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A responsive Cutlery Concept: Behavioral Intervention For Normalising Problematic Eating Behavior

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Master Thesis

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Author's Declaration

Hereby I declare, that I have written this thesis independently.

No academic degree has been applied for based on this material.

All works, major viewpoints and data of the other authors used in this thesis have been referenced.

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Abstract

This thesis explores problematic eating behavior and its effects on the daily life of the people who suffer from eating disorders. The wider research section of this paper aims to offer a general understanding about eating disorders and examines the topic with the support of interviews with specialists and patients. Differing schools of thought regarding best practice for eating disorder treatment are compared for their benefits and drawbacks.

Design methodology is applied to give structure to the research and development process. The ultimate aim of this process is to create a meaningful solution which provides value to the patients and doctors by aiding the recovery process. Aesthetics are also considered as this solution revolves around a physical product. This product is a new smart cutlery concept to aid patients and practitioners who are following a particular existing pioneering treatment method. This method is behavioral intervention for treating eating disorders.

This concept should be viewed as a design student's humble suggestion regarding a complex medical issue. However, the real benefit of a designer working on this topic is to promote a discussion and generate new ideas in a misunderstood field of medical science.

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Abbreviations

AN: Anorexia Nervosa

BN: Bulimia Nervosa

BED: Binge Eating Disorder

EDNOS: Eating Disorder Not Otherwise Specified

DSM IV: Diagnostic and Statistical Manual of Mental Disorders

OCD: Obsessive Compulsive Disorder

ED: Eating Disorders

IoT: Internet of Things

AI: Artificial Intelligence

AR: Augmented Reality

1. Introduction

The scope of this thesis was tailored to reflect the available resources of one design student. In practice this means research was conducted in an individual manner. A broad understanding of the topic was developed and is outlined in this thesis. This research process followed the methodology outlined by Vijay Kumar's "101 Design Methods" book and includes testimonials, interviews, web-based searches and references to academic writing.

The motivation to study this particular topic "eating disorders" came by chance, after I had established that I wanted to explore the area of food and design I immersed myself in a broad selection of literature and media. One documentary film in particular, "Thin"(2006), made a strong impression on me. The film documents four women with different types of eating disorders and their struggle to recovery. Watching this film made me realise my very limited understanding, on what appeared to be, a very complex and important health emergency. This also made me wonder if my ignorance on the subject was wide spread through society. After some brief research it became clear that eating disorders were very misunderstood by the public and the treatment of this, often young girls, was failing. It therefore became clear that my thesis could become a tool to further my own understanding on this important topic, and shed light on an under-reported phenomenon by offering a novel approach to recovery.

To start with, I formulated two research questions:

What are the reasons causes problematic eating behavior and food obsession?

What are the daily life struggles of eating disorder sufferers?

Answering these questions would yield enough data and understanding to develop and frame my central research and development issue:

How to support normalising eating behavior for eating disorder patients and people at risk of eating disorders?

I believed these three questions would cover enough material to give me a firm understanding of the topic. In order to develop new ideas in the context of an established health care practices.

Throughout my research it became clear that the most important issue was: Should eating disorders be treated as mental disorders or behavioral disorders. Untangling these two viewpoints was more difficult than expected. For instance, half of patients have psychiatric comorbidities a fact which causes confusion as to whether it is, or is not a mental disorder. However, it could be argued that all manifestations of this disease are the result of behavioral actions. This argument provides the foundation for my concept which is behavioral intervention tool for normalising problematic eating behavior.

2. Methodology

Unlike science, which employs the scientific method as a universal methodology, designers have an unlimited selection of methodologies to choose from when trying to structure their research and development processes. The designer can select a particular methodology based on their particular preferences and the nature of their design problem. I have chosen the methodology “seven modes of design innovation process” from Vijay Kumar’s “101 Design Methods” book

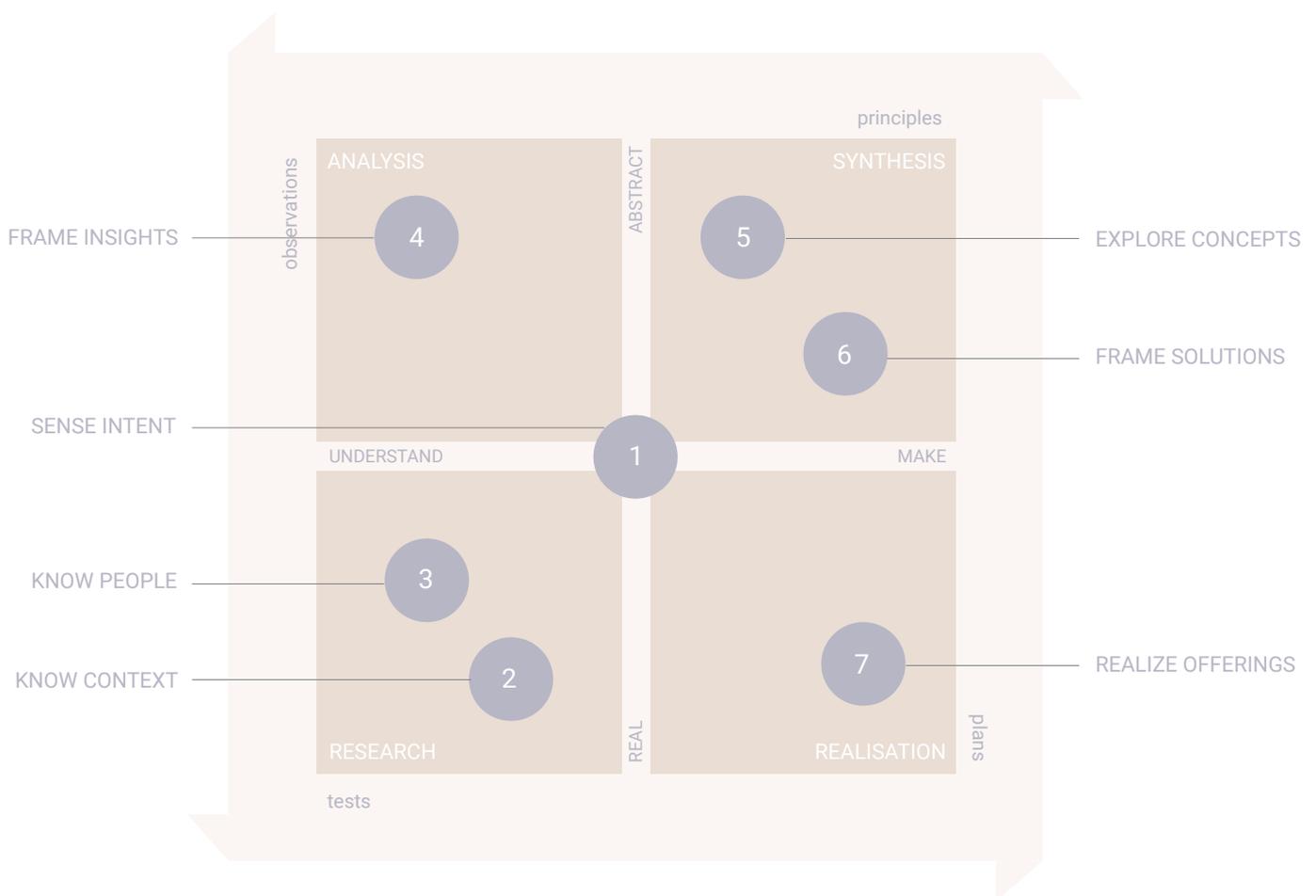


Figure 2.1 Seven Modes Of The Design Innovation Process. Source: 101 Design Methods by Vijay Kumar.

Vijay Kumar outlines seven modes of design innovation process, the modes are numbered sequentially and each mode contains various methods and tools. I have kept the structure of the seven modes intact but have only included a select number of methods and tools which I find to be relevant to this research. Below I show my chosen methods and tools in relation to their modes.

2.1 Sense Intent

When confronted with a broad design brief it is a useful strategy to take a step back from a specific issue and consider it from different perspectives in order to see the problem in a new light. Once multiple avenues of exploration have been identified the designer can choose which route they want to explore. This mode is covered in the introduction chapter.

2.2 Know Context

This mode categorizes all tools designed to explore and understand the context of the research topic. Context can refer to understanding key themes, facts and their relationships to wider issues. As my topic explores eating disorders, a topic with a large amount of stigma and misconceptions, extra care and attention are required to fully understand the nuances of this sensitive subject.

Publications search, is where I scanned related scientific research, articles and studies to gain insights into the topic from the perspective of the medical community.

Popular media search, is useful for gaining a quick overview of a topic. It is also useful to analyse the information which is available on these readily available platforms. People with eating disorders, and those wishing to learn about it, will develop their understanding of the condition and available treatments from the information available in these popular media streams.

Subject matter experts interview, is where I talked to specialists who worked or work on

eating disorders. In this paper I have interviewed a Professor who has authored research papers and pioneered an innovative solution for the treatment of eating disorders. I have also interviewed a nurse who worked with eating disorder patients and has first hand experience of the clinic conditions.

2.3 Know People

Primary research is conducted in the form of a qualitative interview to gain insights to problems which may not appear in scientific papers or popular media on the subject.

Research participant map: This map is based on two axis dividing four areas. The axis are labeled according to the designers needs. This map can help visualise and categorise stakeholders in order to reveal which stakeholders to focus on. [“link to page”](#)

Ethnographic interview: can be described as one or multiple qualitative interviews with persons of interest. For my research I have conducted qualitative interviews with three people who are experiencing eating disorders or recovered from eating disorders. I have asked questions about their disorder, their relation to food, their daily life and attitude towards eating.

2.4 Frame Insights

This stage involves sorting through and organising the gathered data from the methods I used from “know context” and “know people” parts to find meaningful patterns.

Observations to insights: Consists of two steps. The first step is to make objective observations, that is observations with as little bias and evaluation. The next step is to draw insights by analysing those observations and the relationships between them.

Insight sorting: Organizing and grouping insights in relation to each other.

2.5 Explore Concepts

Concept generation is done with the organised data from the previous mode. Mental exercises and visual maps are used to generate new concepts.

Opportunity mind map is a map with the core topic in the middle with development opportunities centered around this topic. Opportunities can be grouped and placed in relation to each other and the core topic.

Value hypothesis: Similar to “value proposition” value hypothesis involves defining the potential future values of a particular proposed solution for users.

Concept sketch: Creating a visual representation of the essence of a proposed concept.

2.6 Frame Solution

Usually involves honing in on a specific identifiable feature for a solution, this is commonly known as a concept. Once a concept has been selected, it can be developed in an iterative fashion.

Concept evaluation: After concept generation they are compared to see which concepts will deliver the most value to users.

Solution enactment: is a form of communication where a design is presented to an audience. In this presentation the design is often framed in terms of being a new solution to a persistent societal problem. The presentation will stress how and where it offers stakeholders value.

Solution prototype: With the use of a functional prototype, or a mock-up, users or actors simulate how a proposed solution may function in real world usage. Feasibility and user interactions tests are suggested.

2.6 Realise Offerings

It refers to capitalising on identified opportunities to provide real value to end users. It also entails ensuring that the solution can exist and thrive in an economic sense.

Market analysis: Comparing with other similar or related products on the market.

3. Know Context

3.1 Eating Disorders

3.1.1 What Are Eating Disorders?

Eating disorders are a category of diseases that are not generally considered as serious health issues by the wider public. A common attitude towards these conditions is that they are self-inflicted and can be cured by individual will power. One major reason of the low level of awareness in the general public for eating disorders is that eating disorder sufferers commonly deny and or hide their problems from public view; often keeping their family and friends in the dark, also they may not be very willing to receive professional help⁽¹⁾. It could take a long time for the patients to realise that they have a serious problem with their eating habits and that they need professional treatment. So patients often ignore and cover their disorder which in turn leads to widespread under estimation of the severity and the nature of those disorders.

When a person's eating pattern, the amount of food they eat and the speed that they eat change in a way that it starts to affect that person's health and their ability to adapt to social and work life, it can then be said that it becomes an eating disorder. Contrary to what is often believed by the public, eating disorders appear to be very complex disorders which affect a person's mental and physical health due to abnormalities in eating habits⁽²⁾. The abnormalities in eating habits could be defined as an unusual amount of food intake, in which are either eating excessively or eating very little⁽³⁾. I will define eating excessively as eating a very large amount of food at once, much more food than is required for normal bodily functions. Some features of excessive eating include eating too quickly and losing the sense of fullness which naturally occurs in people who have healthy eating behavior. Conversely, eating very little can be interpreted as eating an insufficient amount of food, less than the person's bodily requirements. This behavior without being addressed can

lead to having problems with feeling hunger at all.

According to the Diagnostic and Statistical Manual of Mental Disorders(DSM IV) which is a manual published by American Psychiatric Association, the most common types of eating disorders are:

Anorexia nervosa(AN),

Bulimia nervosa(BN),

Binge eating disorder(BED) and

Eating disorder not otherwise specified(EDNOS).

Eating disorders are mental disorders according to DSM IV, however they are much more complex and I will argue that it could be suggested not to describe them just as mental disorders. Although I do not fully agree with all the definitions and treatments methods of DSM IV, I am still going to reference them to help explain the symptoms of eating disorders, as they have published the most referenced text on this topic.

Anorexia nervosa is defined as; obsessively trying to keep body weight below the normal weight (body mass index smaller than 17.5), by being persistently afraid of putting on weight even when they have already low weight and a disturbed image of one's own body contribute to the symptoms of anorexia nervosa⁽²⁾. Body mass index is a value calculated according to a person's age and height to compare a person's body weight to the normal weight of that height and age. Anorexic people are not aware of the potential risks of their low body weight and tend to perceive their weight as higher than it is. This could be understood as the reason why they are obsessed about being very thin. It is the third most common chronic illness in young people⁽⁷⁾. Between 1% to 4% of women suffer from anorexia⁽⁶⁾, considering those figures, it is not hard to say that anorexia nervosa is a serious disorder which deserves a better attention.

Bulimia nervosa is repeated binge eating followed by purging with a self-induced vomiting or laxatives⁽²⁾. Other common symptoms of bulimia nervosa are over exercising or periods of extended fasting as well as an obsession about body weight and shape⁽²⁾. Binge eating could be defined as eating large amounts in a relatively short time, losing self-control

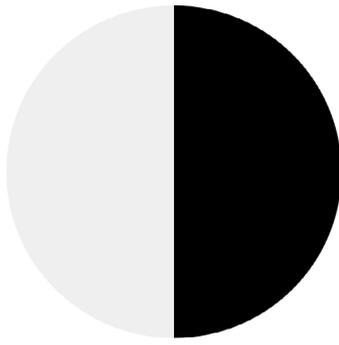
and having problems with the feeling of satiety. Bulimia nervosa patients generally have a normal weight unlike anorexia nervosa patients and they try to limit their food intake between binges⁽¹⁴⁾. BN can develop when people try to limit their food intake with dieting but fail to control their food intake. Approximately 1.5% of women suffer from bulimia nervosa in their life⁽⁶⁾.

Binge eating disorder is defined as repeated binge eating without purging, fasting or over-exercising⁽²⁾. Some of the related traits are; eating fast, eating when they are not hungry, not stopping until feeling disturbingly full, preference to eat alone because of feeling ashamed and feeling self disgust after eating⁽¹⁴⁾. Patients of bulimia nervosa and binge eating disorder both have recurrent binge eating, but it becomes bulimia nervosa in case of purging after binge eating. It also differs from AN and BN from; the age when symptoms appear, gender, racial pattern, psychological symptoms and relation to obesity⁽¹⁾. Binge eating is often exhibited by obese people, however 'binge eating disorder' is a diagnosis which is dependent on the psychopathological symptoms of the patient, the patient's worry about their body shape and size, as well as their reduced standard of living⁽⁴⁾. There is a serious risk of obesity in people who have binge eating disorder or bulimia nervosa, 33-50% of those diagnosed are obese or they will be obese in the future⁽⁹⁾. According to a study from 2007 English speaking Americans, who were the test sample, binge eating disorder is three times more common than AN and BN together, also more common than AIDS and breast cancer⁽⁶⁾. As reported approximately 3% of adults suffer from binge eating disorder in their life⁽⁶⁾.

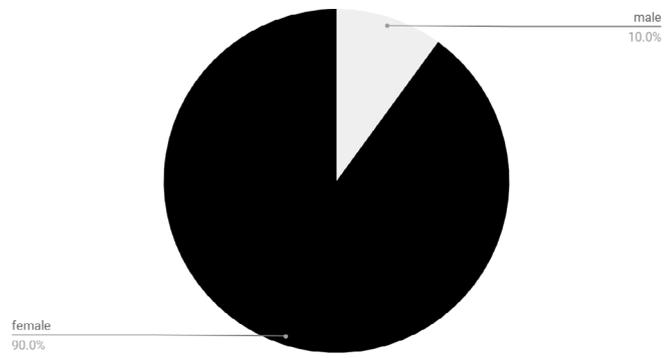
As the most common eating disorder, eating disorder not otherwise specified(EDNOS) is not explicitly characterised and is a hybrid group of eating disorders which consist of different syndromes from anorexia nervosa, bulimia nervosa, binge eating disorder and purging⁽¹⁾. Although EDNOS is the most common eating disorder, it will not be furthermore mentioned or analysed since it is a hybrid group containing previously specified three eating disorders.

To understand the scope of eating disorders, it is helpful to look at some statistics. In contrast to public opinion, all eating disorders have a death risk, anorexia nervosa is the most

Psychiatric Comorbidities



Gender rate



Mortality Rate



Anorexia



Figure 3.1 Graphical Charts For Eating Disorder Statistics

noticeable one⁽¹⁾. The mortality rate in eating disorders is 5% which is the highest among all the psychiatric disorders⁽⁵⁾. Anorexia has the highest **mortality rate** among all the eating disorders with 10%, which again makes anorexia nervosa the deadliest psychiatric disorder⁽⁶⁾. It is important to say that the statistical numbers are shown to emphasize the severity of eating disorders; however I will argue that eating disorders are behavioral disorders although the gathered data considers eating disorders as mental disorders.

There is a recognizable difference in the **gender ratio** in prevalence of eating disorders. Anorexia and bulimia nervosa are much more common in females and young people, however binge eating disorder is more common in males and older people⁽¹⁾. Some argue that the reason between the dramatic difference in the gender ratio in the prevalence of eating disorders is men's unwillingness to get professional help or to be a part of a study of eating disorders⁽³⁾. Therefore, the rate of male patients who have an eating disorder could be higher than it is recorded.

As mentioned, the **prevalence of eating disorders** in adolescents and young people is 3%, furthermore the percentage in subthreshold prevalence is striking with 11%⁽¹⁴⁾. Anorexia and bulimia are most common in teenagers, however the age for binge eating disorder onset is mid-twenties⁽¹⁴⁾. Nevertheless, eating disorders can be seen in any age, race, gender, ethnicity, cultural background or income level⁽⁶⁾.

It is not rare that **psychiatric comorbidities** like depression, anxiety, OCD (obsessive compulsive disorder), insomnia, irritability or mood disorder are seen in people who have eating disorders⁽³⁾. Approximately half of the eating disorder patients have those psychiatric comorbidities⁽¹¹⁾. Substance abuse disorder, especially alcohol, is four times more likely to be seen in eating disorder sufferers⁽¹²⁾. People with eating disorders have commonly low self-esteem due to their obsession with their physical appearance or disturbed eating habits⁽¹⁰⁾. Another issue is high suicidality rate of eating disorder sufferers. As was stated, anorexia nervosa is considered as the deadliest mental disorder and furthermore, one of five anorexia deaths is caused by suicide⁽¹³⁾. It is not surprising that eating disorders are considered as mental disorders when the prevalence of psychiatric comorbidities and low self-esteem are that high. However, it is significant to make the distinction between two

contending viewpoints; that either eating disorders develop with psychiatric reasons, or psychiatric comorbidities develop after eating disorders. This issue will be discussed de-tailly in the next stages.

