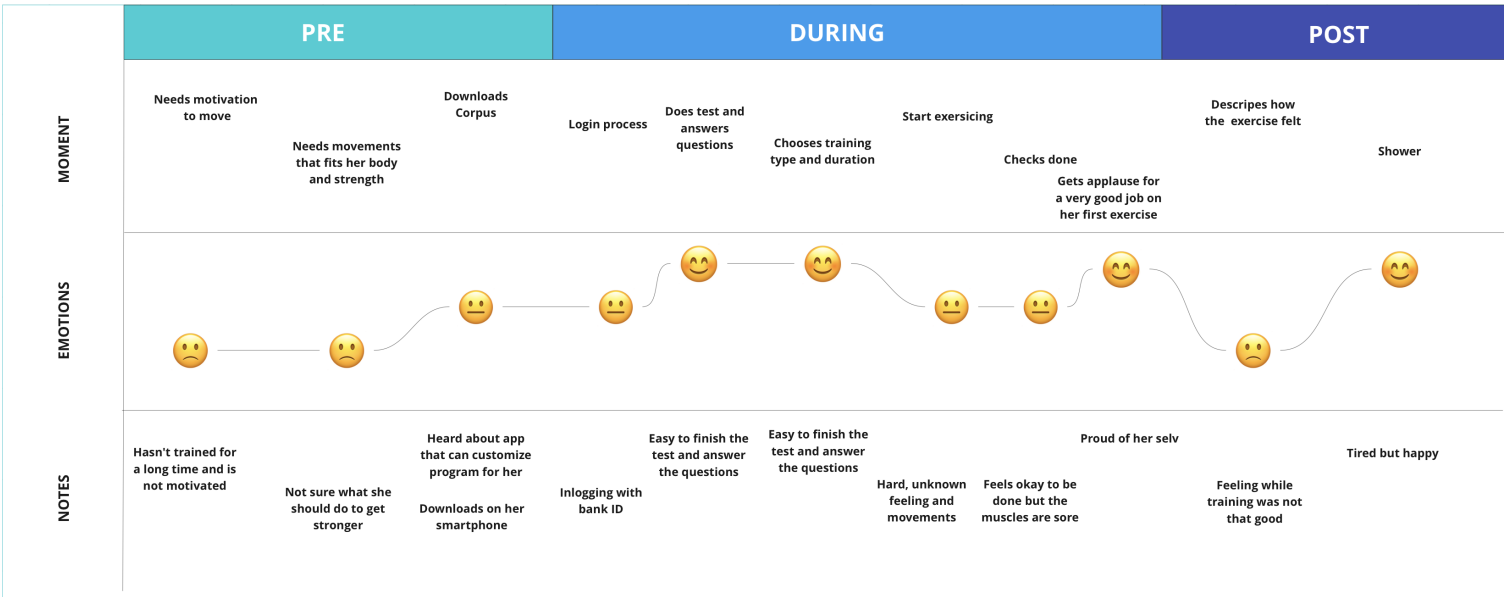
Sensing — Intuition

Appendix E

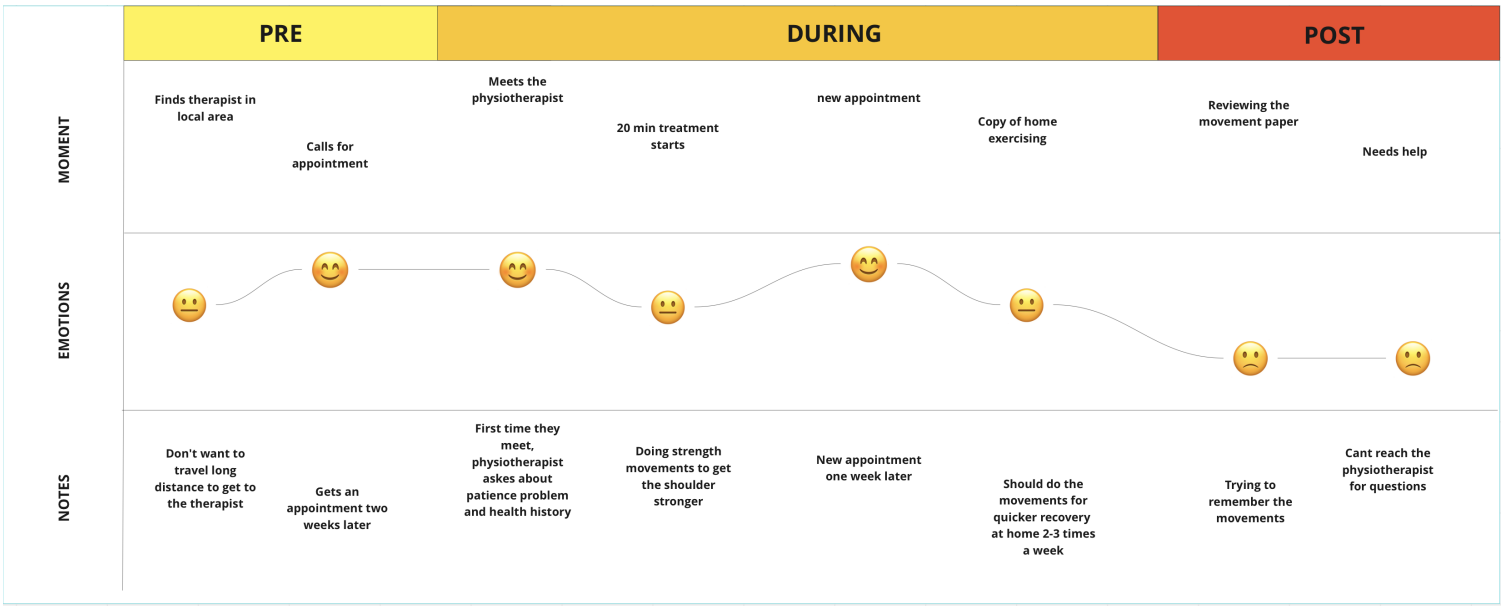
1. Silja Guðmundsdóttir



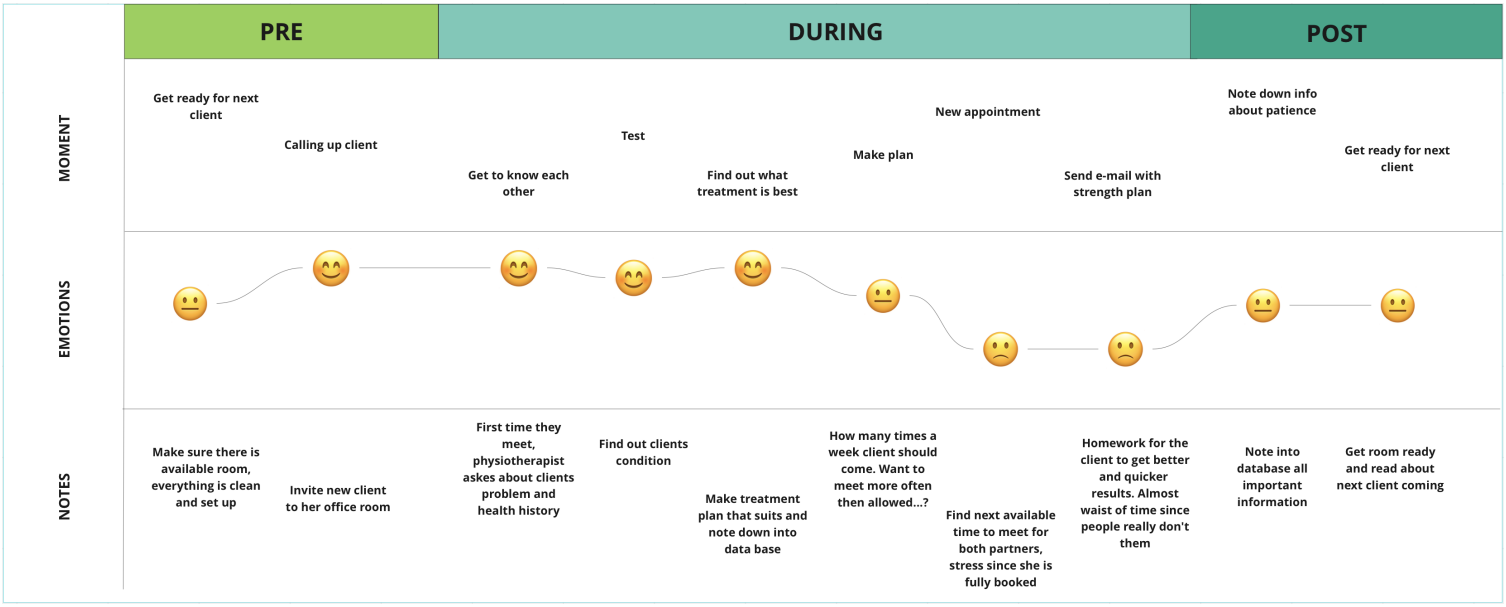
2. Silja Guðmundsdóttir



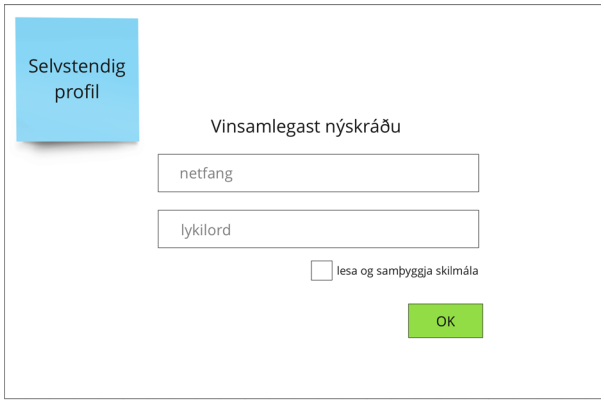
Halldór Antonsson

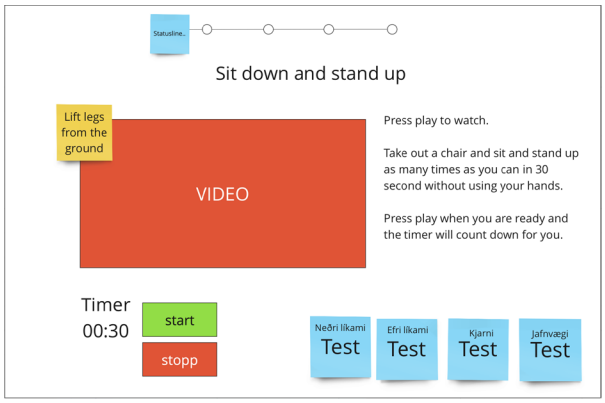


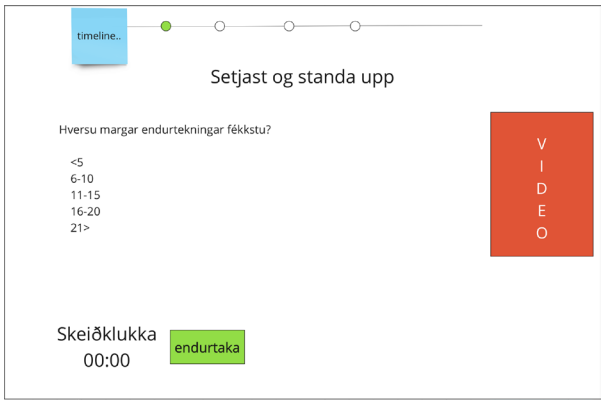
Ragna Sif Rúnarsdóttir

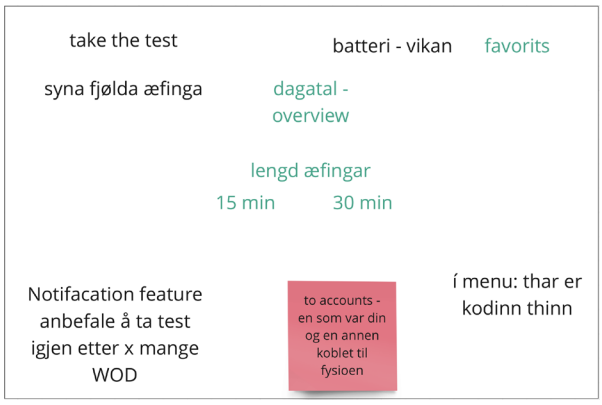


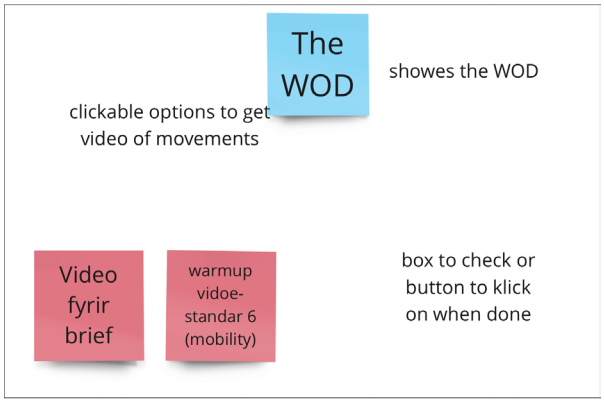
Appendix F