There are also **medical comorbidities** that accompany eating disorders that are related to abnormal weight loss or purging. Problems with endocrine system, anemia, cardiovascular illnesses, electrolyte disturbance, dental problems, dehydration, cold intolerance, hypoglycemia, osteoporosis, blood pressure drop, irritation or bleeding in stomach, hair loss and fertility problems etc. are seen as comorbidities in eating disorder patients^(3,14). When the 'balance' of body is disturbed, biological disorders expectedly start to occur along with eating disorders.

Most eating disorder patients need to be taken care of by **caregivers**, their family, relatives or friends. Coping with eating disorders can be time consuming and challenging, both psychologically and financially for the families of patients. As challenging as it is tackling with eating disorders for the families and relatives, it is also difficult for the healthcare system and requires more time for treatment compared to other disorders. In serious cases of anorexia nervosa, the time consumption for caregiving is doubled in comparison to other severe physical or mental illnesses⁽¹⁵⁾.

Along with mortality rate, problems with social functioning, physically and psychologically suffering and treatment time; eating disorders can also cause considerable social costs⁽¹⁴⁾. There is an economical burden on families, since the treatment takes long time and requires special care. Another issue for the patients is problems with employment. One of five patients between 18 and 24 work partially or not able to work; the rate of incapability of work for older sufferers is going up to 40% according to RIKSÄT - National quality register for eating disorders treatment. In European Union, the cost of eating disorders is estimated as €1 trillion per year for 20 million eating disorder patients⁽¹⁶⁾.

To sum up, eating disorders are very complex and underestimated health issues which affect patients' quality of life negatively in many aspects. Although it is called the deadliest mental disorder, the mechanism of the disorder is not agreed in medical world and public

awareness is inadequate. Due to a whole range of comorbidities, eating disorders are confused with other health conditions by patients, families of patients and sadly even specialists. It is important to understand what eating disorders are and to do so, all aspects of the disorder will be analysed using scientific publications and patients' experiences. In the next step I will explore how the diagnosis of eating disorders is made and what kind of treatments are available.

3.1.2 Diagnosis and Treatment

Diagnosis and treatment of eating disorders can be very challenging due to; the complexity of the signs, symptoms, patients' refusal of the illness, patients' rejection of the treatment as well as psychological and medical comorbidities. The main symptoms can be understood as those characteristics to describe the disorders, however the main characteristics are not sufficient to diagnose eating disorders. Patients are mostly not aware of their problem but family members are more acute to the fact that professional help is needed⁽¹⁴⁾. Aforementioned there are also different subtypes of those four most common eating disorder types.

Anorexic people have noticeably low body weight, however weight loss can not be the only sign to diagnose a person with anorexia nervosa. Some other medical problems can also cause weight loss such as: Brain tumor, diabet, gastrointestinal disease, immune system illnesses or hipertiroid⁽¹⁷⁾. Moreover, depression and schizophrenia patients might restrict their food intake, but they are not concerned about gaining weight or counting calories⁽¹⁴⁾.

Binging is one of the main characteristics in bulimia nervosa. However, central nervous system problems and some other psychiatric disorders can cause binging but they will not cause concerns about body weight like in bulimia⁽¹⁴⁾. As it was mentioned before, although binging is common in both bulimia nervosa and binge eating disorder, they are different types of eating disorders and they have different symptoms. While binge eating disorder concerns obesity and the condition of being overweight, the case for bulimia nervosa is more about purging, using laxatives and body weight⁽¹⁴⁾.

As there are many different theories about the complexity and nature of eating disorders, there are also different types of treatment. Prescribed therapies and treatment style may change according to the clinic and how the clinic interprets eating disorders. Moreover, the severity of the disorder can affect the type and degree of the treatment. Current treatment of eating disorders is applicable as a combined model, since eating disorders are not caused by a single factor⁽²¹⁾. As there are special eating disorder clinics, there are also eating disorder units in hospitals, generally connected to psychiatry branch. Some therapies used for treatment of eating disorders are: Psychotherapy, cognitive behavioral therapy, nutritional therapy, rehabilitation, medication, art therapy, group and single therapy, family therapy, movement and body awareness therapy, relaxation therapy, music therapy, ergo-therapy, psychoeducation, eating protocols, food diary etc.^(14, 18, 19). The table below shows the treatments which are being used in eating disorders, therefore it is apparent that there is not 'one size fits all' recommended treatment, but a diverse array of seemingly unrelated remedies⁽²⁹⁾. In the next paragraphs I will discuss in detail common therapies offered to sufferers of eating disorders, as it is important to give an overview of current treatment styles in order to find commonalities and differences between them. It is also crucial to be aware of all existing treatments to ensure any recommendations from this research do not cover the same ground.

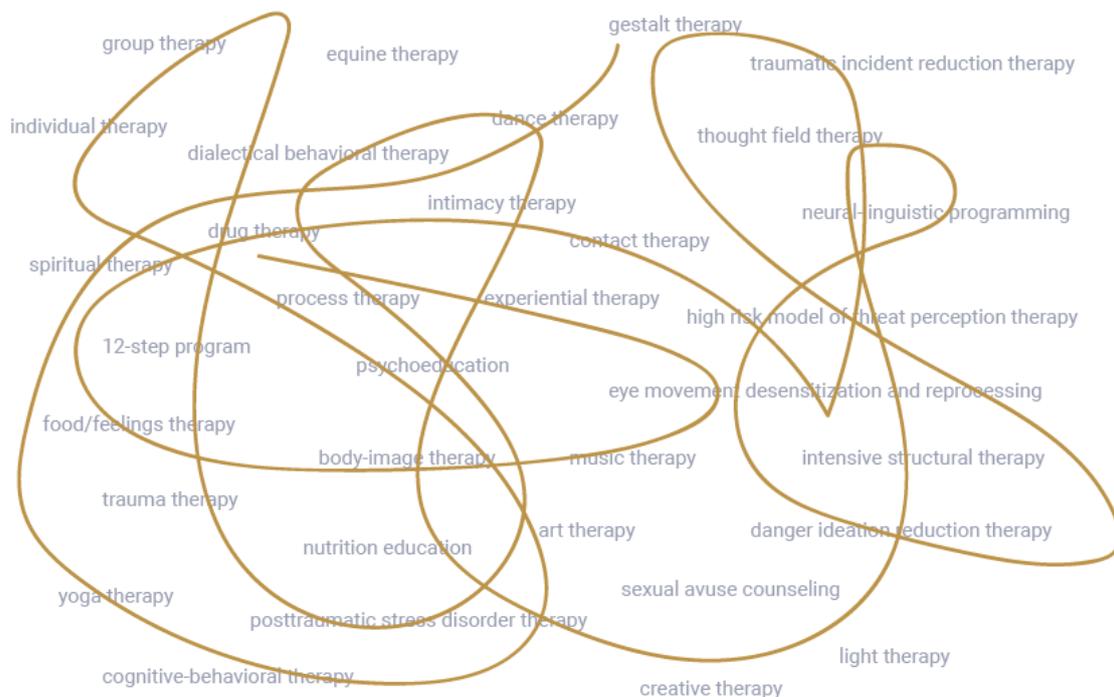


Figure 3.2 Various Treatments Used by Different Clinics⁽²⁹⁾

Hospitalisation is needed in some cases when; a person's weight is less than 75% of the recommended healthy weight, they are perseveringly rejecting food intake, they experience serious abnormal changes in body, suicidality, vital sign changes and body temperature problems⁽²⁰⁾. All those indications are related to severe eating disorder symptoms where the patients need an urgent intervention, otherwise there is a mortality risk. In vital cases where patients reject eating at all, a nasogastric tube is used to feed anorexic people which sends nourishment directly into their stomach⁽²¹⁾.

Nutritional therapy aims to regain a patient's weight in a controlled way by increasing the level of food intake via meal planning, as well as supplementing with vitamin and minerals⁽¹⁴⁾. Patients get support to fix their relationship with food via nutritional therapy and they can openly express their feelings in the clinic with other eating disorder patients with whom they can better relate. It also includes; nutritional education, keeping a diary about food and related feelings, measuring of weight and having a meal under predefined circumstances⁽¹⁸⁾.

Patients are recommended a mix of individually tailored support and group sessions to encourage fast recovery. **Individual and group therapies** are commonly given in eating disorder clinics. The patient's progress, their individual problems and their food protocols are discussed in individual therapy between the patient and therapist⁽¹⁸⁾. In group therapies, patients gather together in the guidance of the therapist and discuss various topics including sharing their feelings, telling stories and giving feedback on treatment effectiveness⁽¹⁸⁾. All of these strategies focus on providing emotional support as opposed to traditional prescriptive medicine. This is due to the fact that their daily life is affected by their disorder in a negative way. Sharing common feelings with other eating disorder sufferers could be a fundamental emotional support.

Art and music therapy includes creative painting, working with clay, doing handicrafts and playing music games or rhythmic drums⁽¹⁸⁾. This therapy can help patients to calm down, relieve anxiety and reduce stress thanks to the psychological effect of arts and music on people. Other therapies that help people to reduce the stress are relaxation therapy, body exercises, warm swimming and cultural visits⁽¹⁸⁾.

As it was mentioned before, psychological comorbidities for eating disorders are frequent. Therefore, psychological treatments are common either as a supportive treatment or the main treatment depending on interpretation of the specialist. Preferred types of psychological treatments for eating disorders are psychotherapy and cognitive behavioral therapy. The treatment style depends on the type of the eating disorder and its severity.

Generally the first attempt to treat bulimia nervosa, **cognitive-behavioral therapy** focuses on regaining lost weight or stopping bingeing, purging, restoring the distorted perception of body image and developing self-esteem⁽²¹⁾. Patients are encouraged, with the guidance of a therapist, to self-analyse as a method of revealing their psychological issues; they also record and monitor their food intake and emotional state⁽²¹⁾. Cognitive behavioral therapy is a psychiatric therapy, therefore it is used for treating psychiatric disorders. Since eating disorders are considered as mental disorders, cognitive behavioral therapy approaches eating disorders as cognitive disorders. According to the interpretation of cognitive behavioral therapy, low self-esteem is the primary reason to maintain an eating disorder, however low self-esteem could be related to many other aspects of the patient's personal history; the argument is not specific enough⁽¹⁹⁾. Even though the statistics about cognitive-behavioral therapy for eating disorders show success with remission of nearly half of patients, the conducted research has some unclear points regarding: Selection of the control group selection, relapses and follow ups etc.⁽¹⁹⁾.

Interpersonal psychotherapy for eating disorders resolves patient symptoms stemming from interpersonal issues; some of those symptoms include: Social withdrawal, low self-esteem and problems with relationships with other people⁽²²⁾. This therapy assumes that the patients with eating disorders are generally escaping from another problem in their life and see the food obsession as a reaction to undesirable personal issues⁽²¹⁾. Interpersonal psychotherapy for eating disorders is similar to interpersonal psychotherapy for depression and it considers that eating disorders are caused by psychological problems of the person⁽²²⁾. However, studies show that interpersonal psychotherapy is not effective to treat anorexia nervosa, it is an alternative to cognitive behavioral therapy for bulimia nervosa but it takes longer to affect⁽²²⁾.

Pharmacotherapy is very limited in its range and availability to patients; and there is currently no dedicated medication for eating disorders, however pharmaceutical drugs are used to treat symptoms caused by comorbidities such as anxiety and depression⁽²¹⁾. Medication for depression and anxiety is more effective for bulimia than anorexia⁽¹⁴⁾.

Family therapy shows success for the treatment of anorexia nervosa in adolescent and children; couple therapy can also be useful for parents with a child experiencing an eating disorder to keep the family strong^(14, 21). Family therapy revolves around discussions with parents to find possible solutions to their child's eating and identity problems, often highlighting family attitudes, intentions and behaviours⁽¹⁴⁾. Contradictorily, when family psychosocial problems are mostly solved, eating disorders are not resolved⁽¹⁴⁾.

Living in the information age means that there are many online platforms readily available with information about treatment of eating disorders. Some treatments can even be delivered over the internet with systematic self-help materials; they are generally cheaper compared with traditional treatment methods, they are also more accessible than the limited number of eating disorder clinics⁽²³⁾. As a relatively new treatment delivery style, guided self-help over the internet is suggested to bulimia nervosa patients, depending on the severity of their illness; this treatment usually consist of cognitive behavioral therapy via internet platforms with additional e-mail support by a psychologist⁽²³⁾. According to a study, internet delivered 'guided' or 'unguided' **self-help methods** were successful in reducing the number of bingeing and purging; approximately 40% of patients went into remission within four months with a 25% drop-out rate⁽²³⁾.

A distinctive obstacle to curing eating disorders is the recurrence of the disorder after recovery. According to a study, which analysed data from multiple other studies has been done on the subject, it discovered that the average relapse rate for the eating disorders is 31% and the first year after recovery has the highest risk for recurrence⁽³⁰⁾. When the success rate of the treatment is already arguably low, the relapse rate makes it even more challenging.

A long-term study over 25 years shows that 45% of the patients went into full recovery

from bulimia nervosa, 27% improved and 23% had a chronic case⁽²⁴⁾. Another study states that only 47% of patients went into full recovery from anorexia nervosa, 34% improved, and 21% had a chronic case⁽²⁵⁾. The average duration of the disorder is 6 years, and as it can be seen that only nearly half of the patients fully recover; therefore if we look at eating disorders as compared to some other well-known disorders, the life quality of eating disorder patients is as low as a person who has a severe depression or chronic heart complications^(26,27). Eating disorders are fully curable, however only a third of the patients receive treatment and there are many patients who remain undetected^(6,27). With the abundance of treatment types and differing interpretations of mechanisms of eating disorders, no one single treatment module has been proven to be the most effective⁽²⁸⁾. This situation is not ideal, especially when considering the high mortality rate of eating disorders, therefore it is apparent that the efficacy of the general current approach to eating disorders is questionable and a new approach might offer better results.

3.1.2.1 An Interview with Caro Holler about the Treatment of Eating Disorders

To gain a better understanding of how the clinic functions and delivers treatment to eating disorder patients, I chose to speak with a specialist, Caro Holler, who worked with eating disorder patients. She worked in a psychiatry clinic specialised for kids and teenagers in Linz, Austria for three years as a psychiatric nurse. She communicated to me that her patients were 95% female between 12 and 17 years old and her job was to analyse their behaviour, to help organise daily routine in the clinic, to assist doctors and to help with medication and infusion.

She said that the treatment process started with measuring patients weight without clothes and they had to go to the toilet before measuring. She continued "On their first days they had to try to eat as much as they could, later they had to eat all what they got and if they can not finish their food, they had to compensate what they did not eat with a caramel drink. We made a diagram with a red line in what time they had to get their goal weight, so it was constantly rising. The own actual line they had was blue. Weighing days were on Monday, Wednesday and Saturday morning. If the blue line was under the red line, the kids had to stay in their room, even in their bed, without doing sport or any movement till the next time of weighing. They cried a lot if they could not get the red line." The kind of

therapies given in the clinic was ergotherapy, psychotherapy, medication and also social therapies like cooking together, playing, painting and dog therapy. **She finds painting, leisure therapies and having walks in the nature beneficial since the patients do not have to think about their eating disorder.** It could be understood that the punishment approach was loading a significant amount of stress on kids, even though it was the part of the treatment of a supposedly mental disorder. On the other hand, the activities like art therapy and relaxation methods which diverts their attention are beneficial for them, especially when contrasted to the gloomy environment of the clinic.

She mentioned that in serious cases some patients needed to get parenteral nutrition. She describes that situation as "I even have seen a girl not eating anything, like committing suicide. She was always taken here for parenteral nutrition. In those cases we do not let them decide on anything. This girl got tied down with 5 point belts to be nourished. A judge person had to come to control if we are in the right to do that for saving her life." This harrowing scene serves as a vivid example of how traumatic this final treatment can be on patients when all other treatments have been proven ineffective. It also highlights the importance of early intervention or early diagnosis.

I asked about the recovery and relapse rate of eating disorder patients that she had observed during her time at the clinic and she said "The recovery rate was very low. In those three years I have seen the same people again and again, and their stationary therapy sometimes took 2-3 months, and then they had to be in ambulant therapy for a very long time. **From 50 ED patients I maybe have seen less than 10 not coming back to stationary therapy.**" She mentioned that in her experience the relapse rate was around 80%, which is considerably higher than the average statistics. However, all of these observations only account for a very small sample size and are most useful when seeking qualitative data points.

Patients had 20 minutes to eat their meal and if the time was up, they had to drink a caramel drink equal to the caloric amount of food that they did not consume. She also added **"After some time being stationary, they were allowed to take their own portion, they should get a feeling of how much is one portion."** She describes how they usually ate

extremely slowly when beginning to consume the meal but as the clock ran down they would speed up to be on time. This eating behavior clearly demonstrates how these patients struggle to consume meals in a normal fashion without strict supervision. If the treatment is going as planned the patient will have, through repeated eating exercises, relearned what a correct portion size looks like.

Responding to my question, she described the relationship between food and anorexic patients as “They were stuck in their thoughts and guilty conscience, they suffered a lot. They knew every kcal of every food and they counted everything. **They had no joy with food and couldn't feel hunger, or hunger was a joy.**” Furthermore, she adds to explain how patients were trying to trick them about their appetite or weight “I have seen a lot of tricks. Putting weights in their hair when they bent them together, putting stuff in their bra or underwear, drinking 2 liters of water before their weight was measured and not going to toilette. While eating, they hide food in their bags or their trousers not to eat it. In their time, they had to be in bed for a whole day, they were cheating with doing a lot of sport if we did not watch them.” These stories show a level of emotional fragility and cunning deceptiveness that is common in many patients who have been institutionalised due to chemical addictions. Unfortunately the horrific nature of this disorder is not fully appreciated by the general public unlike other addictions which have an abundance of pop-culture fiction and exposés revealing the inner workings and seriousness of addiction.

“A very interesting pattern to see on them was that they had similar properties. Most of them were very good pupils in school, only the best grades. **They were very ambitious and strict to themselves.** They had a weird sight of their future.” An interesting anecdote, perhaps hinting at some deeper driving condition that links the ambitious nature and the tendency to develop eating disorder. Ambition and eating disorders are both related to rewards mechanisms and perhaps this is the linking factor.

She also said that “Preventive interventions have to start at home. My own conclusion was that the topic of food was too big, kids couldn't even think of anything else other than eating and food, because it became a very big problem for the whole family.” She thinks that the eating disorder patients felt they had to be special for someone or for themselves.

She mentioned as a conclusion that “Of all psychiatric illnesses I have seen that someone can have as a kid or teenagers, ED is the most terrifying one. It is quite firmly set. ED patients live kind of in their own world, their minds and thinking is depressing, they suffer because of giving themselves strict rules in life. ED patients don’t laugh a lot, I haven’t seen joy in their eyes.” It is a very dramatic depiction of life of an eating disorder sufferer, yet it is true.