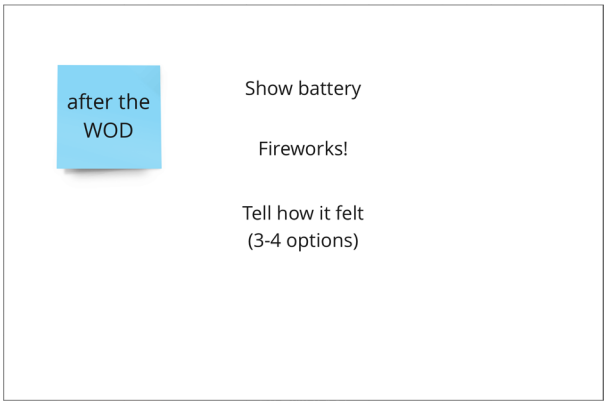

Selvstendig profil
Vinsamlegast nýskráðu
netfang
lykilord
lesa og samþyggja skilmála
OK

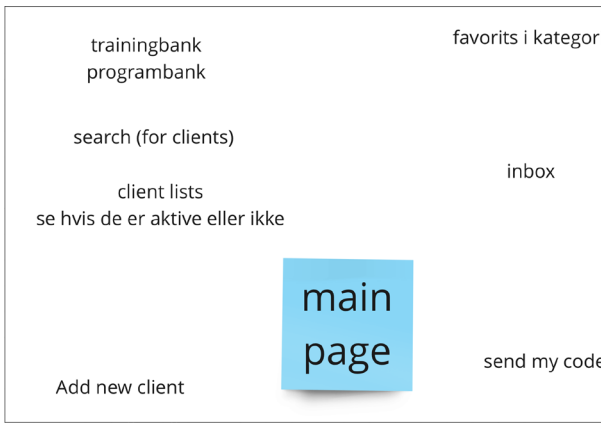

Statusline..
Sit down and stand up
Lift legs from the ground
VIDEO
Press play to watch.
Take out a chair and sit and stand up as many times as you can in 30 second without using your hands.
Press play when you are ready and the timer will count down for you.
Timer 00:30
start
stopp
Neðri líkami Test
Efri líkami Test