After I talked to Caro, it made me realise that life with an eating disorder is nothing less than a nightmare. Although I had a determined idea about eating disorders thanks to my publications search, I was still lacking the qualitative point of view to be able to imagine the complicated mentality of a person who has an eating disorder. The clinic she was working at was a psychiatry clinic, therefore it could accurately be said that eating disorders were approached as a mental disorder. Included in their psychiatric therapies were a behavioral section of therapies, from the interview the therapy consisted of regimes such as portion and eating time control.

One additional insight relates to the fact that the eating disorder patients at Caro’s clinic were classified as children. This is important to consider when thinking about the many strict and painful procedures and treatments which would be even tough for an adult to bear. Equally important is the realisation that as children those patients would not have the same self-determination as an adult would. An adult would have the power to leave the clinic if they chose to do, but a minor would be confined there against their will as the decision would be in the hands of their guardian or doctor.

Caro reported that after all the rigorous treatments and hard work of all the healthcare professionals the relapse rate was still very high at her clinic. It makes one wonder if at any point the efficacy and whole methodology of the clinic was ever questioned seriously. The high difference between the relapse rate in this particular clinic compared with similar clinics (Caro’s clinic was approximately 30% higher) hopefully as Caro clinic’s performance was well below average you would expect, on closer inspection, to find other clinics well above the average with much better relapse rates.

The input that Caro gave me was invaluable, a provided a first hand account of the conditions experienced day to day by patients. The stories she told imparted the tremendous suffering of the patients and their families. This gave me the correct sense of gravity and the sensitivity that would be required to even consider designing a system or product to help these patients. The other main lesson learned from my talk with Caro was that I wanted to explore non-traditional treatment methods as a beginning point to develop concepts.

3.1.2.2 An Alternative Way To Treat Eating Disorders: Mandometer Treatment

Treatment for the eating disorders takes long time and is hard to achieve with traditional treatment methods. When the recovery rate is low and mortality risk is high, there has been new researches and different approaches to treat eating disorders. A treatment called Mandometer method has been developed in Karolinska Institutet in Sweden. Mandometer treatment considers eating disorders as same kind of behavioral disorders and so that patients learn to eat normally and feel satiety again using a device which gives feedback called Mandometer⁽²⁹⁾. It focuses on normalising the eating behavior of the patients without cognitive therapy or psychotherapy and once the eating behavior is normalised, patients do not feel rewarded due to eating less or bingeing and purging⁽²⁹⁾. It is also claimed that the psychiatric symptoms starts to disappear when eating pattern is normalised⁽²⁹⁾.

Unlike traditional treatment methods, the focus of mandometer treatment is interventions on eating behavior. Patients try to relearn normal eating behavior with practicing how much food and how fast they should eat, as well as how satiated they should feel during the meal⁽¹⁹⁾. This feedback system ensures patients to follow up their eating pattern and adapt to the normal eating pattern.



Figure 3.3 Mandometer Device. Resource: <https://mando.se/en/mandometer-method/the-mandometer-device/>

Mandometer device is a scale which can be connected to the smartphone via bluetooth⁽²⁹⁾. Patients place their plates on the scale which gives mealtime feedback. Thanks to the screen, patients are able to see a graph which shows their eating speed and amount, and on the same screen they can also see an healthy person's eating speed and amount values to compare with themselves⁽²⁹⁾. In the beginning of the treatment, a behavioral therapist guides patients, but later on patients are easily able to use it by themselves⁽²⁹⁾. Additionally, it is paid attention for patients to be kept warm with high room temperature, blankets or jackets and their physical activity is limited⁽²⁹⁾. The pictures regarding to the mandometer device could be seen below.

The study has been done with 1428 patients who had anorexia, bulimia and binge eating disorders between 1993 and 2001 at six clinics in Sweden, Holland, Australia and the United States⁽²⁹⁾. The results were very satisfying. Averagely 75% of the patients went into full recovery in a year, only 10% of the patients relapsed and there was no death⁽²⁹⁾. The recovery rate with mandometer treatment is much higher than the recovery rate with traditional treatment methods. As well as the relapse rate is also very low with the patients who was treated with mandometer method. The striking success of mandometer treatment method is path-breaking. It shows us questioning the current problematic situation from a different viewpoint could change the result markedly.

In my interview with one of the founder of Mandometer clinics and researcher of Mandometer treatment, Per Södersten answered my question about that if patients continue to use the mandometer by themselves after recovery. He said the patients don't use the mandometer device after they get into remission and added "but my suspicion they probably should use mandometer for a long time. We have not researched this, eating disorder patients don't use the manometer after they have gone into remission and they are followed up for 5 years. In clinic, eating disorder people use mandometer 3 to 4 months, and they are in the environment that they can socially engage with other ED patients."

Per Södersten also explained that except than the mandometer treatment, they give patients motivational talks and encourage them to provide emotional support. He adds "**What we do is we set up goals and once they reach the goals, they get a reward. But this**

is really standard care which anyone can do. This goal could be even very trivial. This is behavioral principle.” He refers here how dieting affects the brain’s reward mechanism and could cause an eating disorder. This and the other details of my interview with Per Södersten will be discussed detailly later on. Mandometer method tackles eating disorders from the point of behavioral approach without psychiatric interventions. Yet simple but effective mandometer method has become my main inspiration for my thesis.

3.1.3 Causes

Eating disorders are very complex disorders which do not have a standardized treatment. For a more extended comprehension of eating disorders, the causes will be reviewed and discussed with the help of publication research and subject matter expert interview. There are different arguments to compare when the matter is causes of eating disorders. Although there are a lot of researches have been done in possible causes of eating disorders, they have failed to prove main risk factors for eating disorders, as well as they couldn’t figure out the relation between different risk factors⁽³⁾.

Eating disorders have been recognized as mental disorders, therefore most of the treatment methods were focused on treating mental illness symptoms. However, there are other arguments nowadays and the number of predicted risk factors are increasing. It has been claimed that there are evidences on biological, psychological, developmental, and sociocultural causes for the occurrence of eating disorders and it is not decisive⁽³⁾.

3.1.3.1 Psychological

Most of the available treatment options for eating disorders are to treat psychiatric symptoms of eating disorders, for example cognitive-behavioral therapy and psychotherapy as it was mentioned while explaining treatment types. Psychiatric treatment considers the cause of eating disorders as psychological, such as body-image perception and personality traits. Therefore, it sees the reason of developing an eating disorder as a result of psychological problems.

Lack of self-esteem is shown as one of the main psychological trigger for eating disorders and body satisfaction is considered to be the major element of self-esteem⁽³⁾. Ideal body

types may change according to the culture, nation and era. However, people compare their body with the ideal type of body of their culture or popular culture where they see TV people whom are mostly thin and fit models and actors. This comparison might generate body dissatisfaction⁽³⁾. Although there is a study which found out that college women who had an eating disorder had body dissatisfaction and public self consciousness⁽³⁾. Data was collected after occurrence of the eating disorder so it could be related with the worsening the eating behavior⁽³⁾. It seems that there might be a relation between eating disorders and lack of self-esteem but it is not clear if an eating disorder starts due to lack of self-esteem or body-image problems.

Other factor associated with eating disorders is personality disorder. Some of the studies have found that personal traits like perfectionism, seeking novelty, impulsivity, harm avoidance, stress reactivity are prevalent in eating disorder patients⁽³⁾. However, in those studies, personal traits were assessed in eating disorder patients after their illness developed⁽³⁾. Although eating disorder sufferers may have personality disorders, it could also an effect of starvation on human psychology⁽³¹⁾. A study shows that if a person starve and binge and purge repeatedly, it is possible that those previously healthy people might develop anxiety, isolation from social life and high sensitivity after a few weeks food cut⁽³²⁾. Obviously there is an ongoing confusion which affects treatment methods and diagnosis about eating disorders and psychological problems.

3.1.3.2 Social/Environmental

Social and environmental factors on development of eating disorders are correlated to body dissatisfaction, therefore to psychological risk factors which were mentioned before. Western culture praises skinny body for women, so that it affects many people's self assessment about their body and causes dissatisfaction. As western culture is popular around the world under favour of mass media or increased number of visits to western countries, it is believed that it has a role on development of eating disorders⁽³⁾. However, this argument does not stand strong, although it could affect body dissatisfaction.

On the contrary, eating disorders are also common in Asia and Asian patients are not mentioning their weight when they talk about their illness⁽³³⁾. Social pressure and cultural

beauty standards could have a role on body dissatisfaction and this could lead the person to go on a diet which is known as the major risk factor of developing an eating disorder. In this case, social pressure might have an indirect impact on developing an eating disorder.

3.1.3.3 Biological

A currently popular claim for a significant risk factor for eating disorders is genetic factors. It is claimed that some people with a certain kind of genetic feature react differently to the hunger⁽³³⁾. The effect of feeling hungry shows itself as annoyance of search for food, but this is kept until we are full. When we start to feel satiety, the irritating feeling of hunger starts to disappear in most of the people. However, some people feel anxious and unrelaxed through the whole process from hunger to satiety and when they limit their food intake, they feel calm and satisfied⁽³³⁾.

Other supporting study has been done in twins shows that averagely 40% percent of the monozygotic twins with threshold are both sharing the eating disorder while none of the dizygotic twins were sharing⁽³⁾. Monozygotic twins share 100% of their genetic code while dizygotic twins share 50%. Therefore, the regarding theory draws the attention to the commonality in prevalence of eating disorders in monozygotic twins where the same case does not apply to dizygotic twins. The effect of living in the same or similar environment, the time spent together and growing up with the same parents is unknown.

3.1.3.4 Behavioral and Neurobiological

The other theory claims that the eating disorders are not mental illnesses, but behavioral illnesses which affects person's physiology and later on psychology due to the effects of starvation (fasting, dieting, purging, excessive exercise). As it was stated that the main risk factor for losing the control on eating habit and body weight is dieting⁽³⁴⁾. When people are able to continue on their diet which is a restriction on food intake, they are likely to develop anorexia; on the other hand the ones who can not continue their diet, fail and binge, may develop bulimia or binge eating disorder⁽³⁴⁾. That same starting point may end up developing different kind of eating disorders, which might mean eating disorders are different exposition of the same disorder, in contrast to the general opinion.

An experiment where the food was restricted has been done on **mice and rats**. They showed very similar symptoms to anorexic patients, as they started to increase their physical activity and reduced their food intake until they lose a considerable amount of body weight and some died just like anorexic humans⁽³⁵⁾. Furthermore, it is claimed that the eating disorder symptoms can be treated by normalising eating habit, keeping patients warm and limiting the physical activity⁽²⁹⁾. Keeping them warm aims to relaxation and decrease of the physical activity which is commonly seen in anorexia nervosa patients. This is what mandometer treatment clinics are providing to their patients as it was mentioned in previously.

Right after the second world war, scientists did a clinical study to explore physiological and psychological effects of severe and continuous restricted food intake, as well as the recovery of that semi-starvation period in Minnesota University, which is known as **Minnesota starvation experiment**⁽³²⁾. According to this study, the starvation on healthy man effects the psychological health, and both anorexic patients and starving people show the same mental health symptoms⁽²⁹⁾. The findings of the study shows that there are similarities on symptoms of anorexia and starvation, moreover psychological problems appear on both in a similar way. In the study, when food intake is normalised psychiatric symptoms started to disappear⁽²⁹⁾. Therefore, it is likely that same situation could be applicable for eating disorders.

Studies show that **dieting** or restricting food intake increases the dopamine release and activates the **reward system** in brain so that people feel rewarded to eat less and less food and it is the initial reason to develop eating disorders⁽³⁴⁾. Brain's system for attention causes cue conditioning to the reward which was created by disordered eating behavior⁽¹⁹⁾. And in the end of this chain, eating behavior changes. Sadly, half of the teenage girls and one third of the teenage boys are dieting at any given time⁽³⁸⁾.

According to the studies, women are much more likely to develop eating disorders than man, in which 90% of the eating disorder cases are women and only 10% are men⁽³⁶⁾. However, there is no major difference in anxiety or related disorders between male and female⁽²⁹⁾. The reason of **high percentage of prevalence in women** is because women

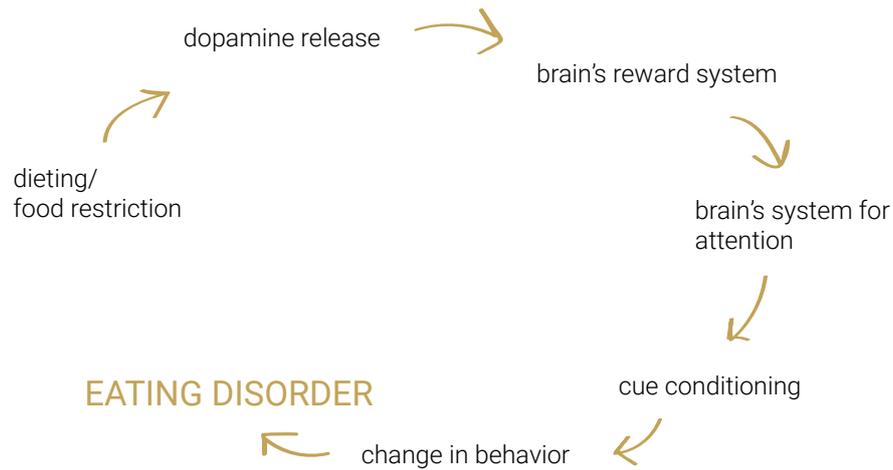


Figure 3.4 Neurobiological Cycle of Eating Disorders

and men don't respond the same to skipping a meal. Men eats more the next day when they skip a meal, whereas women eat less the next day⁽²⁹⁾. Which means, restricted food intake affects differently men and women and makes women more sensitive to dieting as well as eating disorders. However, the response of the women to restricted food intake could also be seen as a response to adapt the situations when the food is limited, which is always a risk for survival of humans⁽¹⁹⁾. Therefore, human homeostasis which was needed in ancient times is still the case today since evolution is very slow compared to the changes in our lives in the last 10.000 years. Finding food was a challenge for humans in ancient times when they had low body weight but high physical activity in daily basis, therefore human body evolved to adapt to starvation, as well as eating large amount of food at once is possible for humans⁽⁴⁰⁾. Binging is explainable from the perspective of evolution.

Approximately 90% of the adolescents who have an eating disorder are members of a fitness center⁽³⁷⁾. One of the symptoms of anorexia is **increased physical activity** which is seen in humans as well as rats when the food is restricted⁽²⁹⁾. This behavior which makes the eating disorder more severe could alternatively be explained with the loss of surface area of the body and suppressed body metabolism⁽²⁹⁾. People with anorexia can not regulate their body temperature and this could be the reaction of thermoregulation mechanism of the body to increase the body temperature⁽²⁹⁾. If the patients are kept in warm rooms, they will stop increased physical activity⁽²⁹⁾.

Eating speed of a person who has a healthy eating behavior is changing during the meal.

In the beginning it is relatively fast and it is getting slower through the meal, which this pattern is called decelerated eating pattern⁽³⁹⁾. However, there are other people whom eating speed don't change and stays the same through the meal and this is called linear eating pattern⁽³⁹⁾. People at risk of eating disorder or people who have an abnormal eating behavior could be distinguished if their eating pattern is linear, because eating disorder patients do not have decelerated eating pattern⁽³⁹⁾. Bulimia nervosa patients might even have accelerated eating pattern whereas anorexia nervosa patients have linear eating pattern⁽¹⁹⁾. In mandometer treatment method which was mentioned previously, the amount of food patients eat is not changing drastically, but the initial rate of eating is changing and their eating behavior becomes decelerated⁽¹⁹⁾. The eating pattern is firstly focused to normalise eating behavior, not the amount of food. This approach could affect the first reaction of the patients to treatment considering eating disorder patients' psychological state.

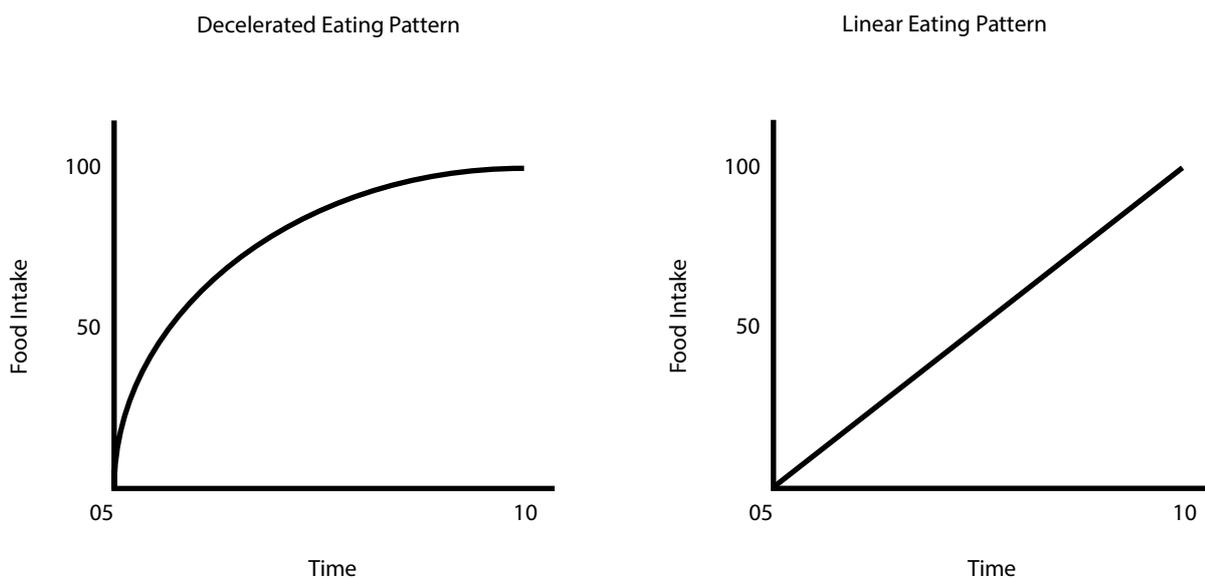


Figure 3.5 Decelerated and Linear Eating Pattern. (Zandian et al. *Physiol Behav*, 2008)

Interview with Per Södersten (Founder, Director of Research & Development and Director, AB Mando, Karolinska Institute)

Per Södersten, Professor of Behavioural Neuroendocrinology the Department of Neurobiology, Care Sciences and Society, as well as one of the creator of Mandometer method which was mentioned previously as one of the treatment methods for eating disorders, agreed to answer my questions about eating disorders.

As Mandometer treatment acknowledges that eating disorders are not mental illnesses. I asked how does he describe eating disorders in that case and his answer was "Eating disorders are a matter of change in eating behavior, however in most healthcare systems they are defined as mental disorders. Eating disorders are associated with mental effects and therefore they are confused with mental disorders. There was a time when once thought that eating disorders are not specific disorders but just a part of an anxiety disorder. So, you didn't need a specific diagnosis, they were anxiety disorders. That's all wrong because if you look at eating behavior and how eating behavior changes, it is always associated with mental/psychological change. That is not by coincidence, because this is as follows. **If you look at human biology, it has evolved to tolerate starvation. Because starvation is the main threat in human evolution.** Today, about eight hundred million people are starving, and all elements all over the world are concerned with finding food. The main force in evolution has been the search for food. Therefore our biology is designed to search for food and to tolerate starvation. Now if you take food away from human, you will find changes in eating behavior. These changes rapidly evolve into behavior that looks like the behavior of an anorexic patient. Now that easy change in eating behavior is associated with a gradual change in psychology. If you starve for a long while, you get depressed, anxious and completely occupied with the idea of food. So this **mental change is a consequence of a change in eating behavior.** Change in eating behavior is a consequence of the starvation and the mental change is obvious and is often to the advantage of the individual. If you were not anxious when you had no food, then there is no chance to survive in evolution. In Minnesota starvation experiment that has been done after the second world war, there are videos of the people who participated. Those people were completely healthy people, they had no problem. When they ate less food, all the mental problems evolved as a consequence of the starving condition. In fact they will develop anorexia nervosa and they had never been ill. All of the mental phenomenon are effects of the state of the patient and can be controlled by eating behavior. Psychiatrists say it is the other way around, you have a mental problem to start with and then you get an eating disorder. That's a very old idea, it's never been proved right. "

Here Mr. Södersten explained why eating disorders are always confused with psychological comorbidities and the effects of evolution on our eating behavior. Eating is our main

daily activity which our body requires to produce energy. When our eating behavior is distorted, it understandably starts to affect our psychological state due to our evolutionary background. As a reaction, anxiety arises to make us search for food to survive. Same kind of symptoms has been observed with the people who participated to Minnesota starvation experiment as Mr. Södersten referred. It is a strong argument which pieces fit together.

Some people argue that eating disorders might be caused by genetic factors and eating disorders are genetic disorders. This might mean some of us tend to get an eating disorder more than others. When I asked Mr. Södersten about this, he explained as "Obviously, it is not possible to do anything unless you have genetics. The way behavioral genetics works out was figured out by Seymour Benzer who is the first man who studied the genetics of behavior in California Institute of Technology. He says that all behavior is a product of the environment and genes and there is no other explanation. You do not do anything because you are exposed to something in the environment unless you have the genes that are required. There are hundreds of genes that are evolved in body weight regulation and that's obvious because eating is the most important trait in history. All life has been dominated by eating. Therefore, there are not some genes, in fact hundreds of genes and each one contributes a little bit. This is true for all complicated human traits like cardiovascular, sight, height etc. There is a paper last year suggesting that all genes are correlated body weight, all of them to a certain extend and no one contributes more than little bit. What about the genetics of eating disorders, first they thought there was a gene that causes the anxiety, OCD and anorexia, and that failed. Now they believe there is a gene that causes ADHD and anorexia, that also failed. The reason is the misunderstanding of the genetics of eating disorders and generally misunderstanding of the place of genetics in psychiatric diagnoses. Bulimia, anorexia, binge eating, obesity are not traits. All eating disorders are inherent. Patients can go from anorexia to bulimia or the other way. Hilde Bruce was interested in obese patients, she had researched some obese people dieting and they developed anorexia. The cause for all these problems is dieting and obesity, bulimia, anorexia are different expressions of the same problem and lots of genes involved. There will never be genetics of anorexia. And how could you possibly come up with drugs if there are hundred genes involved." Here Mr. Södersten highlights other important point about eating disorders. The most common knowledge is that eating disorders are different than

each other and each of them require different kind of treatment. According to him, they are all different versions of the same disorder which is disordered eating behavior and they can be treated in the same way which is normalising eating behavior. Moreover, he also explains why there is no special drug for eating disorders. The reason is that eating disorders are not related to a specific gene set.

When I asked what does he think affects the signal of hunger and satiety in people with eating disorders because he mentioned in his article that linear eaters eat less food but perceive high level satiety. He said "We researched that very carefully 20 years ago. There was an experiment on animals. If you take food away, you get upregulation in peptides in the brain. If you take normal rat with one of these peptides, they will eat more. And that peptide is upregulation of the food removal, then the rat will not feel full, it will search for food and collect food. This peptide in the brain has a role in behavior change as you change the environment. And all those peptides, their main function is aiming the search for food. There was an accidental change in an animal's peptides in the brain and what you got that they were not eating but searching for food. They weren't eating because of an upregulation in the brain but they were searching, searching for food and collect food and save them for tomorrow, because starvation is coming up. In evolution, this has not changed, so the role of these peptides in human biology has not changed. The brain has designed to have us eat as much as we can when we get the chance. That's normal because in history we were starving. If you look at the aborigines in Australia, they used to be thin and when they get the chance, they could eat very large amounts at once. However, they did not get fat but they were chasing for food all the time."

People with eating disorders generally think that eating disorder is a mental illness but Per Södersten's research team and Mandometer treatment method claim that it is not. What Per Södersten thinks about that could be understood by his words "We had now several thousand patients and each one and their parents who came to us said, there must be a psychological problem. This comes by default and the reason is the design of the human mind. Human and children in particular, always think that there is an intention for what happens to them. They believe things happen for a purpose and people act for purpose and that purpose is always mental. So this is into our genetics, this has been described by

Paul Bloom, he has some excellent lectures in which he describes how the human mind develops. And he will argue the humans are born dualist, they believe in mental intentionality. This is why every patient comes to us and all the parents say there must be something psychological and this goes on and on and on. Each time a patient comes, we need to explain this and when we say them there is nothing wrong with you, they are relaxed. Who would like to hear that they have a mental problem.” Here he explains why do patients think that there is something wrong with their mental health. Supposedly, psychological comorbidities and the available information online or in written sources about eating disorders leads them to think in that way.

As a result of my talk with Per Södersten, I had a plausible understanding about the mechanism of eating disorders. He approaches eating disorders from a different perspective which can explain uncanny points of the disorder in terms of behaviorism and evolution. He considers eating disorders as a behavioral disorder which can be treated by teaching the person healthy behavior again. The area which deals with this issue is called behaviorism which is a scientific approach to analyse and comprehend behaviors of humans, as well as animals⁽⁴¹⁾. The main core of behaviorism could be summarised as that our behaviors are developed by environmental factors or the person`s past life with substitutive incidents of reward or punishment, as well as person`s intention and controlling stimuli⁽⁴¹⁾. Teaching a behavior includes conditioning the person with a punishment or reward to the desired behavior. It is important to understand behavioral psychology and behavioral evolution to comprehend Per Södersten`s approach. Mandometer treatment focuses on that principle, as well as providing a warm environment and emotional support to the patients. The success rate of treatment and consistency of the behavioral approach to explain the nature of eating disorders are great indicators to take my research through that direction.

4. Know People

To understand eating disorders and feelings of eating disorder patients, I have conducted couple of interviews with eating disorder patients.

4.1 Interview with Anna B.

Anna B. is 20 years old woman who recovered from an eating disorder. Her eating disorder started as anorexia when she was 16 years old and turned into bulimia nervosa. She had other eating disorder sufferers in her family.

She went through the doctors and tried talking to many different people which was mainly just asking questions and talking about her family life, eating habits. She recently invested into a hypnotherapy session to see if that would help at all. She thinks that treatment can only really be effective if you are treating to help yourself and sitting and talking to people who ask the same questions all the time can become very unmotivating and very tedious. As a self treatment she tried yoga, writing and opening up to her friends.

She believes her home life when she was a child was the main starting point, she grew up around a lot of arguing and she found it as a way to control. She adds "There was a point where food was my worst nightmare and I'd see it as the devil. I enjoy the feeling of being hungry at the start then I feel empty and unable to commit to any responsibilities." Her eating disorder affected her quality of life tremendously as it can be understood from her words.

She enjoys cooking but she tries not to cook because it involves buying amounts of the ingredients that she won't need all of for that one meal and with bulimia if the food is there, she will eat it all and then end up vomiting, she says. She used to trick herself into feeling full with chewing gum, diet coke or eating ice.

She enjoys seeing people eat more than her and has given people food of hers to be sure that they eat more. She tries to eat slowly as possible. She says that she eats with small spoons and small plates. She prefers to eat alone but if she is eating at home she is more likely to binge because she feels comfortable there. However, she also tries to eat as minimal as possible when eating out because she tries to avoid getting sick in public.

As a conclusion she says "Eating disorders are different for every person. For me it was all about control and it was just my body's way of trying to fix my problems. **My bulimia started because when I started to eat again, I realised how hungry I was so my body goes into survival mode and tries to eat as much as possible because it knows that it won't get food again for a while.**" Here she explains her body's reaction after she starved herself. Her explanation corresponds with what Per Södersten pointed out about body's reaction to starvation, tolerance to lack of food and ability to eat large amounts at once if the body thinks starvation is the forthcoming danger.

The fact that Anna's eating disorder shifted from anorexia to bulimia supports the idea of that eating disorders are different versions of the same disorder and they can shift from one to another. Although there are people with eating disorders in her family, this is not enough evidence to claim that her eating disorder is caused by her genetics. Since eating disorders are closely related with our behaviors, environmental factors could have major effects in disordered behaviors.

As most of eating disorder patients, she also believes that her disorder is psychological and comes from her childhood problems. She tries to avoid food related activities like shopping and cooking due to her fear of bingeing and purging. This shows her effort to control her disorder although it is not a solution. Her sensitivity or obsession about food and eating affects her social life that she can not avoid paying too much attention other people's eating. Then she adjusts her eating speed and amount in the way she feels less awkward with other people. Eating with small plates and cutlery is an illusion to trick herself so that she will eat less but she will think she already had a full plate of meal. As a result, she is trying to deal with her disorder as much as she can. She developed some other behaviors along with her disordered eating behavior to adapt herself into social life.

However, finding the right kind of treatment could be more useful than learning how to live with a disorder.

4.2 Interview with Maria B.

Maria is 32 years old woman who is a bulimia sufferer. Her aunt and grandmother also suffered from an eating disorder. Her eating disorder started when she was 17 years old. She went through different kind of treatments. Initially medication, shortly after, the mixture of treatment psychotherapy and medication.

She said that she was treating herself using drugs to lose weight, researching online how to lose weight and suppress her appetite. She said "Everything from cocaine, asking doctors to prescribe me medications to reduce my appetite(amphetamines), taking caffeine pills, reading pro-ana blogs, etc. That was my "treatment" to reaching my goal. Once I got to being so miserable, I went to a doctor at the university I was attending for help. I saw various psychiatrists for over 8 years."

She thinks her disorder developed progressively. "Over the years, when I'm stressed, I compulsively need to reach for something." About her relationship with food she says "**I don't even like food.** I was once taking a medication and instead of food, I craved objects. I actually craved driving. I understand obese people so much. You just keep going, and going. **People who keep taking drugs think they can get higher by taking more and it's the same with food.** You think more will be better, but it isn't. It's worse. There's just no voice saying stop. The same thing happens for me with also alcohol."

She was trying to keep herself busy, trying not sitting still for example to stop herself to think about food or eating. She often pays attention how and what other people eat and feels very uncomfortable. When she is alone she eats very fast; with others, extremely slow. She adds "With others, I ensure I'm half as slow as the people I'm with." She prefers to eat alone and says "**I feel like I am being watched, judged if I am in public or in a restaurant that people are looking at my body and what I'm eating.** Even if I'm with a close friend, I prefer not to think about the fact that I'm eating. I prefer doing something

(e.g. reading and not being in a place focused on eating - such as a restaurant) while eating. Eating reminds me of my eating disorder. The less time I spend eating, the better.”

Although she tried medication and different kind of psychiatric therapies for a long while, it did not help her with the eating disorder. Her intervention of self treatment was just nurturing her obsession of her weight and body. She also thinks she has a psychiatric disorder and it is coming from her family. Considering her claim that she does not even like food and she had same kind of addictive behavior to other substances in different periods of her life, she has issues with self control and it might be about reward mechanism of brain. It also shows that eating disorders are not about loving or hating eating, it has a complex mechanism.

Like Anna, she has a socially awkward situation with eating outside or eating with other people due to being afraid of their judgments. Activities include eating seems to distract her so that it is hard to focus on something else than paying attention how other people eat. She adjusts her eating speed as slower than the person she is with. She is trying to keep herself busy to prevent obsessive thought about eating. Dealing with the eating disorder and suffering from it are the major daily activities for a patient, also for Maria.

4.3 Interview with Clara A.

Clara A. is a 22 years old woman who recently recovered from anorexia nervosa. She is the only one who has an eating disorder in her family. She says she knew that she always had trouble with food even when she was a child that she was growing a lot but not gaining any weight. She thinks it is coming from her childhood but it really hit her when she was 11-12 until last year. She says “That’s the time I started eating really good again, started getting at a healthy weight. Before that I was either anorexic or bulimic, I was never in a good relationship with food.” She describes her disorder’s shift from anorexia nervosa to bulimia nervosa like “I was like a few weeks not eating anything. I was only drinking ice tea all day long and that’s what make me go through the day. But after that for a few days, I was eating like crazy, emptying everything in the kitchen in a few hours to the point of

being sick. Mostly not puking, but just feeling really bad, too full and after that it was going back to anorexia again.”

Her shifts between anorexia and bulimia nervosa from time to time reminds Per Södersten's words about body's reaction to the period after starvation. When food is available again, the body which has been starved wants to and is able to eat large amount of food at once in case of the upcoming starvation period. On the other hand she feels rewarded when she starves herself. This inner conflict between her desire not to eat anything and her body's energy requirement to survive cause the shifts between anorexia and binge eating.

She had a treatment in a specialised eating disorders clinic in France and she was seeing a psychologist for a few years. She got hospitalized once because she was getting dangerously low-weighted. She got parenteral nutrition for a few weeks until she gets bigger stomach and being able to eat again. When I asked about what does she think that the most effective treatment she has got, she said that **the treatment didn't really help for her to recover**. She says “I should have stopped that and I needed to find a solution. **I changed my lifestyle and moved from where I was living. The moment that I met my ex boyfriend, he was very supportive on me, so it made me eat more. It was really the people were around me that helped me, not really a therapist.** Psychiatrist therapy can be a support, but it is not gonna fix your legs. You need the people that are around you to help you to create a good environment otherwise you are gonna get stuck in that.” She also made close friends with online eating disorder forums. She said that **they were sick together, they started to recover together and they did the same recovery pattern**. They supported each other and they were always talking to each other when any of them feels bad.

It can be seen how important the support from family and friends, changing the lifestyle, having a pleased environment and self dedication to recover. Clara had psychiatric treatment, but it did not really help her like in most of the eating disorder cases. Other supportive evidence to the argument is that she and her friends she met via an eating disorder platform experienced recovery together. They motivated each other and in a way they felt rewarded to be recovered instead of starving themselves.

According to Clara, she found different ways to help and motivate herself to eat more and win the battle against her eating disorder with support of people around her. One of the ways was trying to enjoy food more. As she explains "I knew that was the problem, I knew that if I wasn't enjoying what I was going to eat, I would not eat. I tried to eat only what I really like and enjoyed cooking again. That helped a lot and I know that it helped a lot of my friends that had the same problem. **Learning how to cook is helping you to go back to food.** In the beginning it was really disgusting that I was not eating anything, was only eating pasta and a little bit of chicken. Accepting more food, more kind of it is really helping. I was enjoying cooking but I was getting fed by the smell of it. In the end, my ex boyfriend kind of forced me to eat saying that I did not spend two hours in the kitchen for nothing. So, I started to eat." She said that she enjoys sweet food more than salty one and likes baking that she also enjoys watching.

Other ways that helped her to manage to eat again were smoking weed which makes her feel hungry and setting alarms to be reminded to eat otherwise she wouldn't remember she needs to eat. She says that she doesn't feel hungry but her stomach starts to itch so that she understands her stomach is empty. She also describes the hunger comes with smoking weed as false hunger which she also needs to be careful. If she smokes a lot, she might binge and that might cause her bulimia to start again. Other than that, she said that she smokes a little bit before she eats to feel better about eating. She has a daily schedule to eat and setting 7 or 8 alarms to eat small amounts. She eats as small portions so that she will not feel so guilty but eating during the whole day. She sees it as a way to train her stomach to eat again, since her stomach got smaller when she was not eating much.

As she does not feel hunger and satiety anymore, she developed her own methods to help herself to eat. It is remarkable that she is setting alarms to remember eating and she finds eating small portions during all day less annoying. In other words, she developed her own behavioral intervention to treat her eating disorder, since psychiatric therapies did not work. Interestingly, she also found a way to feel hungry which she describes as fake hunger. However, it made her to eat voluntarily.

She describes her relationship with food as an internal battle and she says "I was running

away from food. It was disgusting. I wanted to eat because my body was hungry. But there was a part of me saying that if you eat now, you are not the person that you are before. And you start to identify as a person who is sick. At some point, you just don't know how to identify yourself in another way than being the person who doesn't eat."

She said that she couldn't feel hunger and satiety after a while and also says "I stopped feeling hunger. I still have trouble with that. **I can stay for days without eating and without even realizing that I am not eating.** Even if my stomach hurts, I understand it as a good feeling of not eating anything for a long time. I think that's gonna stay like long time with me. Fullness is more like feeling heavy. When I was eating a lot, I was feeling awful. At some point I preferred not eating instead of feeling like that, it was way better."

She said that she was eating very fast since she was sick and she still sees eating as a burden so, she tries to finish it as quick as possible. She hates people watching her eating, but she obsessively enjoys watching people eating. She says "You look at them and trying to get them sorry for what they are eating. Or sometimes you look at that skinny girl who is eating a lot and you just think that she is going to puke at her place. I was spending my meals just watching other people and talking with them and staying without touching any food." She prefers to eat in a calm environment where other people can not watch her, otherwise she would eat but really slowly and picking stuff, not eating everything in her plate.

Like other two eating disorder sufferers that I have interviewed, she was also very uncomfortable with eating outside and eating with other people. This is a very common attitude of eating disorder patients according to my research so far and an indicator how patients' social life is affected by the disorder. Her eating pattern was not accelerated and she was feeling better when people eat more than her.

She said that even though she is not paying much attention what kind of tableware she is using, **some of her friends with eating disorder was using only really small plates to feel like they were eating a lot even if they weren't eating that much.**

When we talked about people's reaction and awareness about eating disorders, she said

that people think it is gonna pass because she is young. "They don't really care about it until it's getting really bad. Most of the people think it is a choice and you just want to be thinner. It's actually not at all. The way of thinking at that moment, more **like wanting to be disappearing than to be thinner. It is like a long suicide, you are trying to kill yourself but with a slow and easy way.**"

As a suggestion she tells "It should be something that gonna make you enjoy what you are eating right now. Even if you feel a little bit guilty afterwards, you will still have that moment of pleasure and it is not something normal for people who have eating disorders. Literally at some point you just forget about eating, it is not a habit anymore, you are not used to do it anymore. It is really easy to lose the habit of eating but it is so hard to get it back."

About the changes after she gained weight and recovered she says "I still get that euphoria about not eating, like if I was taking drugs. I was really scared of getting fat, I still don't recognize my body sometimes. **And I have that weird feeling of realizing that my image of my body didn't change that much. So I realized that I was seeing myself way more fat than I was.** I didn't see how thin I was. I get shocked when I look at those pictures when I was so thin."

Clara obviously accepted and understood her disorder, and was dedicated to have the control of her life again. Although she was not aware she was trying to fix her eating behavior with self behavioral interventions, it worked for her and now she has a healthy body weight. When she started to eat again, her psychiatric comorbidities started to diminish like Per Södersten claimed. The reason that she was seeing herself larger than she is, was psychological comorbidities and after she gained weight she realised how distorted her body image was. Although she gained weight, her eating pattern is not fixed, since she said she still tries to eat as fast as possible and not really feeling hungry or full. She is happy with her current progress, yet she is aware she needs to pay extra attention on organizing her meals. Clara was an example of how important self dedication is for recovery. Since her eating behavior is not completely healthy yet, there is a high risk for relapse. However, she acknowledges her disorder and fights with it.

5. Insight Framing

Earlier in this thesis, in the “know context” and “know people” chapters I covered: Popular media search, publications search, subject matter expert interviews and ethnographic interviews. Below is my observations as the summary of those topics as well as insights.