Kjarni Test
Jafnvægi Test

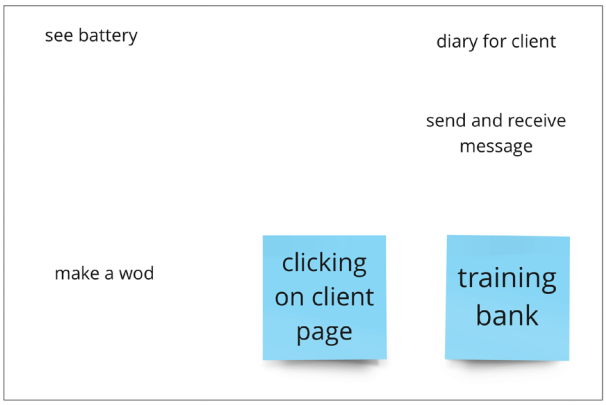

timeline..
Setjast og standa upp
Hversu margar endurtekningar fékkstu?
<5
6-10
11-15
16-20
21>
V I D E O
Skeiðklukka 00:00
endurtaka


take the test
batteri - vikan
favorits
syna fjølda æfinga
dagatal - overview
lengd æfingar
15 min
30 min
Notifacation feature anbefale å ta test igjen etter x mange WOD
to accounts - en som var din og en annen koblet til fysioen
í menu: thar er kodinn thinn


The WOD
showes the WOD
clickable options to get video of movements
Video fyrir brief
warmup vidoe- standar 6 (mobility)
box to check or button to klick on when done


after the WOD
Show battery
Fireworks!
Tell how it felt (3-4 options)


trainingbank programbank
favorits i kategor
search (for clients)
inbox
client lists se hvis de er aktive eller ikke
main page
Add new client
send my code


see battery
diary for client
send and receive message
make a wod
clicking on client page
training bank