5.1 Observations

- Eating disorders are mostly considered as mental disorders with the highest mortality rate.
- Psychiatric symptoms like anxiety and OCD are common in eating disorder patients.
- It becomes an eating disorder when an eating pattern, an amount of the food eaten and eating speed change in a way that it starts to affect a person’s health and their ability to adapt to social or work life.
- The general consensus in the medical community is that eating disorders are different in their symptoms and treatments, however eating disorders have similar mechanisms to each other. For instance, an initial anorexia nervosa condition may turn into bulimia nervosa, binge eating disorder or the other way around.
- There is no standardized eating disorder treatment. Recovery rate is low, relapse rate is high and traditional treatment methods fail in treating eating disorders according to the statistics and also the interview with C.H.
- Behavioral interventions is the most successful to treat eating disorders which can be seen in Mandometer method.
- Art, leisure and relaxation therapies are supportive for the patients to calm down and not to think about their obsessions.
- Learning how to cook helps to go back to food again.
- Traditional clinic treatment for eating disorder patients might cause more pressure on adolescents.

- Eating disorder patients think they have a mental disorder. They think it is a way of having a control mechanism, desire of attention or an identity issue. They are ambitious and strict to themselves.
- It takes some time for people to accept and understand that they have an eating disorder and they tend to deny that they have a disorder in the beginning.
- Eating disorders patients find accepting the disorder and opening up to their family/friends useful.
- The main reason to develop an eating disorder is dieting/semi-starving and dieting activates reward system in the brain. Reward system is related to dopamine. Due to reward system and dopamine, it becomes an addiction and obsession.
- People are reacting similarly to starvation like anorexia nervosa patients.
- Starvation or semi-starvation may generate psychiatric disorders.
- Restriction on food intake may cause increased physical activity.
- Females are more at risk than males.
- Eating disorders are more common in adolescents than adults.
- Athletes are more at risk than other people who are not doing sports.
- Eating disorders are not about hating or loving food, or a desire to be extremely skinny.
- It is not always possible to understand just by body weight if someone has an eating disorder. Some other medical or psychological problems could cause appetite loss and not every eating disorder patient is in very low weight.
- Eating disorder patients' hunger and satiety feelings are distorted.
- Eating disorder patients do not know how much is one ideal portion or how fast they should eat.
- People who have eating disorders do not have decelerated eating pattern.
- When patients' eating pattern is normalised, their psychiatric symptoms disappear.
- People who have eating disorders tend to trick themselves into feeling full or eating less. Some examples are consuming only diet products, eating ice or using small tableware and cutlery etc.
- People who have eating disorders pay attention how and what other people eat. They try to eat less than the other people.
- People who have eating disorders try to eat very slow when they are with other people. They eat fast when they are alone.

- People who have eating disorders prefer to eat at home and alone.
- Anorexic people see themselves fatter than they are.
- Eating disorders highly lower patients life quality and sufferers generally are not able to adapt social life or work life.
- Eating disorders are challenging psychologically and financially also for the families of the sufferers.
- Eating disorder patients use social media to learn about eating disorders.
- Eating disorder patients use social media to meet other eating disorder patients.

5.2 Insights

1. Starvation has psychological effects on humans due to **evolutionary reasons** like foraging for food to survive. When food is scarce the human body gets into survival mode, this causes anxiety which in turn is designed to help warn the human to increase their efforts to secure food. As a person whose anorexia shifted to bulimia, Anna B. noticed that when she started to eat again her body went into survival mode and tried to eat as much as possible because it knew that it won't find food again for a while. This reaction of the body is similar to a person who is starved the food and then suddenly finds some. Thus the brain remembers the starvation period and encourages the person to eat as much as possible when food is available to better prepare for a potential upcoming starvation period.

2. Eating disorders are **behavioral disorders** which are linked to a person's neurobiological systems. Eating disorders are different versions of the same disorder which can be treated by normalising patients' eating pattern, keeping them warm and providing emotional support. One of the interviewees, Clara unintentionally intervened in her own eating behavior by setting alarms on her phone to remind herself to eat during the day. She also changed her environment and her boyfriend was very supportive.

3. Food intake and **physical activity** are directly related. When food intake is restricted it has been observed that levels of physical activity increase. This could be a possible natural self-correcting mechanism which is related to regulation of body temperature. Another instance where food intake and physical activity are linked is demonstrated by the high

prevalence of eating disorders in high performance female athletes.

4.Restricting food intake can trigger the feeling of pleasure and satisfaction as well as obsession with the food since it activates **reward mechanisms** in the brain and causes a dopamine release which is known as happiness hormone. As two of the interviewees Maria and Clara liken food to addictive drugs and their disorder to drug addiction.

5.Eating disorder **patients believe that they have a mental disorder** because psychiatric comorbidities often accompany eating disorders and traditional treatment methods consider eating disorders as mental disorders. This relationship could be the reason why patients identify their eating disorders with their identity or their desire to have a control over something in their life. However, as documented earlier eating disorders are not mental disorders since the **psychiatric symptoms disappear when the eating pattern normalised**, but patients' eating patterns are not always normalised when they receive psychiatric treatment.

6.Eating disorder patients have a **linear eating pattern** during eating a meal, however they often regulate their eating speed depending on their environment. Often eating very slowly in public and very quickly when eating home alone. With these examples we see how those obsessed with food are also obsessed with managing the perceptions and opinions of other people regarding their eating habits.

7.Eating disorder **patients tend to delude themselves** about how much they eat using little tricks to make them feel more comfortable about their situation. They also use these tricks to feign a sense of fullness. As these little tricks, used by eating disorder patients, have demonstrated their effectiveness, perhaps they could be repurposed to get the patients back on track to recovery.

8.Eating disorder patients use **social media** as a social and informative tool to learn about eating disorders, to meet other people who have an eating disorder and to share their feelings. Having access to people who have similar problems can help sufferers feel less isolated. Clara mentioned that she used an eating disorder online forum, she became friends

with some of the other members and together they shared their recovery experience.

9. **Cooking**, baking or learning how to cook can help eating disorder patients to restore their relationship with food, the creativity and fun of cooking can absorb the guilty feelings patients feel towards food.

10. The average eating disorder recovery takes five years. Due to this long time this disorder can place a large financial burden for patients, their family and the state. Patients' social and professional life usually suffer greatly due to their eating disorders.

To be able to categorise and group my findings, I have followed a path which can be seen on the chart. After I listed my observations, I have realised that some of the observations are relational in a way that they can create insights. Furthermore, I have highlighted what each insight is about, to assign tags in order to sort them into groups. According to the tags, I have created four groups which are; behavioral physiology, behavioral psychology, eating as an event and daily life. Those groups are created in order to brainstorm to explore possible ways to develop a workable solution.

Behavioral physiology is the first group. In this group is contained: Patients' physiological problems caused by their eating disorder, the effects of an eating disorder on a person's physiology and the neurobiological mechanism of eating disorders. Physiological and psychological systems of the human body work interdependently, therefore particular changes in one system may trigger problems in other systems. However, these possible links are beyond the scope of this project.

Under the title of **behavioral psychology** are contained both issues related to behaviour and issues related to psychology in the field of eating disorders. The psychological impacts of problematic eating behaviour as well as differences in interpretation of the cause of the disorder may provide interesting topic for discussion and concept generation. One of the major points in my research was to have a clearer understanding about what causes an eating disorder to develop. Behavioural psychology could be seen as one of the more interesting topics. I can possibly make a distinction with a concept to indicate what is a psychiatric disorder and a psychiatric comorbidity, as well as what are the differences between them.

Eating disorders are mostly considered as mental disorders with the highest mortality rate.

Psychiatric symptoms like anxiety and OCD are common in eating disorder patients.

It becomes an eating disorder when eating pattern, amount of the food eaten and eating speed change in a way that it starts to affect person's health and their ability to adapt to social or work life.

Eating disorders are similar to each other, rather than being different

There is no standardized eating disorder treatment. Recovery rate is low, relapse rate is high and traditional treatment methods fail

Behavioral interventions is the most successful to treat eating disorders

Art, leisure and relaxation therapies are supportive for the patients to calm down and not to think about their obsessions.

Learning how to cook helps to go back to food again.

Traditional clinic treatment for eating disorder patients might cause more pressure on adolescents.

Eating disorder patients think they have a mental disorder. They think it is a way of having a control mechanism, desire of attention or an identity issue.

It takes some time for people to accept and understand that they have an eating disorder

Eating disorders patients find accepting the disorder and opening up to their family/friends useful.

The main reason to develop an eating disorder is dieting/semi-starving and dieting activates reward system in the brain.

People are reacting similarly to starvation like anorexia nervosa patients.

Starvation or semi-starvation may generate psychiatric disorders.

Restriction on food intake may cause increased physical activity.

Females are more at risk than males.

Eating disorders are more common in adolescents than adults.

People who have eating disorders do not have decelerated eating pattern.

When patients' eating pattern is normalised, their psychiatric symptoms disappear.

People who have eating disorders tend to trick themselves into feeling full or eating less. diet products, eating ice or using small tableware and cutlery etc

People who have eating disorders pay attention how and what other people eat. They try to eat less than the other people.

People who have eating disorders try to eat very slow when they are with other people. They eat fast when they are alone.

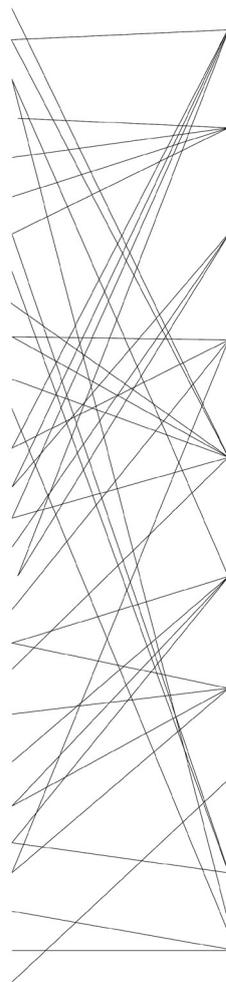
People who have eating disorders prefer to eat at home and alone.

Anorexic people see themselves fatter than they are.

Eating disorders highly lower patients life quality and sufferers generally are not able to adapt social life or work life.

Eating disorders are challenging psychologically and financially also for the families of the sufferers.

Eating disorder patients use social media to learn about eating disorders and meet other sufferers.



Starvation has psychological effects on humans due to **evolutionary reasons** like foraging for food to survive. Human body gets into **survival mode** in case of starvation and anxiety encourages people to search for food.

Eating disorders are same kind of **behavioral disorders** which affects person's neurobiological system due to trying to restrict their food intake, which can be treated by **normalising patients' eating pattern**, keeping them warm and providing emotional support.

Food intake and physical activity are reciprocally related. Restricted food intake might cause increased physical activity as body's reaction to regulate body temperature and metabolism. However, intense physical activity might cause distortion on eating behavior as we can see the examples of high prevalence of eating disorders in female athletes.

Restricting food intake might make people feel pleasure and satisfaction as well as obsession with the food since it activates **reward mechanism** in the brain and causes dopamine release which is known as happiness hormone. Thus patients identify their eating disorders with their **identity** or their desire to have a control over something in their life.

Eating disorder **patients believe that they have a mental disorder** because psychiatric comorbidities often accompany eating disorders and traditional treatment methods consider eating disorders as mental disorders. However, eating disorders are not mental disorders since the **psychiatric symptoms disappear when the eating pattern normalised**, but patients' eating pattern is not always normalised when they get first psychiatric treatment.

Eating disorder patients have **linear eating pattern** during the meal, however they change their eating speed as very slow when eating in public or very fast when eating home alone. They pay extra **attention how much and how fast other people eat**, and regulating their eating speed and amount as it is much less than other people due to being **afraid of their judgement**.

Eating disorder **patients tend to trick themselves and people** on how much they eat and feeling more full. Those tricks generally are concerned with eating less, however it could work other way around or a kind of illusion on perception could be created to promote and help people to normalise their eating behaviors.

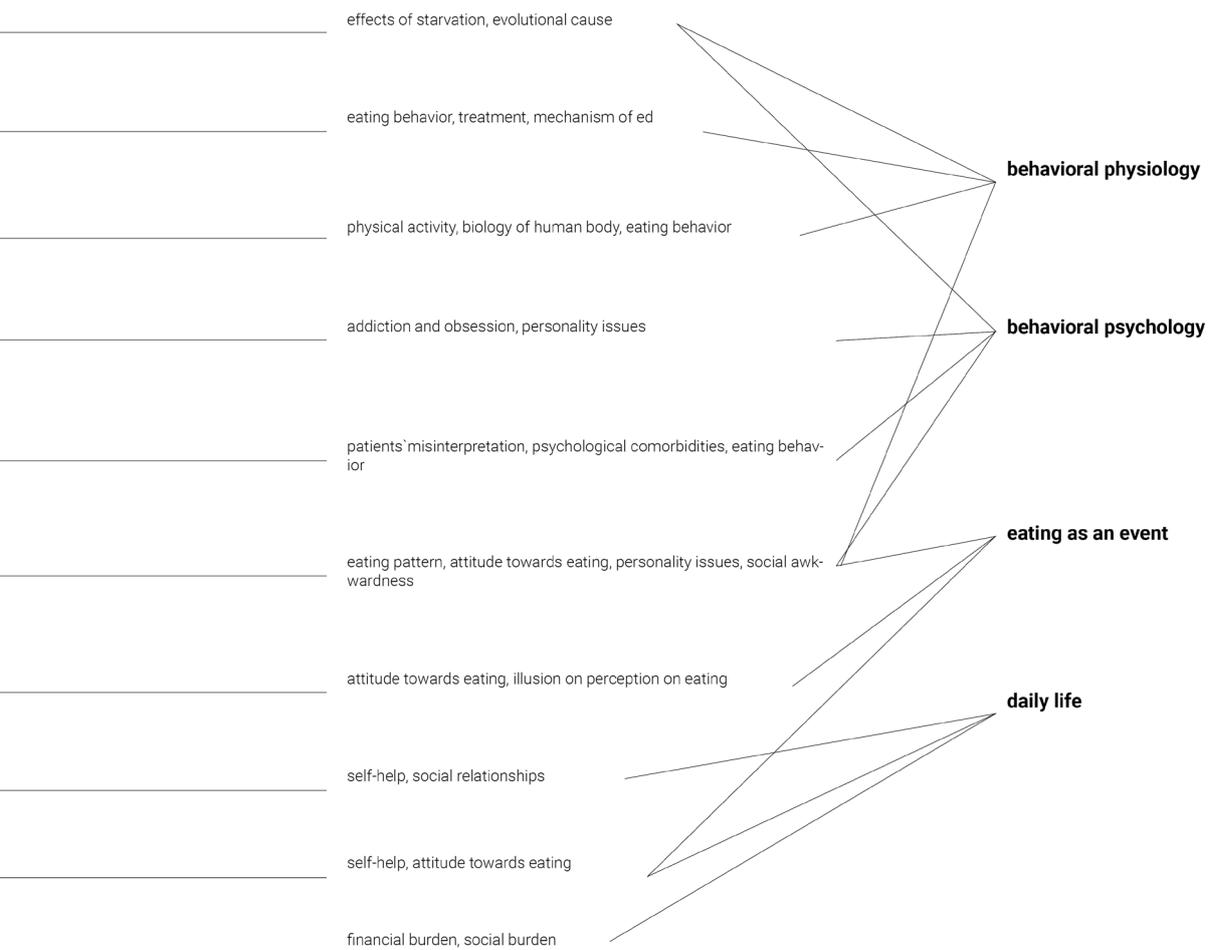
Eating disorder patients use **social media** as a social and informative tool to learn about eating disorders, to meet other people who have an eating disorder and to share their feelings and it could effect recovery pattern.

Cooking, baking or learning how to cook could help eating disorder patients to restore their relationship with food so that they could try to enjoy food without feeling so guilty.

An average eating disorder takes five years and due to the long term prevalence of the disorder, it is a big **financial burden** for patients and their family. Patients social and professional life get highly affected by their eating disorders.

Figure 5.1 Observations to Insights

Eating as an event is another category that I can focus on eating behaviour as a daily and social activity. Being socially awkward while eating in front of other people is a common pattern in eating disorder patients as well as some other people who do not have an eating disorder. Going out for a meal with friends can turn into a nightmare for eating disorder sufferers due to their problematic eating behavior and obsession about eating. Some issues regarding eating 'as an event' can be improved to help both eating disorder patients and people who have problems with eating in front of other people.



One other major subject is **daily life** of eating disorder patients. As it was mentioned many times that eating disorders reduce patients' life quality significantly. Other than professional help, patients can be guided to improve their environment and also strive to become financially independent. Creating concepts to improve the social relationships of patients could be potentially a significant help for their daily life.

6. Exploring Concepts

6.1 Opportunity Mind Map

After grouping insights and creating four groups for disordered eating behavior, I made a quick unstructured brainstorm to explore possible avenues for solutions. Starting with the categorised groups I branched out into sub-categories and examined the relationships between the sub-categories. Next I placed some quick and early solutions in and around those sub-categories. As to be expected most solutions connect in many ways to many sub-categories and not just one but nevertheless this was a useful exercise.

The benefit of mapping the ideas from quick brainstorming was to have a first step into a less abstract area where ideas can turn into concepts that are possible to imagine people using. I have also taken into consideration the technological developments of the current era and the close future. As next, three concepts will be investigated further in terms of their value to users.

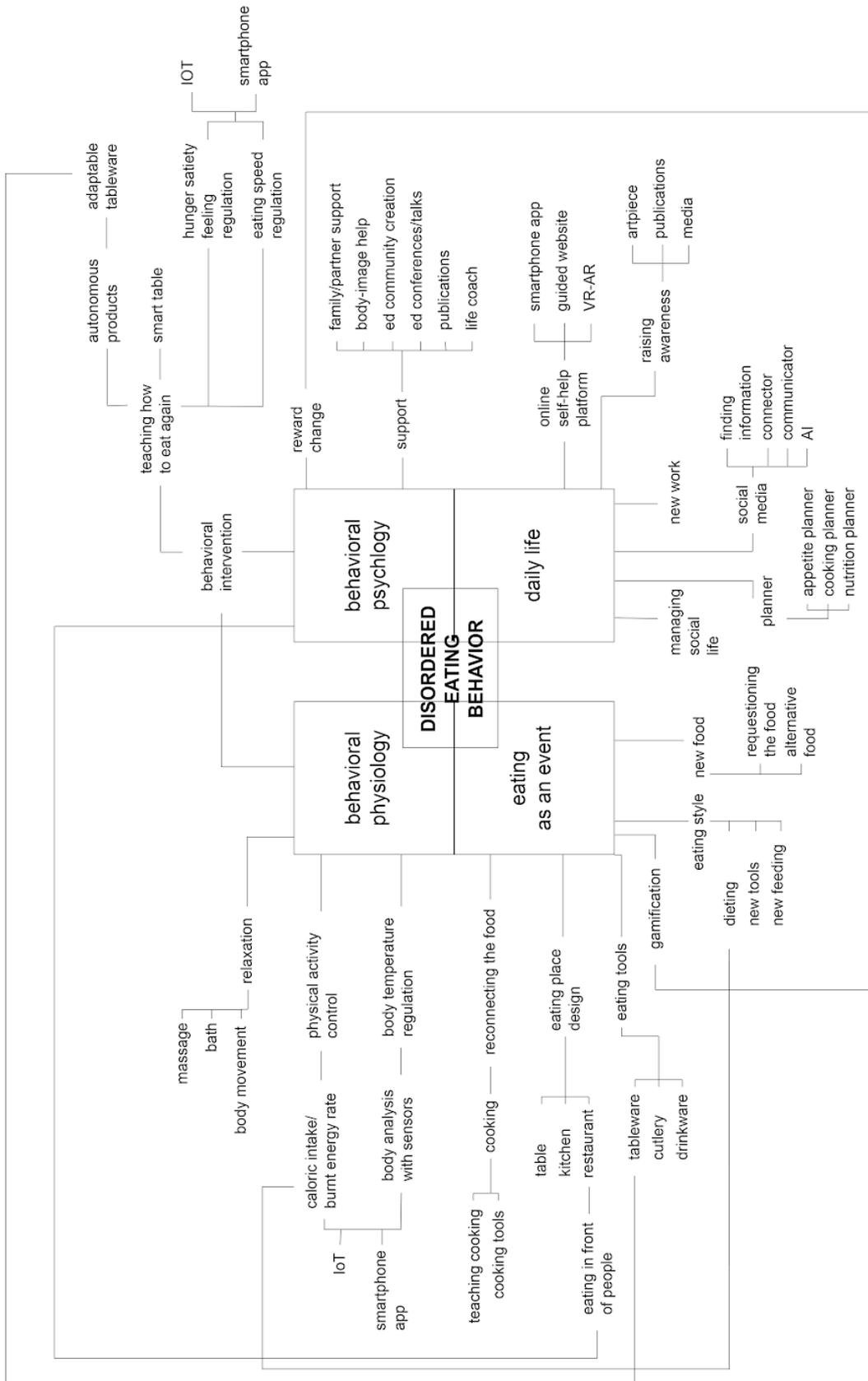


Figure 6.1 Opportunity Mind Map

6.2 Concept Creation

6.2.1 Concept 1: A restaurant where people can eat in a private way

One of the major drawbacks of eating disorders is maintaining social life. Patients' participation to social and work life is interrupted due to the mental and physical effects of the disorder. Many social events and activities often revolve around people eating and drinking together. What should be a moment of celebration and shared culture can turn into a nightmare for many eating disorder sufferers.

According to the interviews I have done with eating disorder patients and publications research, the most common symptom is that eating disorder patients feel uncomfortable eating in front of other people. The reasons could be being afraid of losing control in front of other people, getting criticized and feeling ashamed for their eating style, or it could be exhausting for them to explain others why they do not want to eat anything. They might also be concerned about their eating speed or being watched by others. All in all, eating in public is a big challenge for eating disorder sufferers and they try to avoid it as much as they can.

A restaurant where people have their separated eating space and others can not see them eating could be an option to help reduce social anxiety of eating disorder patients. Separated eating spaces do not necessarily have to mean that people have to eat alone in an isolated area. A divider could be placed reaching up until the eye level of the person so that people can still see each other's eyes and talk, but can not see the eating process. Moreover, it could be thought of as a private eating booth where people can talk to other booths via intercommunication system like chat rooms.

The main idea behind the concept of a restaurant where people can eat without exposing themselves comes from the social anxiety of eating disorder patients about eating in front of other people. However, it could be preferable for other people who don't have an eating disorder but still do not like eating in front of other people. It could also be desirable for people who have a disability that may want a little more privacy or for people who would

like to eat alone occasionally.

Target users: People who have problems with eating in front of other people

Unmet or underserved needs: Social anxiety, fear of being watched and criticized

Proposed new offerings: private eating space with possibility to socialise

Benefits to users: less anxiety, freedom to eat as they would like

Why would users chose that offer over other ones:a new kind of experience

when people want to eat alone

when people want to socialise but not eat in front of other people

6.2.2 Concept 2: Responsive tableware to normalise eating behavior

As it was explained in the research section, mandometer treatment method focuses on behavioral intervention to treat eating disorders. According to the interview I have made with Per Södersten who is also one of the creators of mandometer method, eating disorders are behavioral disorders which affect a person's mental health. Furthermore, starvation could cause an eating disorder due to evolutionary reasons, and dieting is the main risk factor for developing an eating disorder⁽²⁹⁾. Considering the behavioral perspective of eating disorders and the success rate of mandometer treatment, behavioral interventions should be investigated further.

The mandometer method works with a scale and a smartphone application where patients can follow up their eating pattern according to a normal person's eating pattern and try to adapt their eating speed and time to the healthy eating behavior. Intervention is done with a chart on the smartphone screen and the scale is used to measure eating speed and time. When patients' eating behavior is not normal, they can see it on the screen and compare it with the normal one so that they can adjust their eating speed. After a while, patients relearn how to eat normally and then they can stop using mandometer device.

One option is to develop another device or a system to offer a more user friendly product set which can help to treat eating disorders with behavioral intervention. Responsiveness, repetition and comprehensibility seem to be some of the most important factors in

developing a successful behavioral intervention; therefore a new product could be developed around those factor. The product could potentially include main tableware products such as a plate, bowl, spoon, fork and knife. A scale and other sensors could possibly be used to create interactivity.

Target users: People whose eating behavior is disordered

Unmet or underserved needs: decelerated eating pattern, appetite regulation, hunger and satiety feeling, anxiety and unease

Proposed new offerings: relearning how to regulate eating pattern with conditioning the healthy behavior, hunger and satiety feelings, disappearance of anxiety with normalisation of eating behavior

Benefits to users: having a regular eating habit, healthy body weight, feeling less guilty

Why would users chose that offer over other ones:

easy to understand and apply

people can use it by themselves

It is a promising alternative treatment method for eating disorders

6.2.3 Concept 3: Therapeutic cooking tools

The therapeutic effects of cooking is a well-known joy for many, some people say it helps them relax, slow down and focus on something else rather than their daily problems and stressful thoughts. Modern day marvels such as in home refrigeration, microwave ovens and food delivery on demand have led to changes in eating culture for those in a hurry.

Eating is one of our most important survival activities, it also affects our mental and physical health. Some argue that we are losing our connection with food and its origins as so many people opt to take the easy route, skip preparation and cooking of meals, and eat fast-food ⁽⁴⁷⁾.

Contrary to what one would expect those who practice in self-starvation generally still love food and eating disorders are not about loving or hating food. According to the interview I conducted with Clara, who recovered from anorexia nervosa, learning to cook helped her and some of her friends who also have eating disorders to overcome their excessive fear

The concept of therapeutic cooking tools aims to encourage people to cook more and to enable them to benefit from the therapeutic effects of cooking. Therapeutic cooking tools can help people to experiment with cooking and preparing food so that they can develop a deeper understanding cooking, nutritional facts and the relationship between them.

Target users: People who has fear of food and disordered eating behavior

Unmet or underserved needs: anxiety and unease, fear of food, social relationships

Proposed new offerings: reconnecting the food, understanding the relationship between food and body needs, understanding the nutritional facts, experiencing by experimenting, triggering multiple senses

Benefits to users: getting rid of the fear of food, enjoying food, looking at food from another perspective, authentic and stimulating experience

Why would users chose that offer over other ones:

changing the concept of traditional cooking

a different perspective on the subject of food

experiencing by experimenting

7. Framing the Solution

7.1 Concept Selection and Evaluation

Three concepts are evaluated according to the five questions in the value hypothesis in the previous title. My criteria to decide which concept to focus on were: Relevance to the research questions, the level of complexity, the level of problem solving and technological innovation. According to those four criteria, the second concept “responsive tableware to normalise eating behavior” is selected. During this selection process more weight was applied to the criteria the relevance to the initial research question, this criteria was about supporting the normalisation of eating behavior.

Per Södersten and his team’s success using the behavioral intervention method to treat eating disorders stood out to me as an inspirational positive story and I wanted to incorporate some of those principles into my concept. Reconsidering mental as known medical issue from a behavioral perspective and explaining it with the evolutionary process of human body were evocatory and motivating to explore for me. The selected concept will be explored and developed as next.

7.2 Concept Development

7.2.1 Eating behavior and behaviorism

According to the research I have conducted so far, I will categorise normal eating behavior with five parameters which are: **Eating speed, chewing rhythm, eating time, caloric intake, hunger and satiety feeling.** Measuring the values of those five parameters can indicate whether or not a person has a problem with their eating habit.

Eating speed, as well as hunger and satiety feelings are significant factors to diagnose if there is a problem which requires intervention. A person with healthy eating behavior has a decelerated eating pattern which can be described as having an eating speed that is faster in the beginning of the meal and getting slower towards the end and with the feeling of satiety⁽³⁹⁾. As it was mentioned in the “causes” section of the “know context” chapter, eating disorder patients and people at risk of eating disorders do not demonstrate a decelerated eating pattern, instead they have linear or accelerated eating pattern⁽³⁹⁾. Problems with hunger and satiety feelings are also common with eating disorder patients.

Like breathing, chewing is a rhythmically performed act which is automatic, however it can also be voluntarily controlled⁽⁴²⁾. The fact that it can be voluntarily controlled and it is directly related with the neurobiological part of eating behavior shows that chewing rhythm is another parameter which is related to eating speed. Although there are few studies on this particular area, it is a prominent factor to consider when trying to adjust eating speed of a person and teach healthy eating behavior. Improper chewing rhythm is something which is analysed and evaluated by a group of medical specialists and based on this information they can recommend an intervention. Since there are limited studies and I can not further investigate chewing rhythm`s relation to eating speed, I will use this parameter in my concept speculatively to promote future discussions.

According to my talk with Dr. Södersten, his team take an average eating time of 10-15 minutes in their treatment and caloric intake changes according to the BMI(body mass index) of the person. Eating disorder patients` eating behavior do not fit to normal eating parameters as it can be seen in the research phase, therefore the ultimate goal to develop my concept is to aid patients to adapt their eating parameters to the normal level under the supervision of a specialist.

Considering eating disorders as problematic eating behaviors which could be treated by normalising eating behavior, a behavioral intervention is an option to teach normal behavior like in the case of Mandometer treatment. According to behavioral psychology, a behavior can be taught by conditioning the person to new desired behavior; and behavioral intervention is a way to increase useful behaviors or reduce negative behaviors⁽⁴³⁾.

Conditioning is done with the presence or removal of a stimulus which will cause increase or decrease of a behavior. If presenting a stimulus causes the increase of desired behavior, it is called **positive reinforcement**; if removal a stimulus causes the decrease of undesired behavior, it is called **negative reinforcement**⁽⁴³⁾. Moreover, if presenting a stimulus causes the decrease of undesired behavior, it is called **positive punishment**; if removal a stimulus causes the increase of desired behavior, it is called **negative punishment**⁽⁴³⁾.

In the case of this concept positive punishment will be the method of behavioral intervention. There is an undesired behavior which is problematic eating speed, and a stimulus will be presented to the person to decrease that undesired behavior. Stimulus should have a distinctive feature to provide a clear understanding to the patient. Possible options of the stimulus to give a feedback to the patient are light, sound and vibration.

7.2.2 Design Elements

Tableware includes multiple items like plates and cutlery, therefore the design could limit the possible usage area and become inconvenient in terms of **portability**. Although the beginning idea was to develop a responsive tableware set, I have decided to continue to the concept with designing a responsive cutlery.

One of the insights I gained from the interviews with eating disorder sufferers was the discomfort while eating in front of other people or being in a conversation about their eating habits. A **seamless and compact** design was necessary for camouflage and to avoid situations which can provoke questions about their eating habits. For the same reason about discomfort, the design of the cutlery set should not have the look of a medical product but should have a look of a regular cutlery set.

Since it is an eating utensil which is supposed to be carried with the person, **ease of clean and use** is required. A case could act as protection when in transit. Waterproofness is another necessary feature so that electronics can be safe during wash.

The major consideration when designing this cutlery set for user interaction is **compre-**

hensibility and responsiveness of the feedback(stimulus). Among different options like sound, vibration and light, I have chosen to use vibration to give haptic feedback through the handle of the cutlery. The reason that I chose haptic feedback was to keep the stimulus as private as possible so that only the person who is using it can perceive the stimulus. It is likely that other people around the person who is using the cutlery will recognize the stimulus if light or sound is used.

A smartphone application was necessary for; internet connection, calculation of necessary parameters to send feedback signals to the cutlery, data storage and communication with the patient's specialist. A smartphone application could also be useful for the patient to follow his/her progress and use it as a food diary. Connection with a smartphone could be established via bluetooth and wireless induction charging of the cutlery via the cutlery case is likely to be the most convenient way to supply electrical energy to the device.

Responsive cutlery is an IoT device, therefore it should be able to collect and transmit data via embedded sensors. The necessary data needs to be collected while the person is eating. To successfully modify patient behaviour, each bite of food needs to be calculated by the cutlery, with this information eating speed can be calculated and a behavioural intervention can be performed to speed up, slow down or halt patient eating speed. Load sensor is a type of sensor to measure weight and its size can be small to fit inside a handle. Moreover, an accelerometer is a sensor that could be used to detect the position and movement of the hand and it could be the best candidate of sensor for understanding the parameters for each individual user bite. Also a vibration motor could be used to give haptic feedback.

In practice, patients would have their eating behavior monitored via the cutlery set which would be offered to them by the healthcare professional. The intervention includes calculating the eating speed and amount with spoon/fork and giving instant haptic feedback to the patient through the spoon/fork to control the eating speed. The aim is to aid patients to re-learn normal eating behaviour through incremental adaptation which includes; accelerated eating patterns and optimising caloric intake in an average eating time together with the feeling of satiety.

7.3 Solution Enactment

This concept consists of two mechanisms which are designed to help track food and pace eating time. The meal tracking mechanism works with the use of the smartphone application. The feedback mechanism is also linked to the smartphone application but it imbedded in the cutlery. Those two mechanisms can be viewed as having three layers which are software, hardware and interaction as shown in the chart.

The meal tracking mechanism has the ability to: Identifying the type of food, the amount of food, to process and verify this information, and send the necessary signal to the cutlery. It can potentially work with AI image processing and AR technologies as current examples in this area are promising. Google's recent project called "1m2Calories" is a calorie calculator smartphone application which is using image recognition to identify the type of food via pictures and makes comparison analysis from a large database⁽⁴⁴⁾. Similarly Apple is working on an AI and AR nutrition calculator feature for its health application. Apple's AI and AR nutrition calculator works by pointing the camera at food so that it can scan and identify the nutritional values of food⁽⁴⁵⁾. Moreover, precise weight estimation can be done via automatic image processing with the current technology. Background, foreground and boundary analysis is done via image processing so that application can recognise and compare the size and weight of the item⁽⁴⁶⁾. As a consequence, meal tracking via smartphone application is done by pointing and rotating the camera around food so that the type and weight of food is calculated.

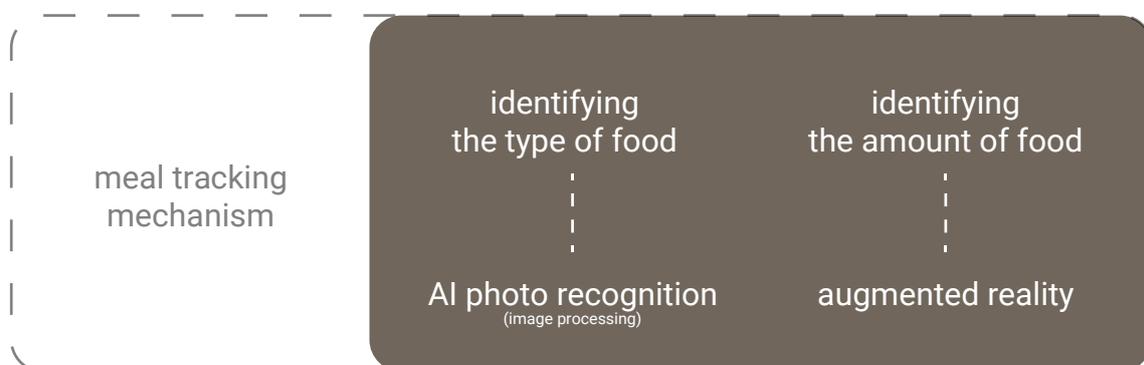


Figure 7.1 Meal Tracking Mechanism

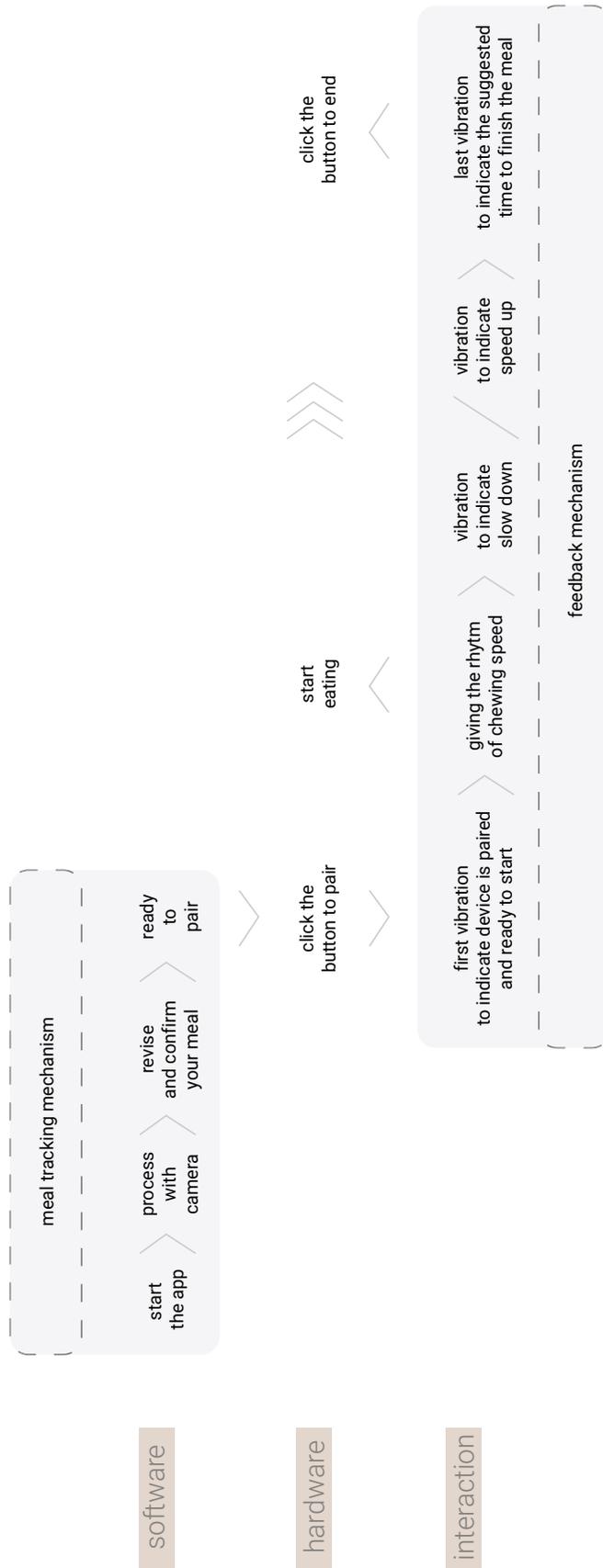


Figure 7.2 Solution Enactment



Figure 7.3 Feedback Mechanism

Identification of the type of food is necessary so that algorithm can make more accurate weight estimation by matching data from database. Detecting the food is also important to track nutritional value. In Mandometer method, weight of food is measured by a scale which is located under the plate and visual feedback is given via smartphone screen. In the case of responsive cutlery concept, dependency to a seperate scale under the plate and following a screen is eliminated.

After considering initial design elements for the responsive cutlery set concept, I visited Prof. Dr. Michael Siegrist from the department of health sciences and technology in ETH Zurich to explain my concept and get a feedback. He mentioned that it could be useful to measure the eating speed of a person and track their eating pattern either they have an eating problem or not. He also added that the cutlery set could be used for future studies about eating and appetite size. I was answered upon my question that testing the first prototype with 3-5 people could give an idea in terms of feasibility, usability and iterations.