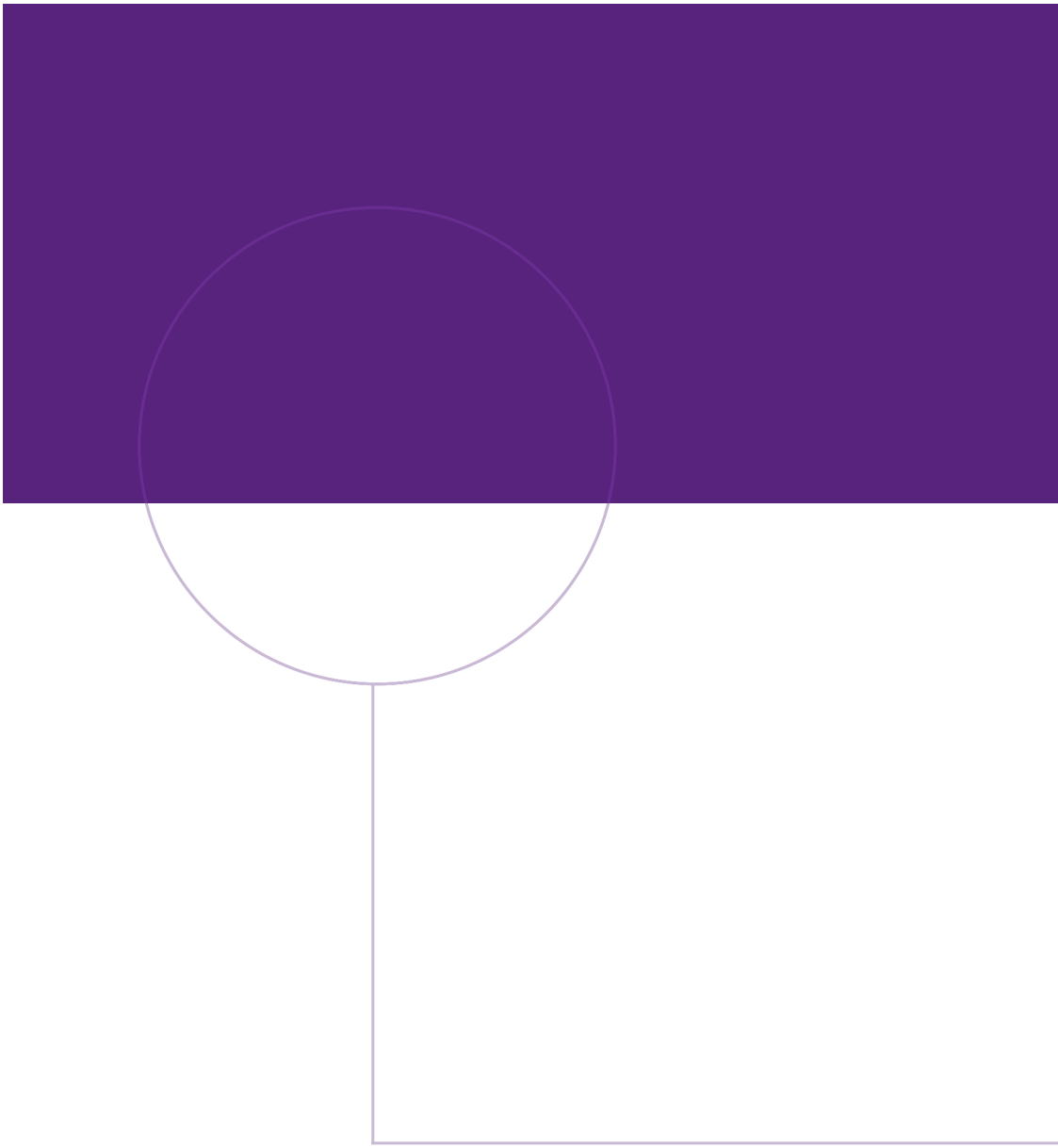
Appendix G

Link to Silja Guðmundsdóttir's scenario:
https://www.figma.com/proto/FmhUftbpDc6UgmR1yi3ZPw/Meistari-lo-fi?node-id=430%3A3117&scaling=scale-down&page-id=430%3A629

Link to Halldórs Antonssons scenario:
https://www.figma.com/proto/FmhUftbpDc6UgmR1yi3ZPw/Meistari-lo-fi?node-id=441%3A19&scaling=scale-down&page-id=441%3A18

Árv

vakr



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