I consulted with Dr. Per Södersten again and asked about chewing rhythm and its possible relation to eating behavior and eating disorders. He mentioned that his team is also working on the subject of chewing rhythm and it is an area which is not yet well studied. This inspired me to use vibration, via the cutlery, to imitate chewing rhythm to help patients pace their eating speed in the beginning of the meal.

According to the methodology, to fully design a responsive cutlery concept I would need access to, and feedback from, the intended users of the concept to gain valuable insights; what elements of the concept are working, and which elements need refinement or omission. However, this avenue of research and development is closed to me because in this

project the target users are extremely vulnerable. Any user tests would have to be carried out with strict medical standards. Due to this limitation user testing is carried out with 'regular' users, those without any eating disorders, to get some broad feedback on how the device performs. A functional prototype in the hands of these regular users can test many of the assumptions I have developed through this research, and some benefits of using these types of users is that they are readily available and quick revisions can be made.

It may turn out, speculatively speaking, that if this concept were to prove successful for eating disorder patients, it may also have wide appeal to the mass public who may want to better manage their eating habits. The device could become more of a preventative tool and not only for patients in critical condition. In this light, general user testing has an identifiable benefit: If the 'everyman' finds some value in this device, then the specific target audience clearly would too.

7.4 Feasibility and User Test

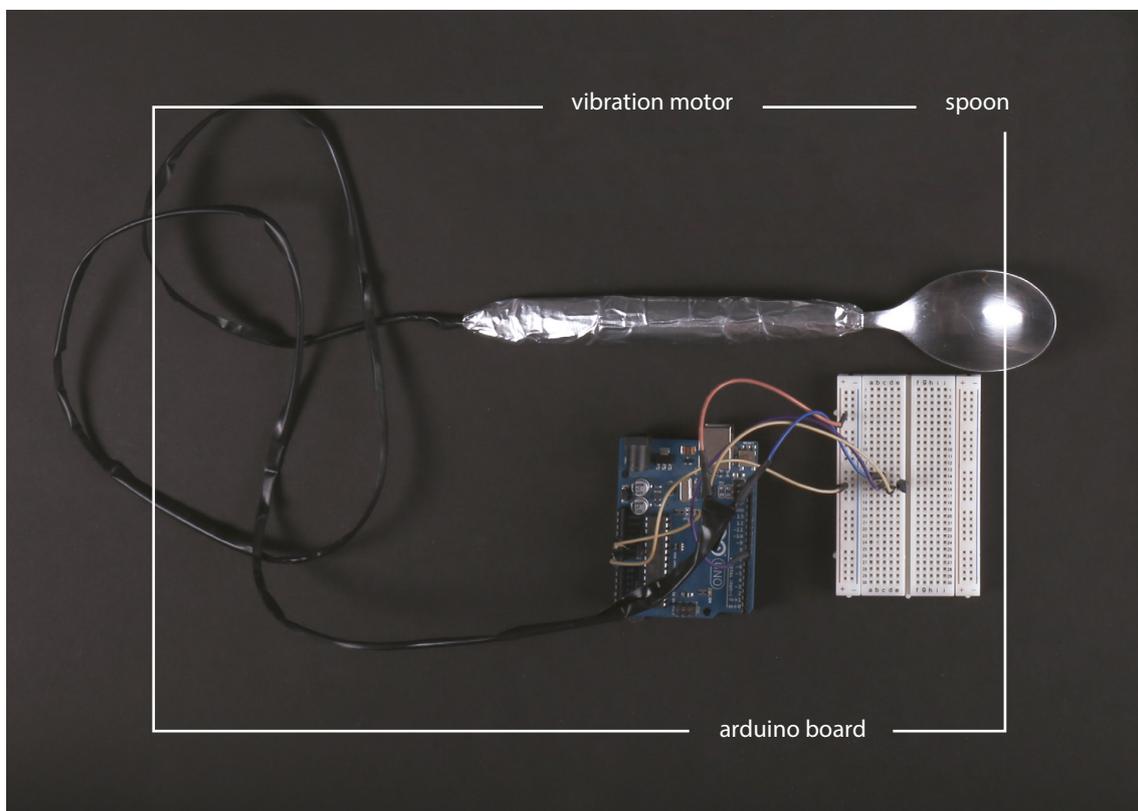


Figure 7.4 Semi-functional prototype

As the next step, I decided to build a prototype that can send haptic feedback to subjects while they are eating in order to test the feasibility and viability of the feedback system. A microcontroller (Arduino) device which is connected to a computer and a small vibration motor attached to a spoon could allow me to simulate behavioral intervention by sending vibration signals.

The simple prototype mechanism can be seen on the picture. The aim is to test responsive cutlery concept in terms of three categories which are:

Intervention

If haptic feedback is understandable and memorisable,

If different haptic feedbacks recognisable,

Intensity of the vibration and frequency of the feedback,

Type of the feedback, whether they prefer lights and sound instead of vibration.

Interaction

If it is bearable to try to control the eating speed with haptic feedback,

The most challenging parts of the control,

If they carry the cutlery set with them and use it for every meal in case they had a problematic eating behavior,

If they can follow the chewing rhythm given in the beginning of the meal,

The way of changing the eating speed either they change their chewing speed or they take change the amount of food for each bite.

Design Language

The importance of the look of cutlery in terms of look of medical device and regular cutlery,

Their opinion about ergonomics of regular cutlery design,

Important factors for the cutlery design,

Cleaning and usage of changeable head set.

I programmed the Arduino microcontroller so that I can send four different kind of vibration set to intervene subjects. I will talk in detail about the different kind of vibration sets in the next chapter.

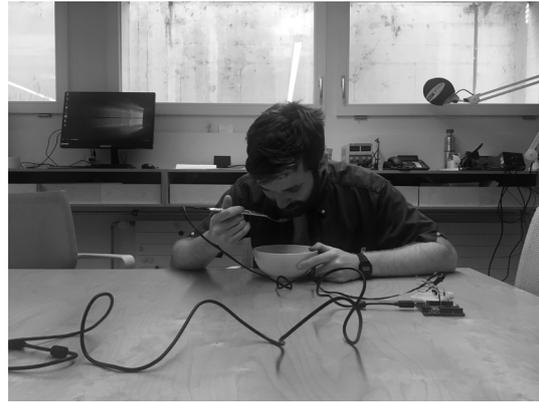


Figure 7.5 Test subjects

Type 1: Chewing rhythm

Type 2: Long continuous 1 buzz to indicate beginning, middle and the end of the meal

Type 3: Short intermittent 8 buzzes to indicate speed up

Type 4: Long intermittent 2 buzzes to indicate slow down

I had four test subjects who I asked them to eat a bowl of cereal with the prototype spoon. Before they started to eat I explain the concept, different kind of vibration sets and what they are supposed to do for each vibration style. First I gave the signal type 2 to indicate they can start eating and then just after signal type 1 chewing rhythm as a reference to eating speed for them. Since I did not have the equipment to measure their eating speed, I gave type 3 and type 4 signals randomly just to test if they can follow up the instructions. I did not take into consideration amount of food or total time that they finished their meal. After they finished their meal, I asked questions which are mentioned above as three categories.

According to the subjects for the intervention category, haptic feedback for chewing rhythm, speed up or slow down was understandable. It took couple of trials for them to learn and distinguish different signals, however it was possible to follow up and adapt even at first meal with the prototype. Type 2 signal created confusion in two of the subjects and they mentioned there could be a different alternative for that kind of feedback or it was not so clear for them to get used to it at the first time. Intensity of the vibration was suitable to distinguish different kind of feedbacks. They were able to follow the chewing rhythm after they felt it but they were not sure how long they could follow it correctly. They all found the vibration as the proper feedback style and more related to eating and chewing, therefore they preferred vibration over light and sound.

Three of them found the intervention tolerable to use and mentioned in the questionnaire that it would be possible to use this utensil everyday. One tester found the spoon difficult to use as he was not comfortable synchronising his eating rhythm with the vibrations of the spoon. All testers were fine with the interval of feedback and also added that learning the chewing rhythm before beginning the meal as a reference is a better idea than having to follow a rhythm through the whole meal. When I asked about how they are adjusting their eating speed to slow down, two of them said they started to chew slower, the other two said that they were chewing longer and swallowing the food later, and the one also mentioned that she was taking less food on to her spoon and waiting longer between bites. However, when asked the testers generally could not explain the exact way that they managed to slow down their eating.

The testers agreed that the look of the cutlery should not reveal the medical purpose of the device so that patients can feel more comfortable to use it everywhere they eat. Three of the testers said that functionality of the cutlery is more important for them than its appearance. One mentioned that for her the appearance of the spoon was more important than its function. All respondents answered in the affirmative that they would like to possess elegant cutlery. The proposed idea of interchangeable heads for the cutlery was appealing to testers mostly because they observed that they almost never use a fork and spoon at the same time.

This concludes the qualitative study it yielded many data points and insights which will be used in the next iteration. The upcoming iteration will place a stronger emphasis on aesthetics and form.

7.5 Form Creation and Rapid Prototyping

To begin the form designing process, I started to freehand sketch to explore spoon forms. I took the average spoon size as a reference to create a form for the responsive cutlery. As informed by my research minimal geometry was essential for the look of the cutlery. After I sketched, I used 3D printing methods for rapid prototyping to help select different shapes. I decided on the final shape of the spoon after feeling and experiencing one of these prototypes in hand.

Since it was an interactive product, electronics needed to be placed inside of the handle. That is one of the restrictions to consider while designing the handle. The handle needed to have a diameter of at least 1 cm to be able to keep sensors and other electronics inside.

Changeable head feature was another requirement for the functionality of the cutlery set. So I needed to consider how it could be easily detachable.

The most common material for cutlery is stainless steel, because it is relatively affordable, does not rust in air or water and it is durable, also aesthetically pleasing. Due to these reasons, it is easy to select this material for Ellen.

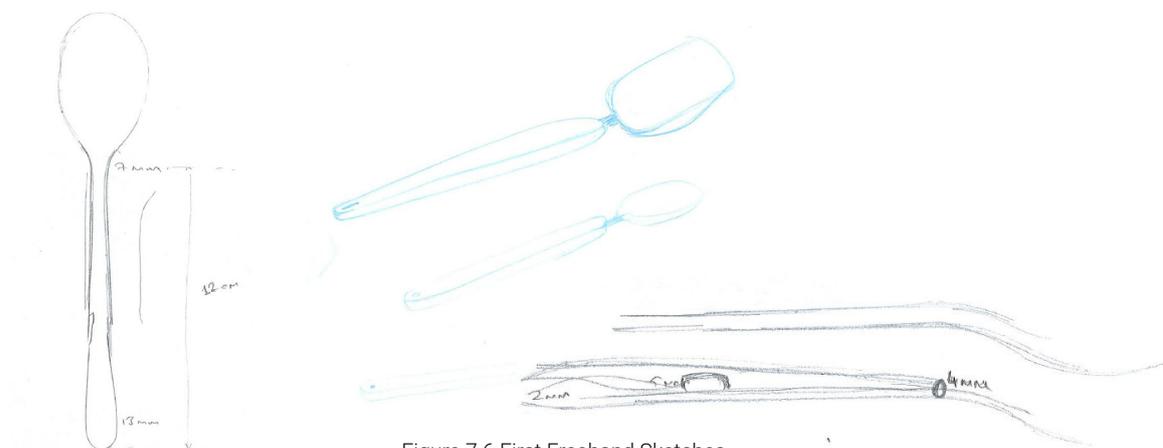


Figure 7.6 First Freehand Sketches

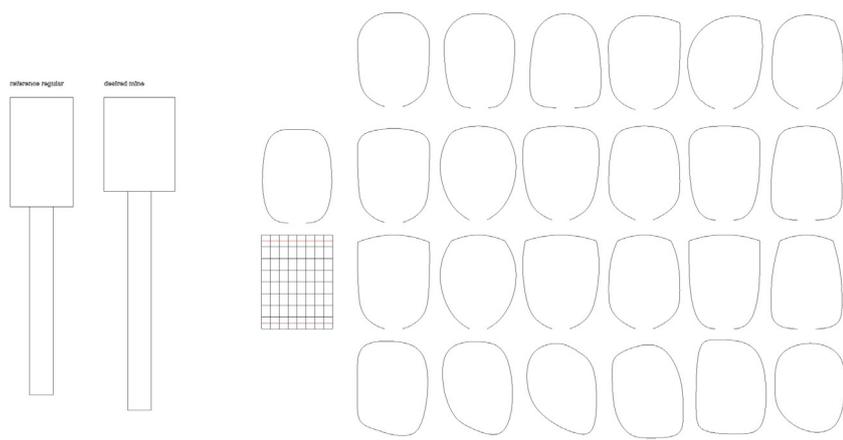


Figure 7.7 Form Finding Sketches

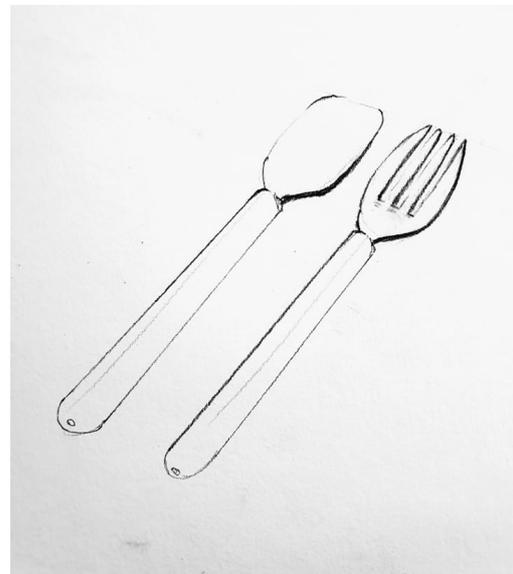
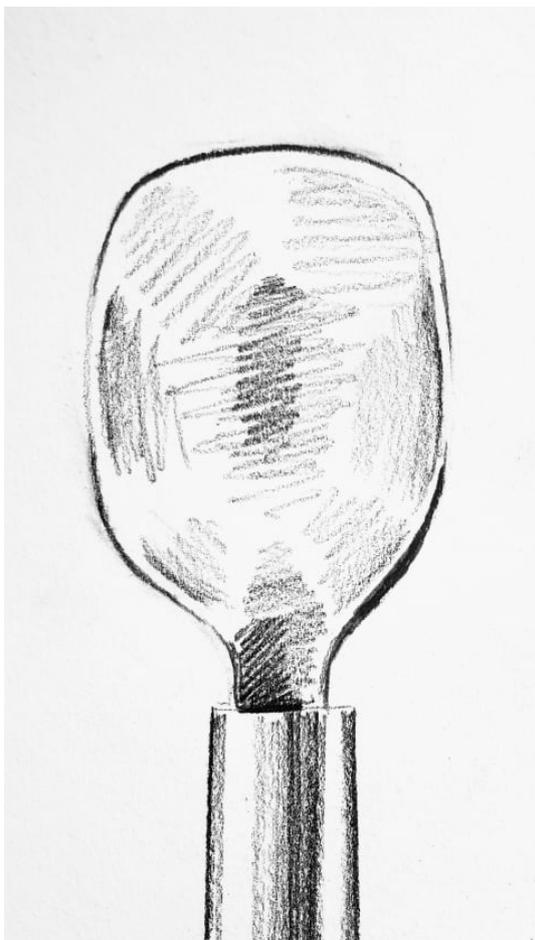


Figure 7.8 Sketches of the Selected Form

7.6 Outcome

7.6.1 Ellen: Smartphone Application

The responsive cutlery system relies on a smartphone application to track meals using image processing and calculates eating speed using data which is collected from sensors in the cutlery. The whole system needs to be used by the patient under a specialist's supervision, so that the specialist can set the application that can work according to the personal data. In this case, the application can only be downloaded after receiving authorisation from the specialist. Patients then can get a training how to use the application and cutlery set together in their daily life or in the clinic. After training, patients can then start to use it by themselves.

The application boots up with the camera on so that the user can scan their food without delay. As soon as camera starts, the algorithm also starts to investigate the environment and look for a food item to detect. The user needs to point their camera at their plate and slightly rotate it by keeping the food in the center of the frame, so that the augmented reality system can recognise the environment and dimensions to estimate the weight of the detected item. Detected items will be labeled with their appropriate food title also food types will be highlighted in different colours. Currently the Ellen application is not designed to track the caloric value of food as some eating disorder patients have expressed sensitivity regarding calorie values as mentioned in interviews in the "know context" section.

If there are missing, unidentified or misidentified items, the user can look up the item, edit it or add it manually. If the detection is correct the user needs to approve by clicking their phone and then the system is ready to pair with the cutlery.

The other features of the application include following up the progress, nutrition tracker, food diary and connecting to other users in case mutual interest. There is also a section where the user can see their account information, settings and consultation history with their specialist. The screenshots of Ellen app can be seen.

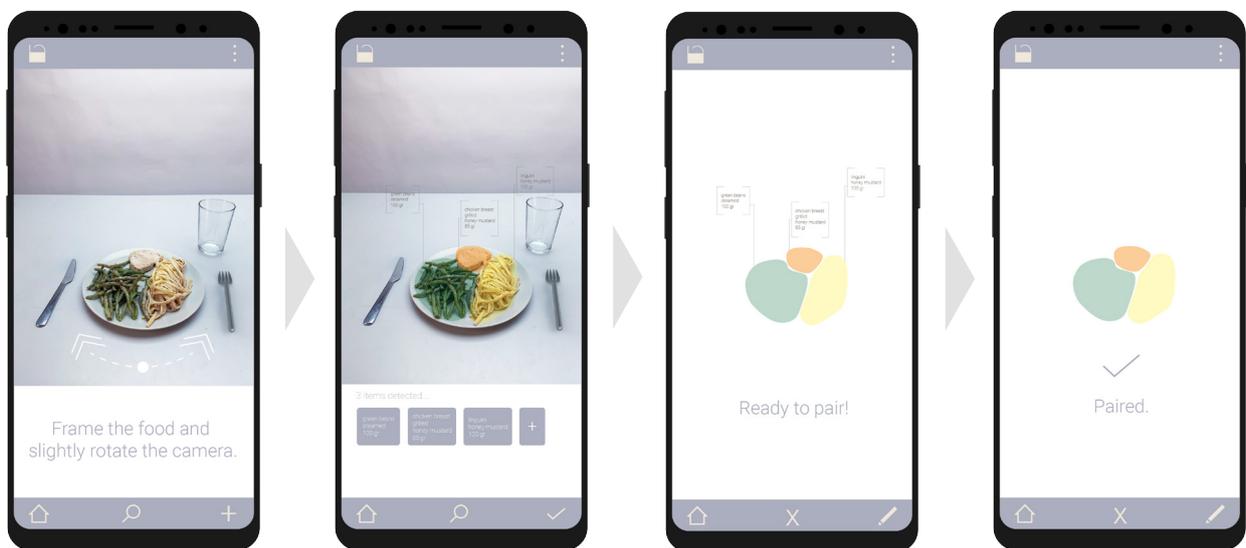
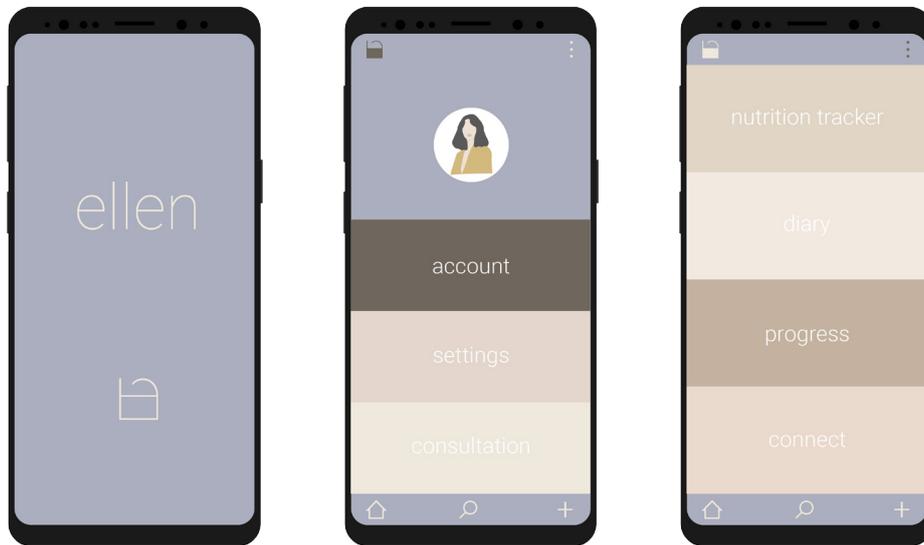


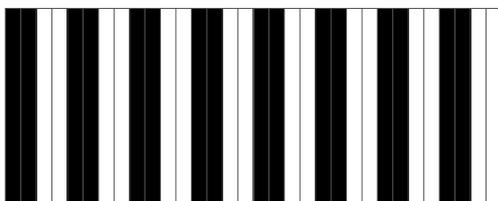
Figure 7.9 Ellen Smartphone Application Screenshots



Figure 7.10 Interaction with Ellen Application

7.6.2 Ellen: The Responsive Cutlery

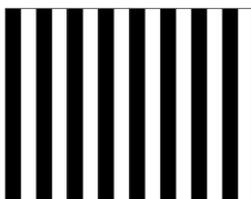
After testing, prototyping, iterations and design decisions; Ellen: the responsive cutlery concept was finalised. The behavioral intervention process can be seen in detail on the next page. Vibration rhythms for different haptic feedbacks are depicted with a stave-like charts in music theory, so that the vibration intervals can be understood.



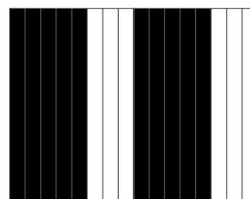
Type 1:
Chewing
rhythm



Type 2: Long continuous
1 buzz to indicate
beginning, middle and
the end of the meal



Type 3: Short
intermittent 8
buzzes to indi-
cate speed up



Type 4: Long
intermittent 2
buzzes to indi-
cate slow down

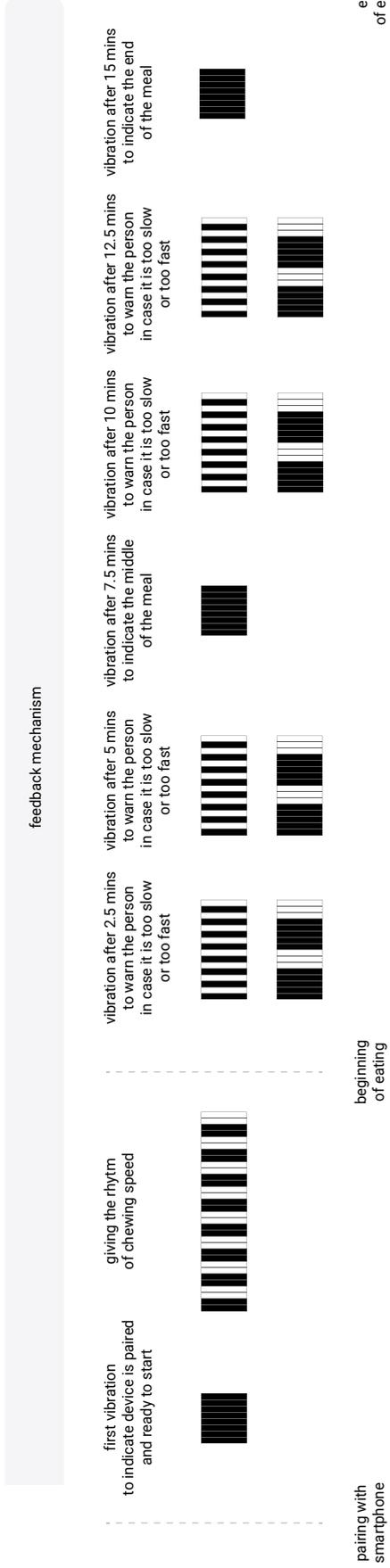
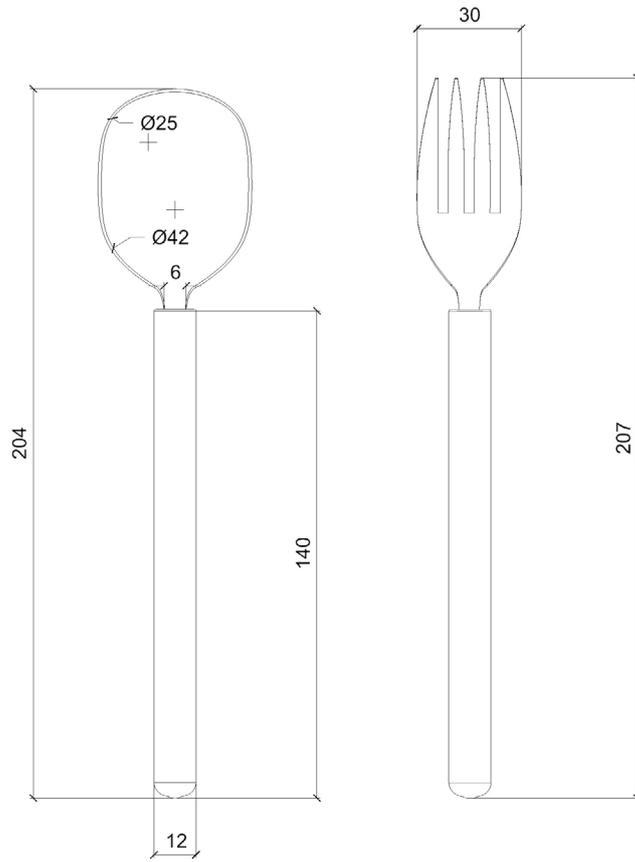
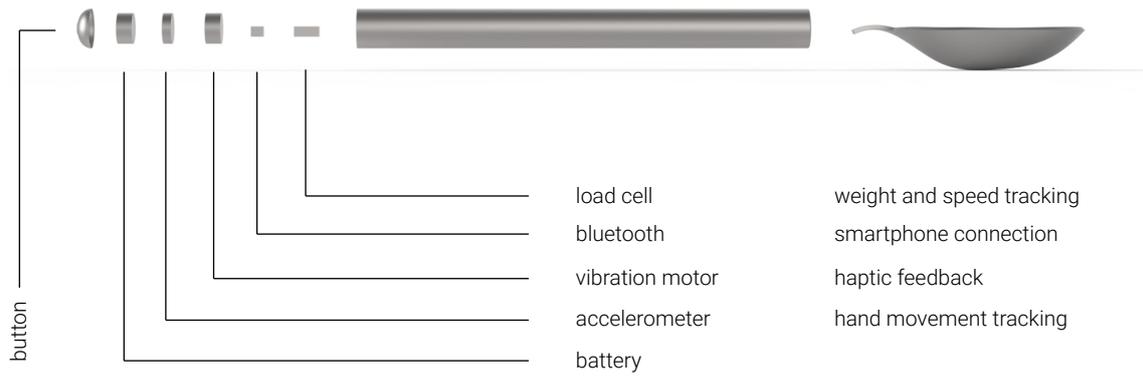


Figure 7.11 Behavioral Intervention Process Map

Technical Drawings



Components



Product Pictures



Figure 7.12 Ellen Spoon Perspective



Figure 7.13 Ellen Spoon and Fork Head



Figure 7.14 Ellen Cutlery Full Set

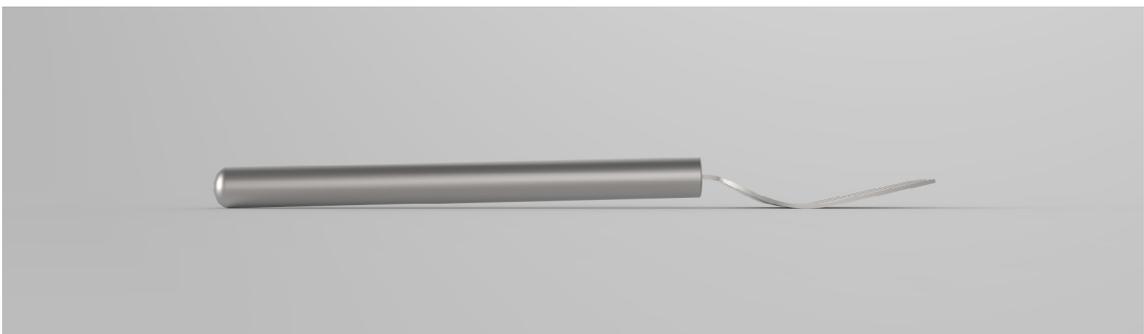


Figure 7.15 Ellen Fork Side View



Figure 7.16 Close-up Spoon

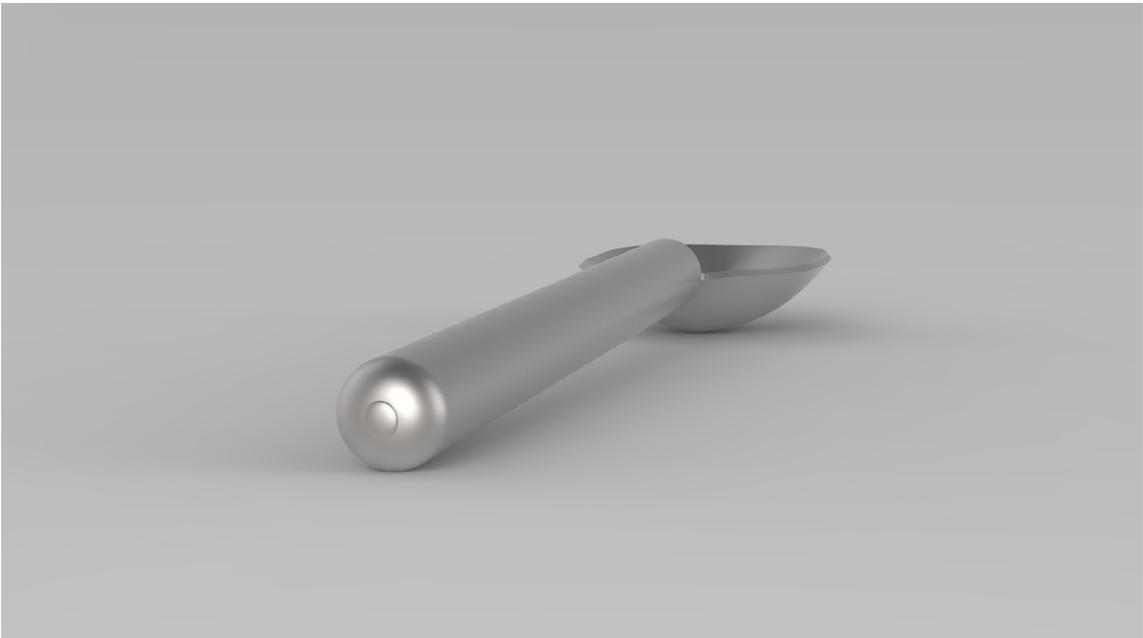


Figure 7.17 Close-up Button



Figure 7.18 Ellen Cutler Set with Its Case



Figure 7.19 Ellen Spoon on Table

8. Realise Offerings

8.1 Market Analysis

Smart cutlery is a popular area where there are new concepts for different purposes. Smart cutlery which helps cooking is the first category can be mentioned. Various parameters are measured via sensors embedded in the cutlery. The Hostweigh weighing spoon and Admetior digital spoon scale are the examples of smart spoon to be used in the kitchen as a measuring utensil. Temp is a smart spoon which measures the temperature of a dish while cooking and monitors it to provide evenly cooked dish. Moreover, Valiber is another smart spoon which monitors sugar level in food and drinks. Those examples are useful to comprehend the use of sensors in cutlery. Temp and Valiber do not have similar features to “Ellen” but their concepts are promising for the probable future iterations of “Ellen” for example detecting the type of the food and energy level with cutlery. Scale spoons are used for precisely measuring the amount of food, and this sensor is one of the main features of “Ellen” to track the speed of eating and regulate appetite. However, scale spoons are not used for speed tracking or giving feedback to the user.

Google’s smart spoon Liftware is created for people who have arm tremor or limited mobility with their arms and hands. It offers two options which are stabilising and leveling according to the person’s need. Although Liftware is focused on quite different health problems than “Ellen”, it is a relatable concept exists on market as smart cutlery. Liftware has a rechargeable battery and changeable attachments which can be used as spoon and fork. “Ellen” differs from Liftware mainly in terms of the design language. The design of Liftware clearly communicates that it has a medical function, however one of the factors considered for form selection of “Ellen” is that it looks like an elegant regular cutlery. Other very similar product, Chinese version of Liftware, is called Gyenno and it has a similar design and the same function.

Well-known companies like Apple and Google are working on a new concept which is AI and AR nutrition calculator works with photo recognition to calculate calorie and nutrition.

The most related smart cutlery concept to “Ellen” is the responsive cutlery which gives feedback to people when eat too fast. Hapifork is a vibrating and glowing smart fork with bluetooth and it is measuring eating speed according to the movement of the hand with a motion sensor. It counts 10 seconds between bites and vibrates if it is less than 10 seconds. Hapifork has a simple mechanism and is not a tailor made product that its settings can be changed according to the person. The other distinctive difference to “Ellen” is that it does not gives feedback when eating too slow, or it does not track calorie.

Other and the most similar example is Spün smart cutlery, which is tracking calorie and eating speed. It works with a smartphone app and uses photo recognition to calculate how much calorie does the person’s plate has. After calculation, it measures the weight of every bite and convert it to calorie and nutrition for giving feedback. It mainly works as a calorie and nutrition tracker, it vibrates if the person reaches to the calorie limit also gives feedback if the person is eating too fast. However, Spün is not a healthcare product, it can not be set differently according to the person’s need and it does not gives feedback when eating too slow.

As previously mentioned, mandometer treatment was the main inspiration to develop “Ellen”. Mandometer device has two connected items which are a smartphone app and a scale. Patients measure their plate with the scale to control the amount of food and the application calculates eating speed according to the decreased amount every bite. Patients can compare their speed and suggested normal speed on the screen to adjust their eating speed. App also monitors how full they should feel during the meal. Mandometer device is a healthcare device which can be used only under a specialist’s supervision. Main differences between mandometer device and “Ellen” are the type of interaction to get the feedback and the technology to determine portion size.

9. Summary

At the beginning of this thesis two questions were formulated to build an understanding of the complexities and issues around eating disorders. The first question “what are the reasons for problematic eating behavior and food obsession?”. After speaking with Prof. Dr. Per Södersten from the Karolinska Institut he explained the behavioral aspect of eating disorders and their pioneering treatment method called Mandometer. According to his explanation, the disorder originates from deep neurobiological survival mechanisms which are present in humans and also visible in some animals. This behavior can create a self serving cycle in which the brain learns to reward food restriction. This cycle of behavior can lead to obsessive behavior regarding food and develop into mental disorder symptoms. It must also be noted that a large majority of sufferers are young females.

The second research question was “what are the daily life struggles of eating disorder sufferers?”. This thesis uncovered the havoc caused to the daily lives of the patients and their families. All normal daily activities were affected and they can not contribute to social or work life. Some life struggles uncovered include the discomfort of eating in front of other people, being over sensitive about food related topics, becoming suicidal, biological problems like regulating body temperature and hair loss.

Those two initial research questions led to the development of an all encompassing question of “how to support normalising eating behavior for eating disorder patients and people at risk of eating disorders?” The answer offered in this thesis revolves around a behavioral intervention utilising a fusion of hardware and software tailored for individual users. As pictured in the previous section, Ellen, the responsive cutlery concept, is an IoT tool to aid people who are suffering from eating disorders to normalise their eating behavior with behavioral intervention. Behavioral intervention includes measuring eating speed via sensors embedded in the handle of the cutlery set and giving haptic feedback so that the user can regulate their eating speed. The system relies on a smartphone application to track meals using image processing and calculates eating speed using data which is collected from sensors in the cutlery.

10. Conclusion

To measure the success of this proposed concept it is crucial to mention my original aims and objectives for this thesis and myself. My personal aims included to further develop my design skills, especially product and interaction design, and software and hardware integration. To learn more about an intriguing and important topic and promote a discussion of eating disorders in public. Learning how to apply design methodology throughout the design process was also a first for me and I believe a key distinguishing feature of a design and technology futures masters thesis.

As to how to conclude if the concept Ellen can be regarded as a success we must consult the user prototype tests. Users were questioned and simulated using the responsive cutlery. Following these tests which are based on a small sample size, users stated that the device should avoid looking like a medical device and be as inconspicuous as possible. Users were also tested to determine whether they could eat according to the signals of the device and they responded in the affirmative. Another specific test was to confirm that users could distinguish between various haptic feedback signals and again they responded in the affirmative.

Positive as those results are it must be noted the very small sample size and the fact that working with authentic eating disorder patients was not a feasible option for this thesis.

11. Evaluation

In this evaluation I will reflect on my methods of investigation and possible avenues of research for the future. In this design thesis I chose Vijay Kumar's "seven modes of the design and innovation process" as my working methodology. I found this methodology to be satisfactory to my needs, as it gave me the flexibility to categorise and refine my research questions. I particularly found the design tools of sub-categories useful especially when considering sections such as "know context" which widened my understanding.

I am happy with the design outcome of my concept which I arrived at by applying the methodology. Some elements of the design were informed by research such as the need of the device to be stealthy, minimal, compact and it must have the ability to track and give feedback. Other design elements can be attributed to my personal aesthetic tastes such as the curvature of the scoop, roundness of the handle, material and colour selection.

I communicated and developed these designs with a variety of methods including: Free sketching, 3D modelling, rapid prototyping, 3D printing, microcontroller testing and feasibility testing. Unfortunately even with all these design tools at my disposal I did not realise my ambition to develop a fully functioning prototype. However I created semi-functioning prototypes that I used to conduct user tests and further inform design decisions. I found 3D printing the most useful design tool because the complex geometries of a spoon were difficult to work with on a computer screen and also tricky to manufacture by hand. If possible I would love to create some more durable prototypes using a 6-axis CNC milling machine with stainless steel.

Even though I managed to conduct user tests the test sample size was extremely small and the test subjects were not eating disorder patients. Further development would make more substantial user testing a must especially working in collaboration with the relevant medical specialists and patients in a controlled scientific clinical trial. Clinical trials such as these consume a lot of time and resources.

For this thesis a product was developed for a very specific set of users. It is my general ambition that this product concept may also hold value for regular day to day users who may want a tool to help better regulate their eating habits. In this way Ellen could act as a preventative tool. We are witnessing the birth of the age of personal digital tracking. Smart watches, a growing consumer commodity, track users' heart rate, sleep quality and even movement. In this light to suggest that users could also track their eating habits more precisely with an intelligent spoon feels like an incremental step towards the realisation of our micro-managed and digitally optimised lifestyle.

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